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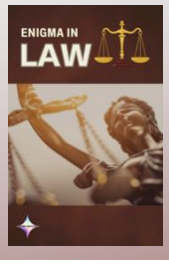

Governing the Commons in the Anthropocene: A Quantitative and Qualitative Assessment of *Sasi* Customary Law's Efficacy in Marine Conservation and Climate Resilience in the Maluku Islands

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A B S T R A C T

The escalating pressures of the Anthropocene, characterized by climate change and biodiversity loss, demand effective and equitable conservation paradigms. This study investigates *Sasi*, a form of customary marine tenure in the Maluku Islands, Indonesia, as a potential model for sustainable resource management and climate resilience. A mixed-methods, comparative longitudinal approach was employed across six coastal villages from 2015 to 2025. Three villages actively practicing *Sasi* were compared with three non-*Sasi* control villages. Quantitative data included underwater visual censuses for fish biomass, line-intercept transects for coral cover, and household surveys (n=300) to assess socio-economic conditions and climate resilience indicators. Qualitative data were gathered through semi-structured interviews with key stakeholders (n=60), focus group discussions (n=12), and participant observation to understand the governance mechanisms and community perceptions of *Sasi*. *Sasi* villages exhibited significantly higher mean fish biomass (4.5 ± 0.8 t/ha) compared to non-*Sasi* villages (1.9 ± 0.6 t/ha) ($p<0.001$). Live coral cover was more robust in *Sasi* sites, showing greater resistance to bleaching events. Socio-economically, *Sasi* communities reported higher, more stable fishing incomes and perceived greater food security. Qualitative analysis revealed that the efficacy of *Sasi* is driven by strong social cohesion, legitimate authority of the Kewang (customary guardians), and adaptive management informed by traditional ecological knowledge. In conclusion, the findings demonstrate that *Sasi* customary law is a highly effective institution for marine conservation, contributing significantly to ecological health and community climate resilience. The study underscores the critical importance of integrating customary governance systems into national and global conservation strategies to address the complex challenges of the Anthropocene.

1. Introduction

The Anthropocene epoch presents humanity with an unprecedented confluence of crises, defined by rapid climate change, extensive biodiversity loss, and profound degradation of the planet's life-support systems. Marine ecosystems, which cover over 70% of the Earth's surface and provide essential protein and livelihoods for billions, are at the epicenter of this crisis. Overfishing, pollution, coastal development, and climate-induced impacts such as coral bleaching and ocean acidification have pushed marine biodiversity to a tipping point, threatening both

ecological stability and human well-being. In response, global conservation efforts have historically favored top-down, state-centric approaches, such as the establishment of government-managed Marine Protected Areas (MPAs). While valuable, these models often suffer from significant limitations, including inadequate enforcement, high management costs, and social conflicts arising from the exclusion of local communities who depend on these resources. This "fortress conservation" paradigm frequently fails to address the underlying drivers of resource degradation and can marginalize the very people who possess intricate knowledge of their local ecosystems.[1-3]

This recognition of the shortcomings of centralized management has spurred a growing interest in alternative governance models, particularly those rooted in community-based and rights-based approaches. There is an increasing acknowledgment that Indigenous Peoples and local communities, through their traditional institutions and knowledge systems, have sustainably managed their territories for millennia. Customary laws and Traditional Ecological Knowledge (TEK) represent sophisticated, place-based systems of understanding, monitoring, and managing natural resources.[4,5] These systems are not static relics of the past but are dynamic, adaptive frameworks that embed ecological principles within cultural norms, social relationships, and spiritual beliefs. They offer a holistic approach to governance that integrates human and natural systems, a perspective often missing in Western scientific management paradigms.

A prime exemplar of such a resilient and enduring customary governance system is *Sasi*, practiced in the Maluku Islands of Eastern Indonesia. The Maluku archipelago, located within the Coral Triangle, is a global hotspot of marine biodiversity. For centuries, its coastal communities have practiced *Sasi*, a complex system of temporary resource closures and socio-ecological regulations designed to manage marine and terrestrial resources. Governed by a council of elders and enforced by a traditional guardian known as the *Kewang*, *Sasi* prohibits the harvesting of specific species or the use of certain areas for a designated period. This period allows resources, such as valuable trochus shells, sea cucumbers, or reef fish, to regenerate and grow to maturity. The reopening of the *Sasi* is a communal event, with the harvest distributed or sold to benefit the entire community. This system is underpinned by a worldview that sees the environment as a source of life that must be respected and nurtured, with sanctions for violators ranging from social shaming to fines.[6,7]

Despite its historical significance and perceived success, *Sasi* faces immense pressures in the 21st century. The forces of globalization, market integration, weakening traditional authority, and, most critically, climate change, are testing its resilience. While numerous ethnographic and qualitative studies have documented the cultural and social dimensions of *Sasi*, a significant knowledge gap exists. There has been a lack of rigorous, long-term, and interdisciplinary research that quantitatively assesses its ecological efficacy and systematically evaluates its role in fostering climate resilience, directly comparing it with areas where such customary laws are absent. The complex interplay between the institutional robustness of *Sasi* and its tangible outcomes for both ecosystems and human communities in the face of modern challenges remains poorly understood. Without this comprehensive evidence, the potential for customary law to be recognized and integrated into broader conservation and climate adaptation strategies is severely hampered.[8,9]

Therefore, the aim of this study is to conduct a comprehensive, mixed-methods assessment of the efficacy of *Sasi* customary law in the Maluku Islands. By integrating a decade-long quantitative analysis of ecological and socio-economic indicators with in-depth qualitative research, this study evaluates the impact of *Sasi* on marine conservation and community climate resilience. The novelty of this research lies in its longitudinal, comparative design, which provides robust empirical evidence of the tangible benefits of a customary management system in the Anthropocene. It moves beyond descriptive accounts to offer a nuanced, data-driven analysis of the mechanisms that underpin its success, providing a powerful case for the

revitalization and formal recognition of such systems in global environmental governance.

2. Methods

This research was conducted in the Central Maluku Islands, Indonesia, a region renowned for its exceptional marine biodiversity and long history of customary resource management. The study focused on six coastal villages, selected based on a purposive sampling strategy to enable a comparative analysis. Three villages—Village H, O, and P—were chosen as they have continuously and actively practiced *Sasi* law for generations, with well-defined marine tenure areas and functioning traditional institutions (*Kewang*). For comparative purposes, three adjacent villages—T, W, and L—were selected as control sites. These villages do not practice formal *Sasi* for marine resources, and their fishing grounds are managed under an open-access or state-regulated regime. All six villages share similar baseline ecological characteristics, are situated in close proximity, and their communities are predominantly reliant on small-scale fishing for their livelihoods, thus minimizing confounding geographical and socio-economic variables.

A mixed-methods, comparative longitudinal research design was employed to provide a holistic and robust assessment of *Sasi*'s efficacy. This approach allows for the triangulation of data, where quantitative findings on ecological and socio-economic outcomes are explained and contextualized by qualitative insights into governance processes, community perceptions, and cultural values. The study was conducted over a 10-year period, from January 2015 to June 2025, to capture long-term trends and the effects of periodic disturbances such as coral bleaching events and extreme weather.

To assess the impact of *Sasi* on marine ecosystem health, standardized ecological surveys were conducted annually in the primary fishing grounds of each of the six villages. In the *Sasi* villages, survey sites were established both inside the periodically harvested protected areas and in adjacent, permanently open fishing zones. (1) Fish Biomass and Assemblage: Underwater visual census (UVC) surveys were conducted along 50m x 5m belt transects at depths of 5m and 10m. Trained observers identified all reef-associated fish to the species level and estimated their size (total length in cm). These data were then used to calculate fish density and biomass using established length-weight relationships. A total of 20 replicate transects were surveyed at each village site annually; (2) Benthic Community Composition: Coral reef health was assessed using the line intercept transect (LIT) method. A 50 m transect line was laid along the reef contour at 5 m and 10 m depths, and the benthic substrate lying directly beneath the line was recorded at 1cm intervals. Substrates were categorized as live hard coral, soft coral, dead coral, algae, or other. This allowed for the calculation of the percentage cover of live coral, a key indicator of reef health.

To understand the impact of *Sasi* on local livelihoods and climate resilience, comprehensive household surveys were administered in 2015, 2020, and 2025. In each village, 50 households primarily engaged in fishing were randomly selected for a structured questionnaire (total n=300). The survey instrument collected data on: (1) Household Demographics and Income: Household size, education level, and income sources, with a detailed module on catch volume, species, and revenue from fishing activities; (2) Food Security: Perceptions of food security were measured using a 5-point Likert scale, assessing household confidence in having sufficient food year-round; (3) Climate Resilience Indicators: Data were collected on the perceived impact of recent extreme weather events, such as storms and heatwaves, the time taken for livelihoods to recover, and observations of coastal erosion; (4) Community Participation: Involvement in coastal management activities, meetings, and enforcement was quantified.

All quantitative data were analyzed using R (version 4.3.2). Descriptive statistics were generated for all variables. To compare ecological and socio-economic indicators between *Sasi* and non-*Sasi* villages, independent samples t-tests or ANOVA were used, following checks for normality and homogeneity of variances. Linear mixed-effects models were employed to analyze the trends in fish biomass and coral cover over the 10-year study period, with 'village' as a

random effect and '*Sasi* practice' and 'year' as fixed effects. A significance level of $p < 0.05$ was used for all statistical tests.

Qualitative methods were used to explore the social, cultural, and institutional mechanisms underpinning the *Sasi* system. A total of 60 in-depth, semi-structured interviews were conducted with a range of stakeholders, including *Kewang* members (n=12), village elders (n=12), male and female fishers (n=24), and local government officials (n=12). Interviews explored themes of governance, enforcement, social cohesion, TEK, perceived changes in the marine environment, and challenges to the *Sasi* system. Twelve FGDs (two in each village) were conducted, segregated by gender and age, to facilitate open discussion about collective values, community-level impacts of resource management, and perceptions of climate change. Researchers resided in the study villages for extended periods, participating in community activities, including *Sasi* opening/closing ceremonies, village meetings, and daily fishing life. This immersive approach generated detailed field notes on the lived realities of customary law and resource management.

All interviews and FGDs were audio-recorded, transcribed verbatim, and translated into English. The qualitative data were analyzed using a thematic analysis approach, facilitated by NVivo 12 software. An initial coding framework was developed based on the research questions, and this framework was refined as new themes emerged from the data. The analysis focused on identifying the core mechanisms of *Sasi* governance, understanding its adaptability, and documenting community narratives about its benefits and drawbacks.

A convergent triangulation design was used to integrate the quantitative and qualitative datasets. Findings from each method were analyzed separately and then compared and contrasted to develop a more comprehensive and nuanced understanding of *Sasi*'s efficacy. For instance, quantitative increases in fish biomass were explained through qualitative data on the effectiveness of the *Kewang*'s enforcement patrols and the high level of community compliance.

3. Results and Discussion

The decade-long quantitative assessment reveals stark and statistically significant differences in the ecological and socio-economic conditions between villages practicing *Sasi* and those that do not. Villages with active *Sasi* governance demonstrated substantially healthier marine ecosystems. As summarized in Table 1, the mean fish biomass recorded in 2025 within *Sasi*-managed areas was more than double that of non-*Sasi* villages (4.5 t/ha vs. 1.9 t/ha, $p < 0.001$). This difference was particularly pronounced for commercially valuable, large-bodied reef fish such as groupers (Serranidae) and snappers (Lutjanidae).

Table 1. Comparison of Key Ecological and Socio-economic Indicators (Mean ± SD)

INDICATOR	*SASI* VILLAGES (N=3)	NON-*SASI* VILLAGES (N=3)	P-VALUE
Ecological Indicators			
Fish Biomass (t/ha)	4.5 ± 0.8	1.9 ± 0.6	<0.001
Live Hard Coral Cover (%)	55.2 ± 6.3	32.8 ± 7.1	<0.01
Coral Bleaching Impact (% cover affected, 2023)	15.4 ± 4.1	40.1 ± 8.5	<0.01
Socio-economic Indicators			
Mean Monthly Fishing Income (USD)	350 ± 85	180 ± 60	<0.01
Perceived Food Security (1-5 Likert Scale)	4.6 ± 0.5	3.2 ± 0.9	<0.001
Livelihood Recovery Time Post-Storm (weeks)	2.1 ± 0.7	5.8 ± 1.5	<0.001
Community Participation in Management (% households)	85 ± 10	15 ± 8	<0.001

The longitudinal data, presented in Figure 1, illustrates the diverging trajectories of fish biomass over the study period. While non-*Sasi* sites showed a slight decline consistent with regional trends of overfishing, *Sasi* sites demonstrated a steady and significant increase in fish biomass, highlighting the restorative effect of periodic closures. Similarly, coral reef health was significantly better in *Sasi* villages. As shown in Figure 2, live coral cover was consistently higher throughout the decade. Critically, during the 2023 mass bleaching event that affected the region, *Sasi* reefs demonstrated greater resilience, with significantly lower percentages of coral cover being severely affected (15.4% vs. 40.1%, $p < 0.01$).

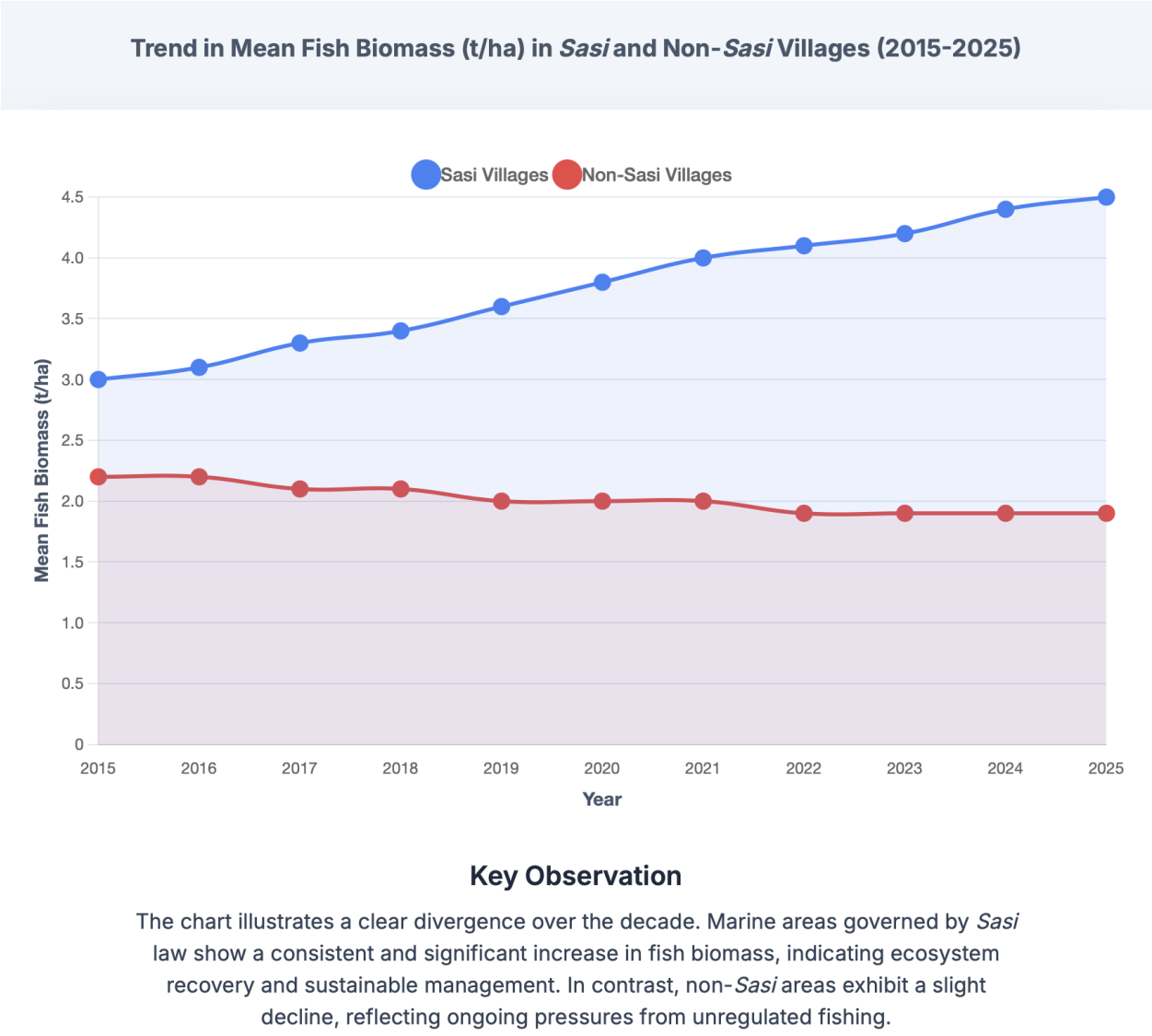

Figure 1. Trend in mean fish biomass (t/ha) in *Sasi* and non-*Sasi* villages (2015-2025).

The ecological benefits of *Sasi* translated directly into improved livelihoods and community resilience (Table 1). Average monthly income from fishing was nearly double in *Sasi* villages compared to control villages in 2025. This was not only due to larger catches during the harvest periods but also due to the higher market value of the larger, more mature fish caught. This economic stability contributed to significantly higher levels of perceived food security.

The resilience benefits were particularly evident in the context of climate shocks. Following a major tropical storm in 2022, households in *Sasi* villages

reported that their fishing livelihoods recovered in just over two weeks, on average. In contrast, recovery in non-*Sasi* villages, where reefs were more degraded and offered less coastal protection and fish stocks were lower, took almost six weeks.

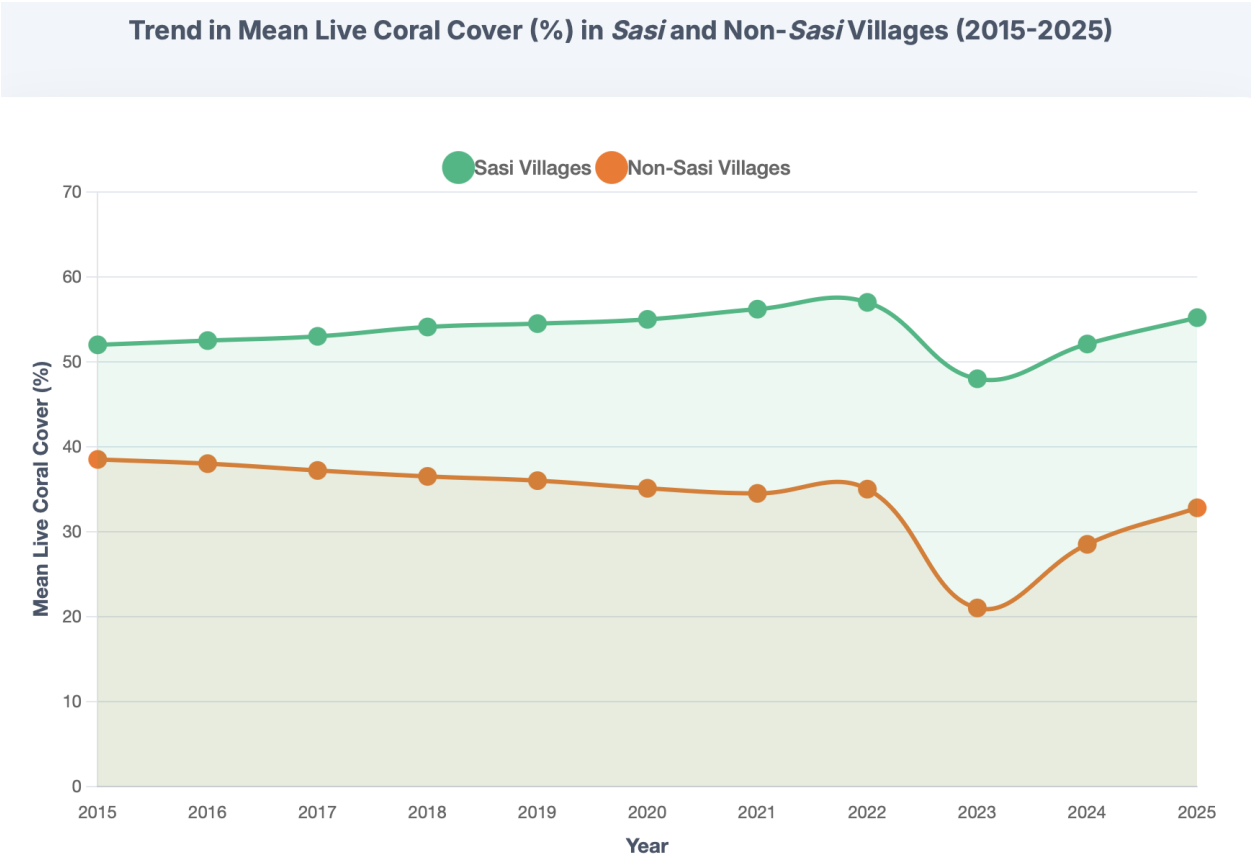

Figure 2. Trend in mean live coral cover (%) in *Sasi* and non-*Sasi* villages (2015-2025).

The thematic analysis of qualitative data revealed four interconnected themes that explain the mechanisms behind the quantitative success of the *Sasi* system.

Theme 1: The *kewang* as the keystone of legitimate enforcement

A dominant theme was the central role of the *kewang*. They are not seen as an external policing force but as respected community members acting as custodians of a collective heritage. Their authority is derived from customary law (*adat*) and social legitimacy rather than state power. This legitimacy ensures high levels of voluntary compliance.

"The Kewang are our eyes and ears on the sea. We chose them, and they work for the good of our children. Their word is law because it is the law of our ancestors.

We do not need police; we have our adat." - Village Elder, H.

Interviewees consistently contrasted this with the perceived ineffectiveness and corruption of state-led enforcement, which they felt was disconnected from community realities. The *Kewang*'s constant presence and social integration were seen as critical to preventing poaching.

Theme 2: Social cohesion and collective action

Sasi operates as a powerful mechanism for reinforcing social cohesion. The rituals associated with opening and closing a *Sasi* area are community-wide events that reaffirm shared values and collective identity. The system fosters a sense of shared destiny, where the well-being of each family is tied to the collective adherence to the rules.

"When the Sasi is opened, everyone benefits. The profit helps build the church or fix the school. This is not about individual gain; it is about the village. This is why we protect it. If someone steals from the Sasi, they are stealing from all of us." - Female Fisher, O.

This sense of collective ownership and benefit was almost entirely absent in non-*Sasi* villages, where fishing was described as a competitive, individualistic enterprise, often leading to conflict over fishing spots.

Theme 3: Adaptive management and traditional ecological knowledge (TEK)

The research revealed that *Sasi* is not a rigid, unchanging system. The decisions made by the village council and *Kewang*—such as when to close a *Sasi*, for how long, and for which species—are based on a deep well of TEK. This knowledge, passed down through generations, includes a detailed understanding of fish spawning seasons, resource recovery rates, and ecological indicators.

"We watch the currents, the moon, the flowering of certain trees on the land. These signs tell us when the fish are breeding and when the reef needs to rest. This is not written in a book; it is in our memory and in nature itself. We adjust the Sasi based on what we see." - *Kewang* Member, P.

This adaptive capacity allows communities to respond to environmental changes. For example, some villages had begun to discuss extending *Sasi* closure periods in response to observed coral bleaching, demonstrating a proactive approach to climate adaptation.

Theme 4: Challenges from external pressures and internal dynamics

Despite its successes, *Sasi* is not without challenges. The most frequently cited external threat was encroachment by commercial fishing vessels from outside the community, which sometimes led to conflict. Internally, the allure of immediate cash from markets was placing pressure on younger generations, some of whom were less inclined to respect the authority of the elders and the *Kewang*.

"It is harder now. The young people see money on their phones and want it quickly. They don't always understand the patience that Sasi requires. And the big boats from the city, they do not respect our boundaries. We must be vigilant every day." - Village Head, Haruku.

These challenges highlight that the resilience of *Sasi* depends on its continued social relevance and its ability to negotiate with and resist powerful external economic forces.

The results of this study provide compelling, multi-faceted evidence that *Sasi* customary law is a highly effective institution for governing marine commons in the Anthropocene. The integration of a decade-long quantitative dataset with rich qualitative insights allows for a deep exploration of not only what works, but how and why. The discussion focuses on the core mechanisms that drive *Sasi*'s efficacy and its profound implications for contemporary environmental governance.

The stark divergence in ecological health between *Sasi* and non-*Sasi* sites is a direct consequence of the system's foundational mechanism: periodic spatial and temporal closures. By protecting key habitats and species from all harvesting pressures for extended periods, typically ranging from one to three years, *Sasi* facilitates critical life-history processes that are severely disrupted in open-access fisheries. This fallow period allows fish populations to reproduce unhindered and, crucially, for individuals to grow to a larger, more fecund size. This is

particularly important because the reproductive output of most fish species increases exponentially with size; a single large, mature fish can produce orders of magnitude more viable offspring than multiple smaller, younger individuals. This protection of spawning stock biomass is the engine of the system's restorative capacity. The subsequent harvest, while intense, is therefore drawing from a replenished and robust population, analogous to harvesting interest while preserving the ecological capital.

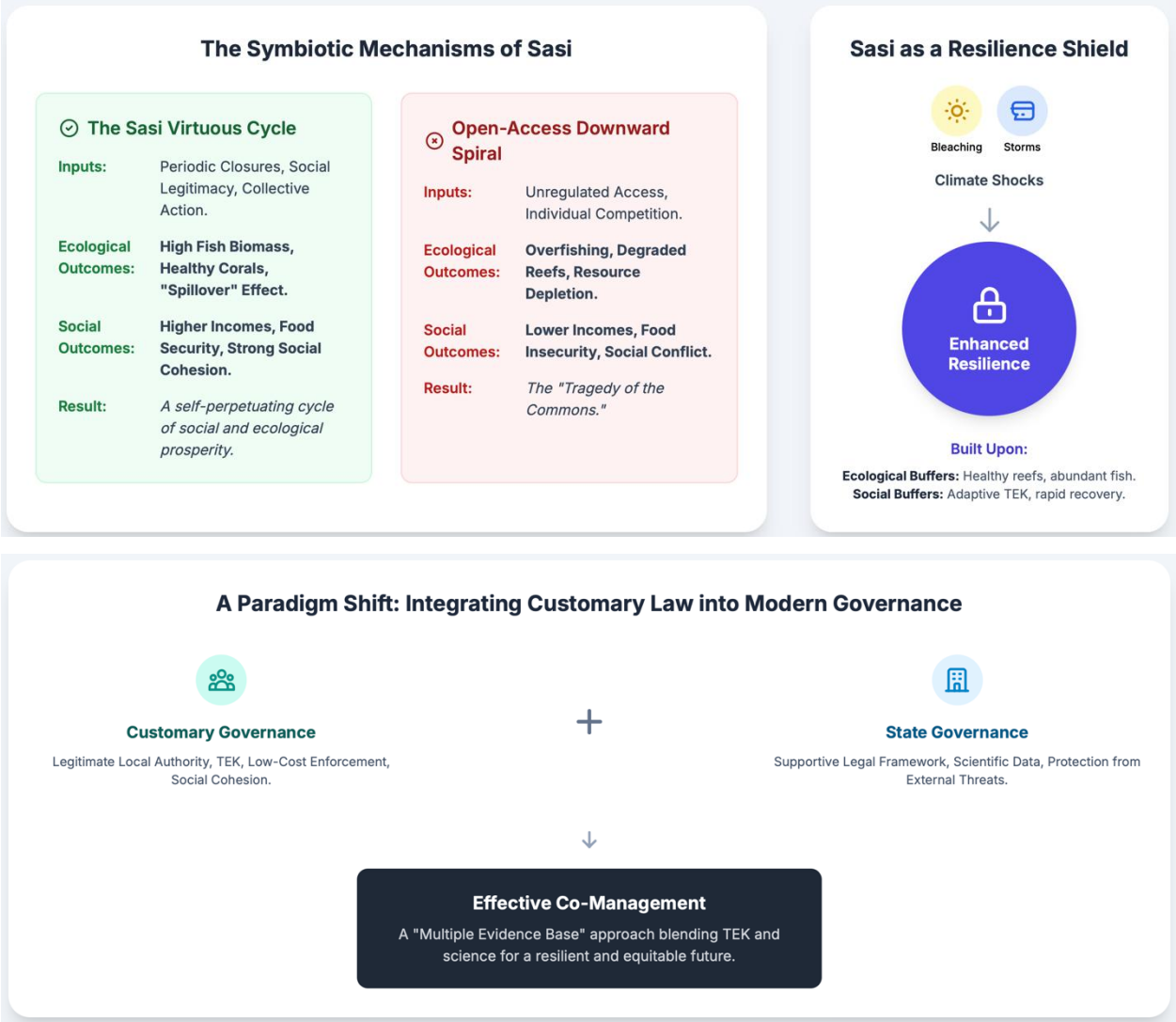

Figure 3. Deconstructing of *Sasi* system.

This concentrated increase in biomass within the protected area generates the well-documented "spillover effect," a cornerstone of marine reserve science. As fish populations grow denser, individuals move into adjacent, non-protected fishing grounds through natural migration and foraging behaviors. Concurrently, the massive reproductive output from within the *Sasi* area results in the dispersal of larvae on ocean currents, seeding surrounding reefs. This phenomenon directly explains why community members in *Sasi* villages benefit even during the closure period and why their overall fishing income is significantly higher. They are, in effect, harvesting the ecological dividend of their collective restraint.[10,11]

Furthermore, the practice of *Sasi* represents a holistic, ecosystem-based management (EBM)

approach, which contrasts sharply with the single-species quota systems that have dominated Western fisheries management. By closing off entire reef sections, *Sasi* protects the intricate web of ecological relationships—predator-prey dynamics, symbiotic partnerships, and competitive interactions—that constitute a functional ecosystem. This approach is instrumental in building overall resilience. The greater resistance of *Sasi* reefs to the 2023 coral bleaching event is a powerful illustration of this principle. The protection of herbivorous fish populations, such as parrotfish and surgeonfish, is a critical factor. These species act as "reef gardeners," controlling the growth of macroalgae that compete with corals for space and light. In the aftermath of a bleaching event, when corals are weakened and vulnerable, rampant algal growth can smother and kill recovering polyps. By maintaining healthy populations of herbivores, *Sasi* ensures that reefs are kept clean, creating the necessary conditions for coral recruitment and the recovery of surviving colonies. In this way, *Sasi* actively maintains a more balanced and functional ecosystem, enhancing its intrinsic capacity to absorb and recover from climate-related shocks.[12,13]

However, it is a fundamental conclusion of this study that these ecological outcomes are inextricable from the robust social and institutional structures that govern them. The efficacy of *Sasi* is fundamentally built on a foundation of social legitimacy and collective action. Unlike many state-managed Marine Protected Areas (MPAs), where compliance is often low and enforcement is a costly cat-and-mouse game, compliance in the *Sasi* system is largely voluntary. The qualitative data reveal that this is because the rules are not perceived as an external imposition from a distant government. Instead, they are seen as internally generated, culturally resonant, and procedurally fair.[13,14]

The institution of the *Kewang* is the lynchpin of this social contract. Their authority is not derived from state law but from *adat* (customary law), social consensus, and ancestral mandate. Their deep embeddedness within the community—as neighbors, relatives, and elders—creates a low-cost, highly effective monitoring and enforcement system rooted in social accountability rather than punitive force. This model stands in stark contrast to the immense financial and logistical challenges faced by government agencies attempting to patrol vast and remote coastal areas.

Moreover, *Sasi* fundamentally transforms resource management from an individualistic, often zero-sum competition into a collective enterprise. The system's clearly defined rules of allocation—whereby benefits from the harvest are equitably shared among community members or invested in public goods like schools and churches—foster a powerful sense of shared ownership and mutual responsibility.[15-17] This social cohesion constitutes a form of social capital that is crucial for overcoming the "tragedy of the commons." It aligns individual incentives with long-term collective goals, prioritizing sustained stewardship over short-term, unsustainable gain. The tangible socio-economic benefits documented in this study, such as higher and more stable incomes and greater food security, create a powerful positive feedback loop. These clear, observable benefits reinforce the value of conservation within the community, which in turn strengthens their commitment to upholding the *Sasi* rules, thereby creating a self-perpetuating cycle of social and ecological prosperity.

The findings of this study are particularly significant when viewed through the lens of climate change and the increasing volatility of the Anthropocene. The Anthropocene is defined by non-linear change, growing uncertainty, and the increasing frequency and intensity of ecological shocks. In this context, the resilience of a social-ecological system—its capacity to absorb disturbances, self-organize, and adapt while retaining its essential function and structure—is the ultimate measure of its sustainability.[18,19] This research demonstrates that *Sasi* is not just a conservation tool; it is an active resilience-building framework.

Ecologically, *Sasi* fosters the creation of a crucial natural buffer. Maintaining healthier, more complex, and structurally diverse ecosystems enhances the delivery of critical ecosystem services that mitigate climate impacts. For instance, healthier reefs with greater structural complexity are more effective at

dissipating wave energy, providing tangible protection to coastlines from storm surges and reducing coastal erosion—a direct adaptation benefit for vulnerable island communities. The higher and more stable fish stocks provide a reliable and accessible source of protein, creating a vital food security safety net, especially when terrestrial agriculture may be compromised by drought or flooding.[20]

Socially, the institutional framework of *Sasi* provides a pre-existing, trusted platform for collective deliberation, learning, and adaptation. As highlighted by the *Kewang*, who noted adjusting closure times based on ecological cues, the system has an inherent and well-practiced adaptive capacity rooted in Traditional Ecological Knowledge (TEK). This local-level, real-time monitoring and response is far more agile and responsive than the often cumbersome and slow-moving processes of centralized bureaucratic management. TEK, built upon centuries of empirical observation and intergenerational knowledge transmission, acts as a fine-grained, highly localized information system. It allows communities to detect subtle environmental changes—shifts in spawning times, unusual currents, the appearance of invasive species—long before they might be captured by conventional, large-scale scientific monitoring. This capacity for continuous learning and management adjustment is essential for navigating the unpredictable challenges of the Anthropocene. The significantly quicker livelihood recovery time post-storm observed in *Sasi* villages is a clear and powerful metric of this enhanced resilience, demonstrating how the dynamic interplay of ecological health and social cohesion creates a robust safety net against climatic shocks.

While the success of *Sasi* is undeniable, it is crucial to recognize that it is not a monolithic, universally applicable blueprint. Its effectiveness is deeply contextual, inextricably tied to the specific cultural, social, and ecological landscape of the Maluku Islands. However, the core principles that underpin *Sasi*—the vesting of legitimate authority at the local level, the recognition of community tenure rights, the implementation of equitable benefit-sharing mechanisms, and the integration of TEK into decision-making—are universally relevant. This study powerfully argues against the continued marginalization of customary governance systems in national and international policy. For decades, top-down conservation and development initiatives have often ignored, and in many cases actively undermined, these local institutions, viewing them as obstacles to modernization rather than as sophisticated systems of environmental stewardship.[13,14]

The path forward lies not in replacing one system with another, but in forging a new synthesis through co-management and polycentric governance. This involves creating genuine partnerships where the distinct strengths of customary and state-based systems are blended. The state can provide a critical enabling environment, enacting a supportive legal framework that formally recognizes customary marine tenure, thereby empowering communities to defend their territories from external threats like industrial fishing fleets, destructive mining, or unregulated tourism. State agencies can also offer scientific and technical support where requested, creating a "multiple evidence base" where TEK and Western science can inform and enrich each other. For instance, regional climate models provided by national agencies can help communities anticipate future bleaching risks, while scientific data on larval connectivity can help them optimize the placement of *Sasi* areas to maximize network benefits. Conversely, the deep, place-based knowledge of the *Kewang* on local spawning aggregations and ecosystem dynamics can guide scientific research and lead to more effective, context-appropriate conservation strategies.[15,16]

Ultimately, the most significant challenge lies in navigating the inherent power asymmetries in such partnerships. True co-management requires that the state cede genuine authority and control to local institutions, moving beyond tokenistic consultation. It demands a paradigm shift from viewing communities as mere "stakeholders" to recognizing them as rights-holders with the autonomy to govern their ancestral territories. Fostering this collaboration without co-opting or undermining the local autonomy and cultural values that are the very source of the system's

strength and legitimacy is the critical work ahead for a more effective and equitable approach to governing our shared planetary commons.

4. Conclusion

This study provides robust, mixed-methods evidence that the *Sasi* customary law of the Maluku Islands is a highly effective, resilient, and equitable system of marine governance. Over a ten-year period, villages practicing *Sasi* demonstrated significantly better outcomes across a suite of ecological, socio-economic, and climate resilience indicators compared to villages under conventional open-access or state-managed regimes. The research confirms that the success of *Sasi* is driven by a powerful synergy of periodic resource closures, legitimate local authority, strong social cohesion, and an adaptive management framework built on centuries of traditional ecological knowledge.

In an era defined by the twin crises of climate change and biodiversity loss, this research carries profound implications. It demonstrates that the customary institutions of Indigenous Peoples and local communities are not relics of the past, but vital, proven models for navigating the challenges of the Anthropocene. The findings issue a clear call to policymakers, conservation practitioners, and scientists to move beyond top-down management paradigms and to actively recognize, respect, and support customary governance systems. Integrating these systems into national legal frameworks and global conservation strategies, such as the UN Sustainable Development Goals 13 (Climate Action) and 14 (Life Below Water), is not merely an option but a necessity for achieving a sustainable and just future for both humanity and the planet.

5. References

1. Aurellado MEB, Ticzon VS, Nañola CL, Cabansag JBP, Bacabac MMA, Sorgon KES, et al. Effectiveness of Philippine nationally managed marine reserves in improving biomass and trophic structure of coral reef fish communities. Coast Manage. 2021; 49(3): 293–312.
2. Soares MO, Rossi S, Gurgel AR, Lucas CC, Tavares TCL, Diniz B, et al. Impacts of a changing environment on marginal coral reefs in the Tropical Southwestern Atlantic. Ocean Coast Manag. 2021; 210(105692): 105692.
3. Reskiwati R, Ompi M, Rembet UNWJ, Kusen JD, Mantiri ROSE, Sumilat DA. Vertical distribution and effect of the depth on growth form and genus of hard coral on coral reef in Bunaken Island, North Sulawesi, Indonesia. Aquat Sci Manage. 2022; 10(1): 1.
4. Smith AK, Cook N, Songcuan A, Brown RE, Molinaro G, Saper J, et al. Effectiveness of coral (*Bilbunna*) relocation as a mitigation strategy for pipeline construction at Hayman Island, Great Barrier Reef. Ecol Manage Restor. 2024; 2024: 112-30.
5. Suess C, Maddock JE, Palma M, Youssef O, Kyle G. An application of protection motivation theory to understand the influence of fear-appeal media on stated donations for coral reef restoration. Tour Manag. 2024; 100(104797): 104797.
6. Ochieng CN, Thenya T, Mwaura F, Owuor MA. Awareness and perceptions of coral reef ecosystem use and management in 'pseudo community' and government-managed marine protected areas in Kwale county, Kenya. Ocean Coast Manag. 2024; 248(106949): 106949.
7. Hernández-Andreu R, Félix-Hackradt FC, Schiavetti A, S Texeira JL, Hackradt CW. Marine protected areas are a useful tool to protect coral reef fishes but not representative to conserve their functional role. J Environ Manage. 2024; 351(119656): 119656.
8. Razak TB, Lamont TAC, Hukom FD, Alisa CAG, Asri AR, Ferse SCA. A review of the legal framework for coral reef restoration in Indonesia. Ocean Coast Manag. 2024; 248(106944): 106944.
9. Mentzel S, Nathan R, Noyes P, Brix KV, Moe SJ, Rohr JR, et al. Evaluating the effects of climate change and chemical, physical, and biological stressors on nearshore coral reefs: a

case study in the Great Barrier Reef, Australia. Integr Environ Assess Manag. 2024; 20(2) :401–18.
10. Cleguer C, Garrigue C, Fuentes MMPB, Hamann M, Payri C, Marsh H. Temporal changes in habitat use by dugongs in a spatially restricted coral reef environment. Pac Conserv Biol. 2024; 30(2).
11. Pascoe S, Anthony K, Scheufele G, Pears RJ. Identifying coral reef restoration objectives: a framework. Ocean Coast Manag. 2024; 251(107081): 107081.
12. Severati A, Nordborg FM, Heyward A, Abdul Wahab MA, Brunner CA, Montalvo-Proano J, et al. The AutoSpawner system - Automated ex situ spawning and fertilisation of corals for reef restoration. J Environ Manage. 2024; 366(121886): 121886.
13. Nakano T, Hata K, Kinjo K, Watanabe N. Efforts to create a comprehensive management system for sustainable aquatic environments in coastal areas of subtropical regions: Constructing a management system to accommodate both human activities and coral reef ecosystems. J Jpn Coral Reef Soc. 2017; 19(1): 95–108.
14. Mendes VS, Coelho-Souza SA, de Oliveira FF, López MS. Sun coral regeneration after management actions in a Brazilian no-take marine protected area. Coral Reefs. 2025; 44(4): 1427–32.
15. Zumpano F, Copello S, Castano MV, García GO. When birds meet recreational fishers: Understanding interactions in a protected coastal area of Argentina. Aquat Conserv. 2025; 35(9).
16. Doyle KE, Pearce L, Ning N, McGregor C, Hale R, Duffy D, et al. Fish diversity and abundance before and after a wildfire: a case study from an Australian river. Aquat Conserv. 2025; 35(9).
17. Sowman M, Sunde J. Social impacts of marine protected areas in South Africa on coastal fishing communities. Ocean Coast Manag. 2018; 157: 168–79.
18. Myo A, Ajayi O, Huang F, Cheng Y, Li J. Valuation of ecosystem service of rice-fish coculture in Maubin District, Myanmar. Anthr Coasts. 2024; 7(1).
19. Changeux T, Dragotta A, Franquet E, Stolzenberg N, Fruget JF, Marion L, et al. Ecosystem based approach to assess the impact of invasive or expanding species in the lower Saône River. Anthropocene. 2024; 47(100446): 100446.
20. Li S, Chen M, Ding L, Zhang M, Wei W, Luo B. Ecosystem assessment of semi-natural tidal flat in the Yangtze estuary by pressure-state-response model and fuzzy comprehensive evaluation method. Anthr Coasts. 2025; 8(1).