

Funding gap for national marine protected area management in Indonesia: an opportunity for blue financing

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Abstract. Indonesia, known for its rich marine biodiversity, relies heavily on its marine ecosystems for both economic and ecological sustainability. Marine protected areas (MPAs) play a crucial role in conserving biodiversity, protecting endangered species, and maintaining healthy ecosystems. However, these MPAs face increasing threats from overfishing, pollution, and climate change, which demand strong management supported by sufficient funding. This study analyzes the funding gap in Indonesia's MPA management by examining budget profiles and assessing effectiveness through data analysis. The financial sustainability of MPAs in Indonesia is hindered by limited government budgets and dependence on external donors, highlighting the need for innovative financing solutions. The study explores various funding sources such as government allocations, international aid, philanthropy, and ecotourism revenue, while evaluating how funds are distributed across activities like monitoring, enforcement, community engagement, and research. By linking funding levels to MPA effectiveness indicators, the research offers evidence-based strategies to optimize financial management, including conservation trust funds, payments for ecosystem services, and public-private partnerships. These findings aim to guide policymakers and conservationists in addressing funding shortfalls and enhancing MPA management through diversified and sustainable blue financing.

Key Words: alternative financing, budget gap, financial sustainability, Indonesia, marine conservation, MPAs management.

Introduction. Indonesia, a mega-biodiverse nation, relies heavily on its marine ecosystems for sustenance and economic prosperity. Marine protected areas (MPAs) are crucial for safeguarding this biodiversity, acting as vital refuges for threatened species and critical habitats. They play a significant role in maintaining ecosystem health, supporting fisheries productivity, and mitigating the impacts of climate change. The vast archipelago's diverse marine environments, including coral reefs, mangroves, and seagrass beds, are under increasing pressure from human activities. This marine ecosystem faces mounting pressures from overfishing, pollution, and climate change, necessitating robust management strategies for its extensive network of MPAs (Dee Boersma & Parrish 1999). Effective MPA management, however, requires substantial and sustained financial investment (Bohorquez et al 2019).

Adequate funding is paramount for the success of MPAs management. Insufficient resources severely hamper the effectiveness of conservation efforts, leading to compromised monitoring, enforcement, and community engagement. Studies have consistently demonstrated a strong correlation between funding levels and MPA effectiveness. In some study, while insufficient financial resources were found to directly limit the effectiveness of all MPAs, finance was found to be indirectly relevant as a weakness in their current management strategy that could have a more direct impact on future MPAs if not addressed. However, when the effectiveness of the financial value

provided is increased, the weakness gap for MPA management shrinks (Bohorquez et al 2022). Financial constraints often result in inadequate staffing, limiting the capacity for effective patrolling and enforcement of regulations against illegal fishing and destructive practices. In Indonesia itself, laws regarding funding schemes for MPAs have not yet been explicitly explained. This has resulted in limited access to funding and legal provisions in these areas (Solihih et al 2025). Furthermore, insufficient funding restricts the implementation of crucial management strategies, such as habitat restoration, community-based conservation initiatives, and scientific research (Worboys & Trzyna 2015). Ultimately, a lack of resources undermines the ability of MPAs to achieve their conservation objectives, highlighting the critical need for sustained and appropriate financial investment to ensure their long-term success and the preservation of valuable marine ecosystems (Gill et al 2017).

This research undertakes an examination of the budget profile for MPA management in Indonesia, clustering into several classes based on gap analysis of budget compliance, using assessment of the MPAs effectiveness (EVIKA) data. Understanding the financial landscape of MPA management is paramount for ensuring the long-term health and resilience of these vital ecosystems.

The financial sustainability of MPAs in Indonesia is a complex issue, often characterized by limited government funding, reliance on external donors, and the exploration of innovative financing mechanisms. This article investigates the various funding streams supporting MPA management, including government budgetary allocations (such as the Indonesian Ministry of Marine Affairs and Fisheries budget), international development aid (e.g., from organizations like the World Bank and the Asian Development Bank), philanthropic contributions (e.g., from foundations like the Walton Family Foundation and Bloomberg Philanthropies), and revenue-generating activities such as ecotourism. Furthermore, it analyzes the allocation of these funds across different management activities, such as monitoring and enforcement, community engagement, and research and development. A clear understanding of funding sources and allocation patterns is crucial for identifying potential gaps and optimizing resource utilization.

This research also examines the effectiveness of current budgetary practices in achieving conservation outcomes within Indonesian MPAs. By analyzing the relationship between funding levels and indicators of MPA effectiveness, such as fish biomass, coral cover, and enforcement capacity, this article aims to provide evidence-based insights into the financial requirements for successful MPA management. This analysis will inform the development of more targeted and efficient budgetary strategies, maximizing the impact of limited financial resources. Furthermore, the journal explores the potential of innovative financing mechanisms, such as conservation trust funds (e.g., the Indonesia Climate Change Trust Fund) and payments for ecosystem services, to enhance the financial sustainability of MPAs in the long term.

Given the increasing threats to marine ecosystems and the limited availability of public funding, exploring alternative financing mechanisms is crucial for ensuring the long-term viability of MPAs. This article investigates the potential of these innovative approaches to diversify funding streams and reduce reliance on traditional sources. It also examines the challenges and opportunities associated with implementing these mechanisms in the Indonesian context, considering factors such as governance structures, stakeholder engagement, and capacity building. Specifically, it will analyze the role of public-private partnerships and the potential for leveraging private sector investment in MPA management.

The findings of this research will be relevant to policymakers, conservation practitioners, and researchers working on MPA management in Indonesia and other regions with similar challenges. By shedding light on the financial dynamics of MPA management, this research aims to contribute to the development of more effective and sustainable financing strategies for the conservation of marine biodiversity. Further research and analysis in this area are essential to navigate the complex interplay between conservation needs, budgetary constraints, and the evolving socio-economic landscape of Indonesia's coastal communities. The result of research seeks to provide a

foundation for future studies and contribute to the ongoing dialogue on financing marine conservation in Indonesia and beyond.

Material and Method

Site of research. This research was conducted at ten national MPAs in Indonesia. The areas highlighted in pink on the map represent MPAs spread across various regions of Indonesia. These areas include Anambas, Pieh, Kapoposang, Gili Matra, Sawu Sea, Southeast Aru, Banda Sea, Padaido, Raja Ampat, and West Waigeo (Figure 1).



Figure 1. The location of of all marine protected areas (MPA).

Type of data. The data used in this research comes from the results of the evaluation of MPA effectiveness (EVIKA) and also financial data from each relevant MPA area. The Evika data used is the total result of the input, process, output, and outcome values of a conservation area. The input values consist of the status of the conservation area, zoning plans, management plans, human resources, budget, and infrastructure. The process includes assessments of standard operation procedures (SOPs) management, supervision, outreach, partnerships, monitoring of area resources, infrastructure management, licensing, and community empowerment. The outputs include assessments of controlled utilization, threats, compliance levels, community knowledge, community empowerment, and data. Finally, the outcomes include the condition of conservation targets, the condition of core zones, the socio-economic condition, and community participation. This data is then compiled and calculated to obtain the EVIKA value. These values are then compared across each area to determine the extent of their influence on one another.

Data analysis. The data will then be processed to determine the size of the funding gap owned by each MPA studied. Then a comparison will be made to determine the amount of EVIKA value obtained with the amount of funds received by the region. Then the financial data from each region will be combined and analyzed based on expenditure groups. In the analysis process, financial data is processed using Microsoft Excel to determine the expenditure groups of each region. In addition, the financial components of each region's expenditure and the EVIKA value components are analyzed using "rawgraph". This analysis uses an open-source website named rawgraphs.io, which is a visualization tool to see how EVIKA values and costs relate and interact.

Results

Funding structure. Based on the funding structure in each MPA, it can be seen that there is a funding gap in the MPA. This gap can be clearly seen with the highest funding

in Sawu Sea and the lowest in Southeast Aru (Figure 2). Also, it is known that the largest funding in each area is in capital funding for equipment and machinery, official travel (regular and within the city), and material expenditures. These four components of expenditure tend to have large values in each year and in all areas. We identified that it needs different actions to alleviate the funding gap in each MPA. The MPA's had to re-evaluating how current resources are used to eliminate their funding gap, they can also start reviewing which financing is a priority in each region.

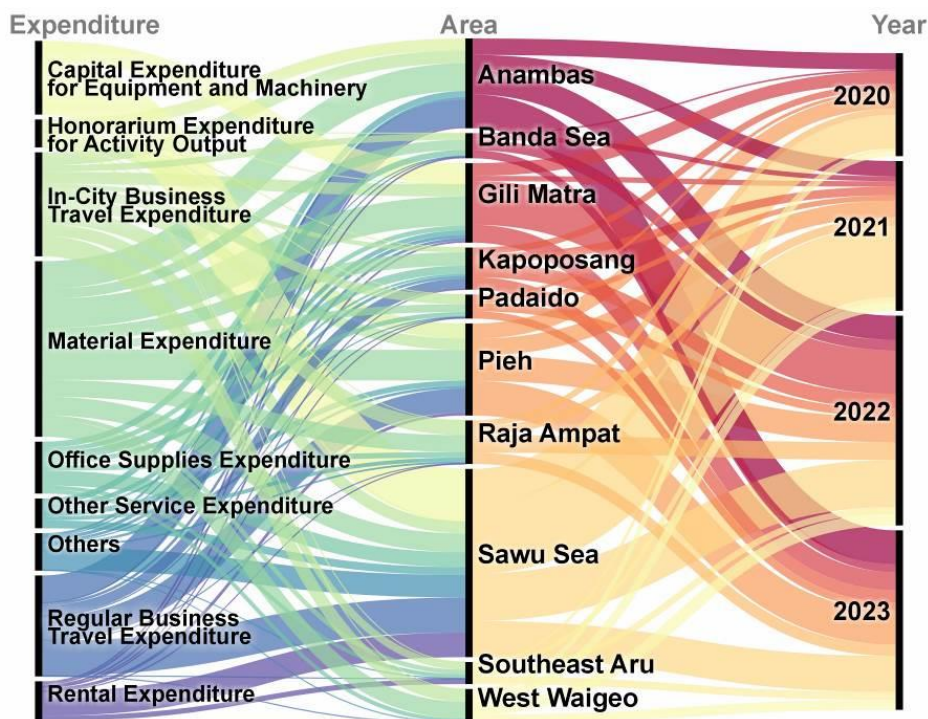
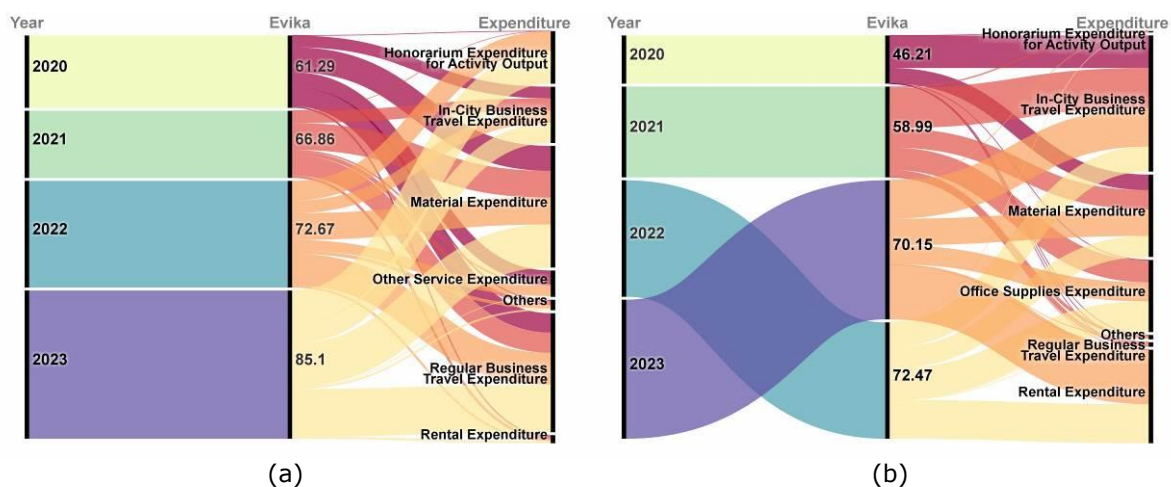


Figure 2. Funding structure of all marine protected areas (MPA) in each year.

MPA funding governance performance. This analysis was conducted to determine the relationship between the amount of expenditure on a conservation area and its EVIKA value. Through this analysis, we can determine whether the expenditure incurred has been effective in managing the MPA based on the EVIKA value in each area. The results of the analysis show that each funding component is related to the effectiveness of management in each region (Figure 3).



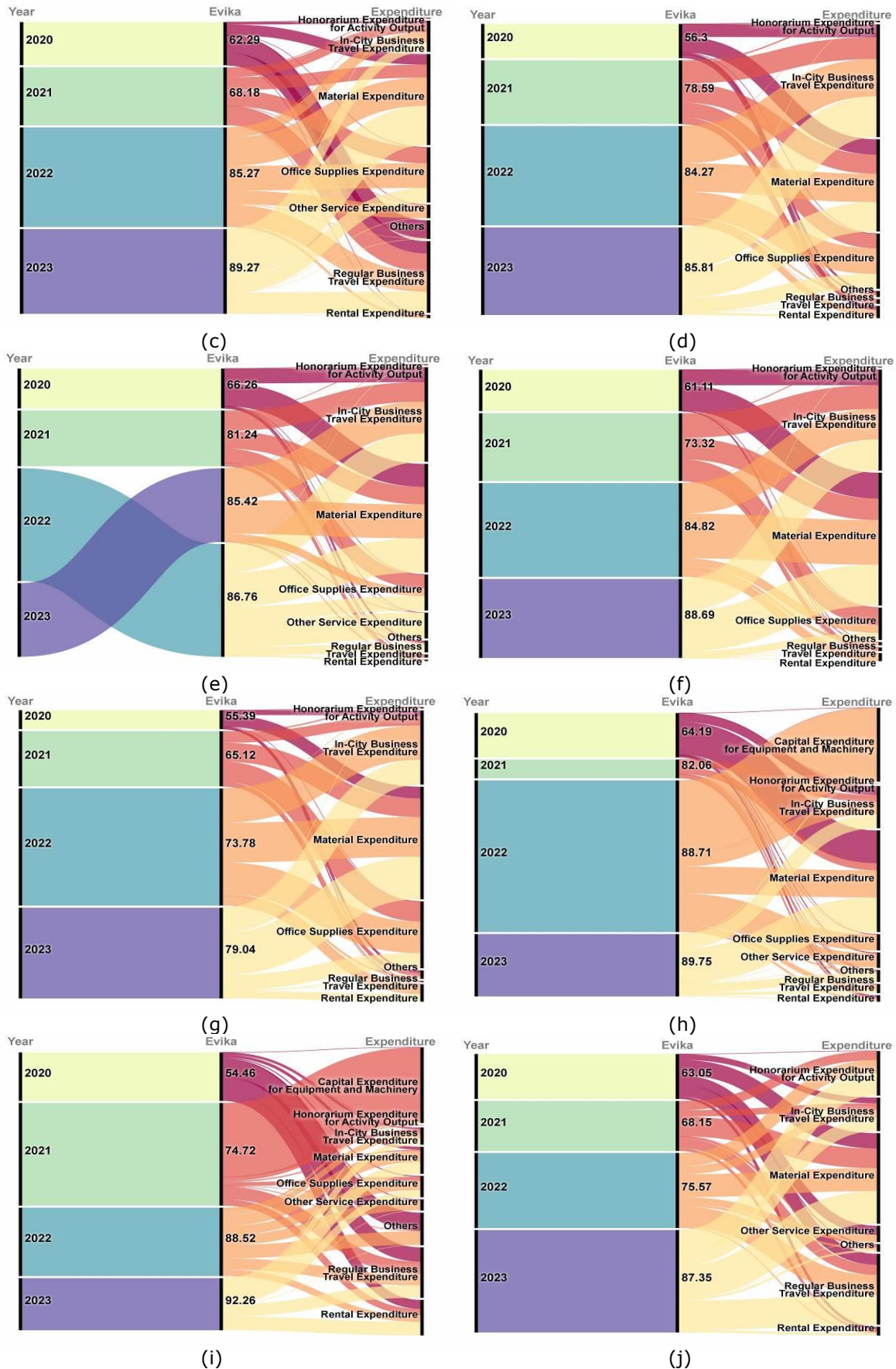
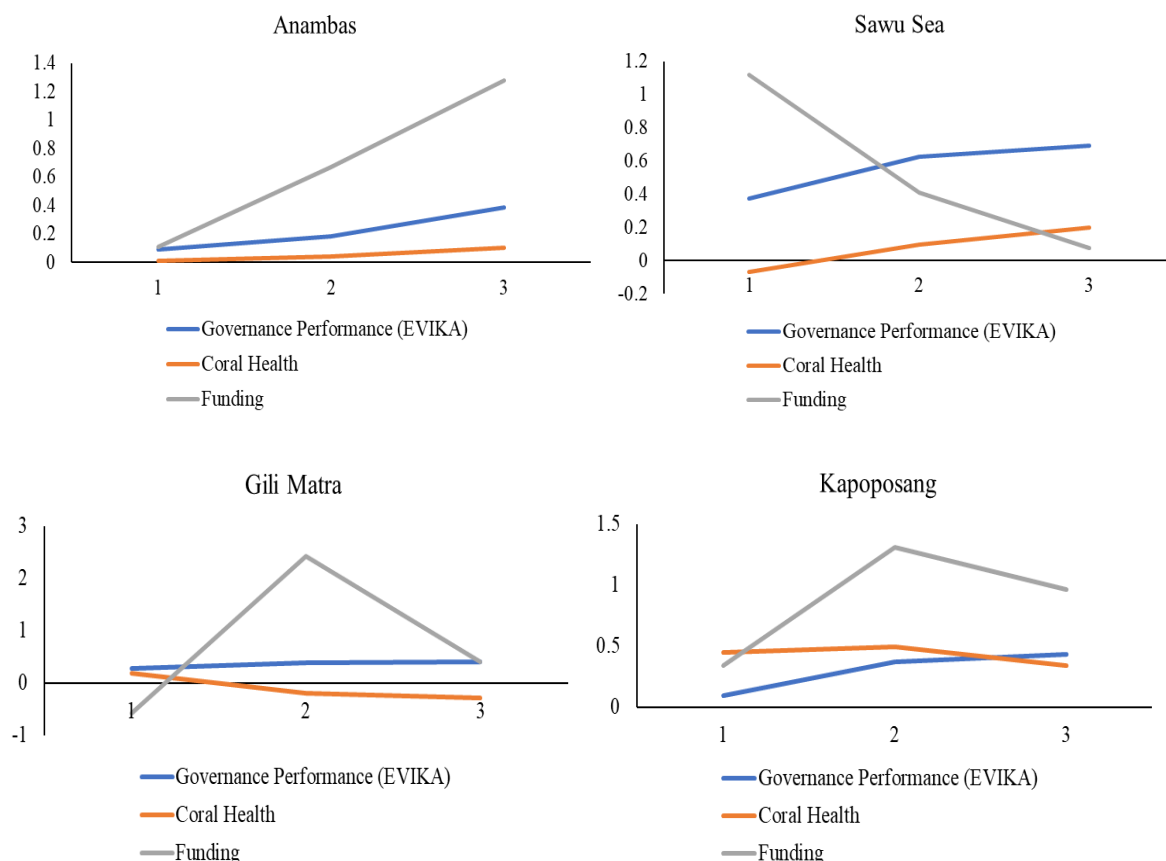


Figure 3. Correlation between MPA funding and governance performance (EVIKA) in each MPA: (a) Anambas, (b) Southeast Aru, (c) Kapoposang, (d) Padaido, (e) Raja Ampat, (f) West Waigeo, (g) Banda Sea, (h) Gili Matra, (i) Sawu Sea, (j) Pieh.

As demonstrated by the aforementioned correlation, a close relationship is evident between funding and governance performance. The role of funding in the governance performance value obtained is a critical factor that must be considered. In addition to the types of funding illustrated in the graphs (Figure 3), there are several other types of funding that also influence changes in governance performance value. These include: 1) out-of-city meeting package business travel expenditure; 2) consultant service expenditure; 3) official travel expenditure for in-city meeting packages; 4) expenditure for building and construction value addition; 5) professional service expenditure; and 6) non-operational goods expenditure, which can be seen in the "others" category. It has been demonstrated that the governance performance score of a MPA is directly proportional to the amount of funding received by said MPA. The repercussions of this increase can be perceived immediately or only manifest in the subsequent year. For instance, in Pieh, funding increased by approximately 10% in 2021 compared to 2020, resulting in an EVIKA value increment of 5.10 points. Similarly, in 2022, funding grew by 50%, leading to an EVIKA value increase of 7.42 points compared to the previous year. However, in certain instances across multiple domains, it has been observed that the outcomes of substantial funding are only manifest in the subsequent year. Consequently, the subsequent year's funding allocation may be diminished compared to the previous year, while the governance performance score continues to escalate. This case study focuses on the Sawu Sea, where funding decreased by 33% in 2022 compared to the previous year, yet the EVIKA score exhibited an increase from 74.74 to 88.52. In 2023, funding experienced a 23% decrease from the previous year, yet the EVIKA score demonstrated a 3.74-point increase.

Funding, governance, and ecosystem health growth. Financing and income growth can affect the value of governance and coral reef health. Through this analysis, we can clearly see how financing influences the sustainability of coral reef health and governance value. The results of this analysis show that the relationship between these three aspects in each region varies (Figure 4).



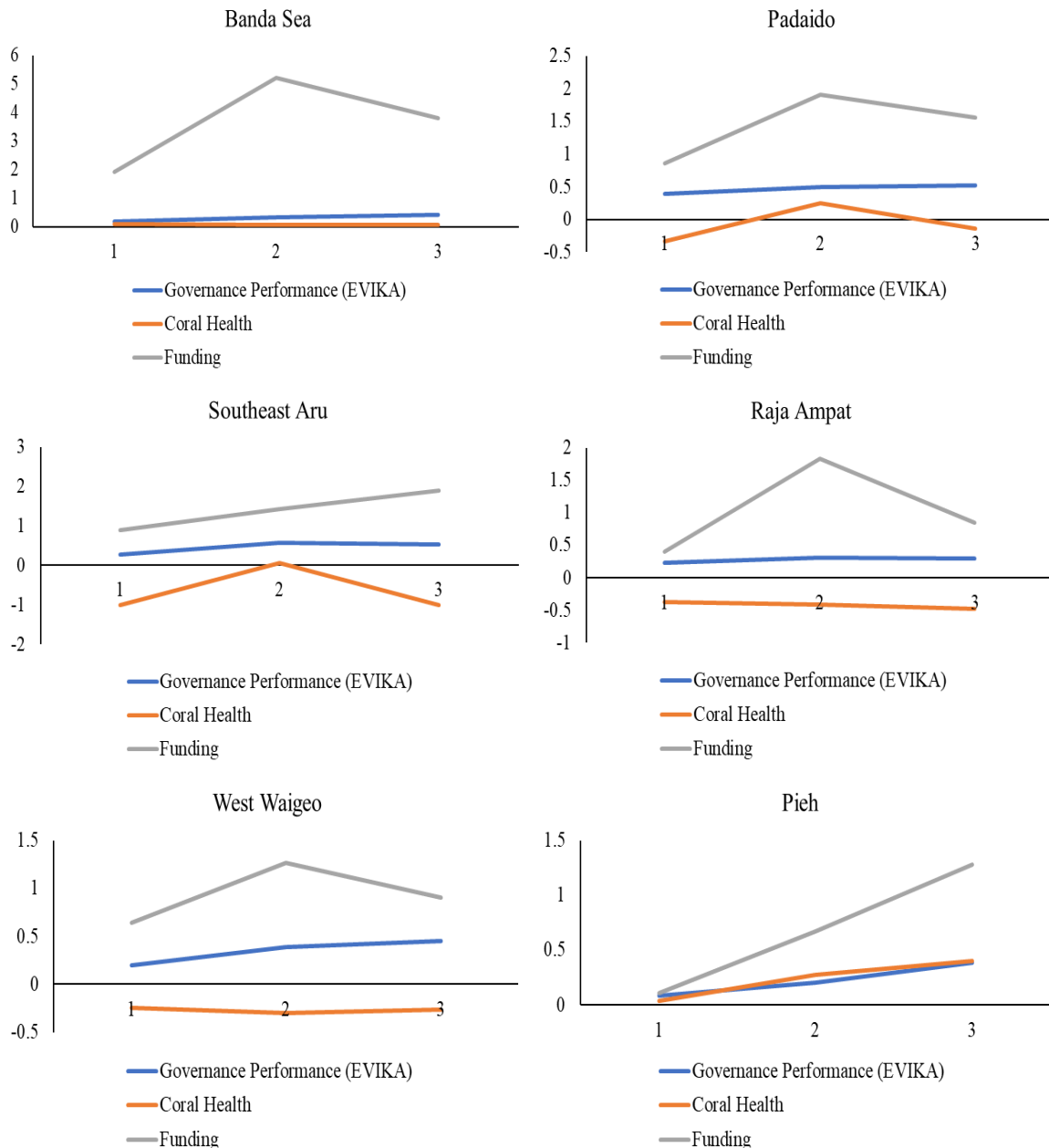


Figure 4. Funding, governance and ecosystem health growth in each MPAs.

Our analysis indicates that increases in funding for a given area do not appear to have a substantial effect on changes in coral health or governance values. In some cases, it was found that coral cover tended to decline even though funding in the area increased. This indicates a lack of funding role caused by inadequate distribution and management of funding. Additionally, the perception that funding is not used for ecosystem restoration but rather to slow down the decline in ecosystem quality should not exist. In practice, this funding should be utilized for ecosystem restoration, ensuring that ecosystems are maintained and indicating efficient management of an MPA.

Discussion. Good MPA management can be assessed based on how well funding is procured and how well the MPA is maintained. Funding plays an important role in the management of MPAs. Efficient funding can support optimal area management. It can also ensure that MPAs are managed properly and sustainably. This funding is often an obstacle for managers in carrying out management due to the limited amount of financial support available (Tarigan et al 2019). Inadequate funding to support the management

of MPAs can be a major issue that hinders management (Zhao et al 2022). This is in line with the results obtained in this study, based on ten MPAs studied, it is known that funding can influence the governance performance value of an area by the EVIKA score that the area got. The higher the funding received by a MPA, the higher the governance performance value received. However, the effects of effective funding are not always felt in the same year. In some cases, in certain regions, the effects of funding may only be seen in the following year. This can happen because the results of the management require a little time before changes or effects from the management can be seen.

Governance performance is clearly influenced by or derived from how well a MPA is managed. This also includes the health of the ecosystem in the area. The present analysis will examine the extent to which governance performance influences coral cover in the specified area (Figure 5).

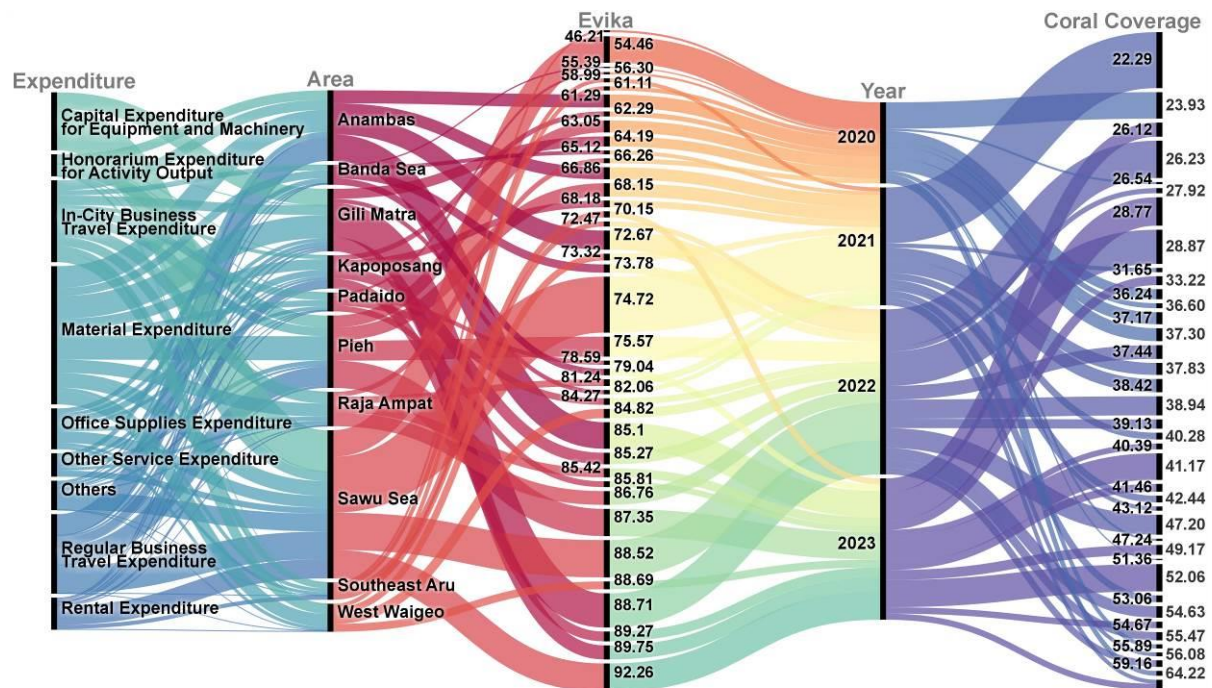


Figure 5. Correlation between MPAs funding, governance performance, and ecosystem health.

It has been established that there is no direct proportionality between governance performance and coral cover. This finding suggests the presence of inefficiencies in the allocation of financial resources. Consequently, measures undertaken to preserve the integrity of the ecosystem may not have yet attained the desired level of effectiveness. This phenomenon has been evidenced in a myriad of regions, where enhancements in funding and governance effectiveness have been observed, yet this has not invariably translated into augmented coral cover.

In EVIKA's assessment criteria, funding is an important aspect that is assessed in the management input category. This budget then provides access to other management activities so that they can be carried out. Funding as an input category then supports the processes and outputs desired by various parties to achieve efficient and optimal conservation area management (Lumbantoruan et al 2023). Funding for MPAs needs to be maintained and sustained through collaboration and coordination between agencies. For example, when there is a lack of training or legal regulations governing the management of conservation areas, collaboration and support from various parties is needed to minimize this problem and ensure that funding for MPAs is utilized properly and optimally. There needs to be good cooperation between funding providers and managers and those who manage the MPA (Bohorquez et al 2022). In addition to the availability of funds, good collaboration and management of funding allocation must also be considered to ensure that the funds are used appropriately for the management of MPAs, whether for ecosystem management or for the procurement of goods or services

that support the management of these areas (Sari et al 2016). Ineffective allocation of funding can result in suboptimal management. As observed in several areas within the ten MPAs studied, many of these areas showed a non-linear relationship between funding and coral cover. If this continues, effective management of MPAs could be hampered (Nurhaliza & Yuliani 2024). If this happens, ecosystem management in the area may also be disrupted, and if the ecosystem is disrupted, it will affect many other components of the water system.

Conclusions. This study highlights the persistent and critical funding gap that constrains the effective management and conservation outcomes of marine protected areas. While increased funding positively influences governance performance, it does not necessarily translate into improved ecological health, such as coral cover, revealing inefficiencies in resource allocation and management practices. Addressing these challenges requires the development and implementation of innovative financing mechanisms that go beyond traditional government budgets and donor contributions. Additionally, strengthening financial governance through enhanced transparency, accountability, and efficiency is essential to maximize the impact of available resources. Equally important is fostering inclusive collaboration and active engagement among diverse stakeholders - local communities, government agencies, non-governmental organizations, and private sector partners - to ensure co-management and sustainable funding solutions. Closing the funding gap is imperative to secure the long-term sustainability of marine protected areas, which play a vital role in marine biodiversity conservation, ecosystem resilience, and community livelihoods.

Conflict of interest. The authors declare that there is no conflict of interest.

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