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Article

Marine Regulatory Technology, Resource Allocation, and Local Exclusion: A Case Study of the Bajau Community in Semporna, Sabah, Malaysia

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Abstract: Drawing on short-term field observations and in-depth interviews with four residents conducted on February 12, 2026, in a Bajau settlement in Semporna, Sabah, Malaysia, this paper utilizes resource access theory to critically examine how technological marine governance, rapid tourism development, and unequal public service allocation jointly shape the life chances of marginalized coastal communities. Globally, indigenous maritime populations face increasing pressures from modernization, yet their specific socio-economic vulnerabilities remain underexplored. The study finds that the community's severe difficulties in accessing clean water, reliable electricity, adequate waste management, and traditional fishing opportunities are not merely the result of outdated or insufficient facilities. Rather, these challenges reflect a profound local exclusion produced through the complex interaction of strict identity registration, rigid spatial demarcation, significant capital barriers, and systemic infrastructure stratification. Although contemporary marine conservation efforts and tourism development initiatives have introduced stricter regulatory systems aimed at ecological preservation, they have unfortunately not been accompanied by stable public services, meaningful channels for civic participation, or viable alternative livelihood support. Consequently, local practices of so-called sustainable development demonstrate a glaring gap between the presence of stringent rules and the absence of adequate social guarantees. Ultimately, this paper argues that modern marine governance must urgently move beyond a single regulatory logic. Policymakers should adopt a comprehensive resource access perspective, actively building more flexible, inclusive links among Indigenous communities' daily survival needs, traditional livelihoods, and institutional eligibility.

Keywords: marine governance; resource access; infrastructure inequality; coastal communities; sustainable development; social exclusion

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1. Introduction

In recent years, marine governance has increasingly relied on technological and regulatory tools such as satellite remote sensing, vessel identification, protected-area boundaries, and fisheries permits. These tools are often considered essential for enhancing regulatory efficiency and safeguarding ecological resources [1]. However, at the local level, technology does not always function as a neutral force. When standardized rules are introduced into marine communities that have historically depended on mobile fishing practices, kinship networks, and oral knowledge, institutional arrangements intended for ecological protection may inadvertently create barriers that exclude traditional users.

The Bajau people are a maritime community in Southeast Asia whose livelihoods have traditionally depended on fishing, near-shore trade, and inter-island mobility. With the reinforcement of coastal state boundaries, the establishment of marine protected areas, and the development of diving tourism, the waters surrounding Semporna have been integrated into more structured systems of management and consumption. The sea, once

a familiar space for sustaining livelihoods, has been subdivided into protected areas, tourist zones, port regions, and administratively controlled spaces. For Bajau residents, the challenges extend beyond the ability to continue fishing; they also face difficulties in securing stable access to water, electricity, waste disposal, employment, and avenues for expressing their needs [2, 3].

This paper explores the question of why a community situated near a tourist hotspot and protected area continues to experience inadequate public services and limited access to resources, despite the increasing emphasis on marine regulatory technologies and the Sustainable Development Goals. By analyzing short-term fieldwork materials, it is demonstrated that local exclusion does not always manifest as direct expulsion [4]. More commonly, it is gradually shaped through seemingly routine arrangements involving time, service levels, procedural requirements, and spatial segregation.

2. Theoretical Perspective and Research Design

Resource access theory highlights that resource inequality extends beyond mere ownership to encompass whether specific groups can effectively utilize resources. This capability may stem from formal rights but is also influenced by factors such as capital, knowledge, technology, social networks, and identity recognition [5]. For marine communities, simply remembering traditional fishing grounds does not guarantee legal fishing rights, and residing near water does not ensure consistent access to clean water. Often, barriers to access are embedded within administrative processes and material infrastructures.

Studies on infrastructure underscore that systems like water pipes, power grids, waste collection, and roads are not purely technical constructs but are material manifestations of social relationships. A stable water supply and uninterrupted electricity signify inclusion within a public service network, whereas scheduled supply, delayed maintenance, or lack of collection services indicate a community's relegation to a lower service tier [2]. While infrastructure may appear to be a technical concern, it often reflects disparities in development priorities, identity classifications, and public investment.

The data for this study were gathered during an exploratory field visit. On February 12, 2026, the researcher conducted a five-hour observation in a Bajau community in Semporna, documenting housing patterns, water supply facilities, shoreline waste, nighttime lighting, and contrasts with nearby tourism areas [6]. Semi-structured interviews were also conducted with four residents, focusing on water sources, electricity, waste disposal, fishing activities, and community governance. These interviews were not recorded but were translated on-site and compiled from field notes afterward. No identifiable information, such as names, identity documents, or addresses, was collected. Only identity details pertinent to the analysis are included in this paper. Given the limited sample size, the study refrains from making broad generalizations. Instead, it uses the collected material to identify potential mechanisms: through detailed observations of daily life, it develops explanatory insights that warrant further long-term investigation. The data were analyzed using a thematic analysis approach, involving repeated examination of interview statements, observational photographs, and the concept of "access capacity." This process led to the identification of three themes: infrastructure stratification, ecological burden shifting, and regulatory thresholds. This approach ensures that the brief field visit is not misrepresented as a comprehensive ethnography but rather serves as an entry point for exploring institutional dynamics.

In the analysis, "access" is deconstructed into four interconnected levels. The first is material access, which refers to the reliable availability of services such as water, electricity, and waste collection. The second is institutional access, which concerns whether residents are formally recognized through registration, licensing, and application processes [5]. The third is spatial access, which examines whether traditional fishing grounds, docks, and markets remain accessible. The fourth is expressive access, which pertains to whether community members have opportunities to communicate their needs to administrators. These levels are interrelated; for instance, the absence of stable electricity can hinder

mobile communication and external contact, while the lack of formal identification or proof of address can complicate efforts to request facility improvements. The subsequent empirical discussion explores these interconnections in detail.

3. Infrastructure Stratification: An Unstable Life Organized by Circumstance

The most noticeable issue in the field was the disparity in water supply. The community's freshwater supply relies mainly on rainwater and a government-built water tower and pump system. A female resident explained that the pumps usually run twice a day, around 5 a.m. and 3:30 p.m.; if the equipment lacks power or experiences technical issues, the water supply is interrupted. This system fixes daily life around the pump schedule [7]. Residents have to store water in advance, and activities such as washing, cooking, and cleaning must be adjusted to an unpredictable water supply cycle (Figure 1).

Figure 1. Community Water Supply Facilities: Water Tower and Pump System. Source: Photo by the Author during Fieldwork, February 12, 2026.

By contrast, nearby tourist areas, including hotels, dive shops, and commercial shorelines, are closer to the standard of continuous water and electricity supply. Tourists rarely notice that water and electricity can be resources that require waiting [8]. It is through this contrast that infrastructure inequality becomes visible. It is not an abstract condition of disparity, but the placement of different groups into different temporal orders: on one side, tourist time is organized around convenience and mobility; on the other, community time is organized around waiting for water, electricity, and equipment repair.

Respondents also noted that the community is not entirely without alternatives. Rainwater can be collected during the rainy season, and some households also use groundwater. However, these methods depend on weather, equipment, and storage conditions, and they cannot be equated with a stable water supply network. There is a clear gap between "having some water available" and "having safe, continuous, and predictable water." To outside observers, a water tower may suggest that the problem has been resolved [7]. For residents, the key questions are when the pumps will start, who will repair them if they malfunction, and whether stored water will last until the next supply. This difference shows that infrastructure should be evaluated not only by whether facilities exist, but also by whether they can reliably support daily life.

Electricity also produces a time-based form of exclusion. Interviewed fishermen mentioned that the community's electricity supply lasts only until 10 p.m., after which they must rely on other energy sources or stop certain activities. Power cuts are not merely a lighting issue [9]. They also affect children's evening study, mobile phone charging,

access to information, and the household's sense of security. Modern governance often treats connection to the power system as the arrival of public service. Yet if the supply exists only during certain hours, residents remain only partly connected. Once a technical node is interrupted, life opportunities diminish as well.

More importantly, waiting and storing water themselves consume time. Residents must arrange water collection, transportation, and storage before and after supply periods, and family members must also prepare alternatives for power cuts. For outside visitors, water and electricity are invisible background conditions. For community residents, they are conditions that must be checked again every day. Infrastructure instability therefore enters the organization of housework, study, rest, and daily routines, becoming a low-intensity but continuous pressure in daily life.

Communication conditions further deepen this semi-connected state [7]. Interviewees noted that residents buy mobile phones, but the signal is unstable and more likely to fail during bad weather. Mobile phones could help residents contact markets, relatives, schools, or government offices, but unstable electricity and signal coverage weaken their usefulness. This shows that modern technology does not automatically produce integration once it enters a community. It needs support from electricity, networks, language, and administrative responsiveness. Without these conditions, mobile phones are fragile connections rather than real gateways to public services.

This tiered configuration also changes how residents perceive their position. The lights, roads, and commercial services along the tourist waterfront constantly suggest that "development" is nearby, while the community receives an infrastructure arrangement with low resilience and little redundancy [10]. Water towers and timed electricity indicate that national or local governance has intervened, but the mechanisms for maintenance, upgrading, and accountability remain unclear. The result is not a complete absence of governance, but inadequate governance: facilities have been installed, yet stable living conditions have not truly arrived.

4. Waste Governance: How Ecological Responsibility Is Shifted

Waste disposal emerged as the second major issue. Respondents indicated that common practices in the community include dumping waste into the sea or burning it on site [7]. While they were aware that plastics are difficult to degrade and that burning waste pollutes the environment, the community lacks fixed recycling points, collection boats, and sorting facilities. One elderly resident remarked, "It is not that we want to throw it into the sea; it is that there is nowhere to put the waste." This statement highlights a disconnect between environmental responsibility and the capacity to act.

Judged solely by its consequences, dumping waste into the ocean or burning it might be interpreted as a lack of environmental awareness among residents (Figure 2). From an access perspective, however, it represents a forced choice when waste management services fail to reach the community. Residents are expected to uphold the moral obligation of "responsible consumption," yet they lack the material conditions necessary to fulfill it. When the collection system is inadequate, waste is displaced from household spaces into public waters, and the resulting ecological risks are then attributed back to the community.

Figure 2. Waste and Drainage Below Nearshore Housing. Source: Photo by the Author during Fieldwork, February 12, 2026.

Notably, residents proposed feasible ideas during interviews. Some suggested establishing an environmental recycling station or using barges to transport waste to town for centralized treatment. However, these proposals would require community acceptance, external funding, and management arrangements. This demonstrates that the community is not entirely passive in addressing challenges; it can propose solutions tailored to local conditions. The difficulty lies in the need for stable organizers, transport costs, shoreline docking points, and a back-end treatment system, all of which are beyond the capacity of individual households. Without institutional support, these reasonable suggestions remain verbal proposals.

This transfer of responsibility is particularly concerning. Global goals emphasize responsible consumption and production, as well as the protection of marine ecosystems. If local governance focuses solely on marine debris without addressing the lack of alternative waste disposal options, policies risk portraying communities as sources of pollution rather than as those affected by gaps in public services. In this way, the framing of "environmental problems" can obscure deeper issues related to resource allocation. From this perspective, waste is not a secondary issue but a visible indicator of uneven development in daily life.

5. Regulatory Thresholds and Spatial Development

The resource challenges faced by the Bajau community are also evident in the restructuring of marine spaces. The waters surrounding Semporna serve diverse purposes, including ecological preservation, diving tourism, and traditional fishing. Protected areas can help reduce harmful fishing practices, sustain coral reef ecosystems, and align with global marine conservation objectives. However, once these protected boundaries are formalized into administrative maps and enforcement protocols, the success of such policies depends on whether traditional fishers are included in processes such as negotiation, registration, and compensation.

For groups characterized by high mobility, incomplete identity documentation, or lack of fixed vessel registration, the licensing system itself may act as a subtle form of exclusion. This exclusion does not necessarily manifest as direct displacement but rather as an inability to meet eligibility requirements, afford necessary equipment upgrades, navigate the application process, or avoid violations due to unfamiliarity with boundaries. While technological governance may appear to clarify rules, it can simultaneously

marginalize those lacking documentation, financial resources, or procedural knowledge, effectively excluding them from being classified as "compliant" users.

It is crucial to differentiate between the existence of rules and their accessibility. Policies that rely solely on official language, fixed administrative offices, and written applications can alienate fishers who depend on oral communication, seasonal mobility, and informal living arrangements. As boundaries become more precise, unrecorded routes and traditional fishing knowledge risk being invalidated [11, 12]. Similarly, as permits become increasingly standardized, individuals without proper documentation are more likely to be excluded from the system.

Tourism development further accentuates spatial stratification. Expenditures by tourists, along with investments in diving services and waterfront businesses, generate higher economic value in specific coastal areas, attracting more stable infrastructure development. However, local residents remain predominantly engaged in low-income fishing, temporary work, and informal trade. Respondents noted that part of their catch is used for household consumption while the remainder is sold elsewhere, yet overall income remains low [5]. The economic benefits of tourism primarily flow to marinas, hotels, and diving service providers, with limited impact on local households.

The community possesses its own organizational structure. Interviews revealed that fishing activities are primarily undertaken by men, with income distribution influenced by arrangements made by the village chief. The village chief, who is elected, has the capacity to organize residents for collective actions. This indicates that the Bajau community is not devoid of governance mechanisms or the ability to engage in public affairs. On the contrary, external governance could potentially leverage these local organizational structures to facilitate waste management, infrastructure maintenance, and dissemination of fishing regulations at lower costs. Unfortunately, governance models centered on tourism and protected areas often fail to fully recognize these local resources (Figure 3).

Figure 3. Differences in Nighttime Lighting between Tourist Shorelines and Residential Areas. Source: Photo by the Author during Fieldwork, February 12, 2026.

This analysis suggests that marine conservation and tourism development do not inherently exclude the Bajau people. Exclusion arises when institutional frameworks prioritize ecological metrics, tourist experiences, and commercial order while neglecting community participation and equitable revenue distribution. Certain spaces are designed as consumable, regulated, and displayable marine landscapes, whereas others are labeled as inefficient, unclean, or challenging to manage. Within this framework, the traditional

livelihoods of the Bajau people are increasingly perceived not as valuable marine knowledge but as governance challenges.

Local exclusion is not the result of a single policy but rather the interplay of identity, spatial, and technological factors. In terms of identity, mobility and informal living arrangements reduce access to public resources [13]. Spatially, the establishment of protected areas and tourist zones diminishes traditional usage areas. Technologically, tools such as pumps, electricity systems, registration processes, and boundary enforcement translate inequality into tangible daily constraints. Together, these elements create significant barriers for communities near development hubs to access the benefits of development.

This dynamic also explains why proximity to development does not guarantee shared benefits. Communities may be located near tourist facilities but lack access to equivalent services. Residents may possess extensive knowledge of the ocean but struggle to justify their presence under new regulatory frameworks. Local landscapes may derive cultural value from the Bajau way of life, yet the economic benefits are often redirected outward through travel agencies, hotels, and diving businesses [3]. Development thus generates a form of localized inequality: spatially close yet institutionally segregated, visibly apparent yet with limited resource redistribution.

6. Conclusion

Based on short-term field data, this paper analyzes the local exclusion experienced by a Bajau community in Semporna at the intersection of marine management, tourism development, and public service allocation. The study finds that timed water supply, power cuts, the absence of waste collection, and fisheries eligibility barriers together create multidimensional access constraints. These are not isolated difficulties, but a mutually reinforcing structure: unstable infrastructure weakens daily capabilities, administrative thresholds restrict resource use, tourism absorbs development benefits, and identity categorization makes it more difficult for the community to obtain institutional responses.

Improvements therefore should not be limited to strengthening management or raising residents' awareness. First, a basic service list for the community should be established, clearly defining minimum standards and responsible parties for water supply, electricity, and waste collection, especially for urgent issues such as pump maintenance, nighttime lighting, and waste removal. Second, protected-area and fisheries licensing systems should include registration, explanation, and transition mechanisms suitable for traditional fishers, reducing barriers related to documentation, language, and capital. Third, a portion of tourism revenue should be used to support public services in nearshore communities, so that improvements in tourist landscapes do not become disconnected from improvements in residents' livelihoods. Fourth, stable communication channels could be established through community leaders, school teachers, or local translators, allowing residents' suggestions to move beyond ad hoc interviews and enter project design and budget discussions. Fifth, future research should conduct longer-term, multi-stakeholder interviews that include local government, tourism operators, NGOs, and women residents in order to test the mechanisms proposed in this paper.

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