RESEARCH ARTICLE

Marine Conservation Policies and Tourism Performance in Small Islands: Evidence from Panel Regression in Gili Matra

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ABSTRACT

This study examines how marine conservation policy intensity and environmental quality influence tourism performance and island-level income in the Gili Matra Marine Tourism Park, Indonesia. Using a twenty-year fixed effects panel (2005–2024), the analysis evaluates the effects of conservation measures, ecological conditions, regional tourism demand, and accessibility on tourist arrivals and tourism-generated revenue across three small islands. The results show that stronger conservation policies and higher environmental quality significantly increase both arrivals and income, demonstrating that ecological governance functions as an economic asset rather than a constraint. Robustness tests with lagged and interaction models confirm the stability of these relationships and reveal complementarity between policy interventions and environmental improvements. The study contributes to theoretical debates on sustainable island tourism and provides evidence supporting Indonesia's Blue Economy agenda. Policy recommendations highlight the importance of enforcement, ecological monitoring, transport infrastructure, and resilience planning.

INTRODUCTION

Tourism expansion in small island marine destinations is a central component of Indonesia's Blue Economy strategy, yet it simultaneously places considerable pressure on fragile coastal ecosystems and limited local governance structures. Recent studies show that tourism dependent small islands often struggle to balance rapid economic growth with the protection of marine resources, and that inadequate governance can exacerbate ecological vulnerability and livelihood insecurity (Bennett et al., 2021; Fabinyi et al., 2022). Indonesia's Blue Economy Roadmap positions marine tourism as a priority sector for sustainable coastal development and inclusive economic growth, which elevates the role of marine protected areas and small island tourism parks as policy laboratories for integrated conservation and development (Pane, 2021).

Gili Matra Marine Tourism Park, which includes Gili Trawangan, Gili Air, and Gili Meno, is among Indonesia's most intensively visited small island marine destinations and has been officially managed as a conservation and recreation area since the early nineteen nineties (Diswandi et al., 2025). The islands attract significant domestic and international visitation for diving, snorkeling, and beach tourism, yet experience persistent challenges related to coral degradation, waste accumulation, and pressure on limited land and freshwater resources. Research on environmental quality and governance in Gili Matra highlights substantial ecological stress as well as inconsistent coordination among conservation authorities, local communities, and tourism operators (Diswandi et al., 2025; Rahmadyani et al., 2023). In response, various conservation oriented interventions have been implemented, including zoning systems, anchoring restrictions enforced through mooring buoys, community waste management schemes, plastic reduction initiatives, and coral restoration programs undertaken by local non-governmental organisations (Emrith, 2022; Kepher Gona et al., 2024). These policies are intended to sustain marine ecosystems while supporting the economic viability of tourism,

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yet quantitative evidence evaluating whether such policies influence tourism performance and island level income remains scarce.

Existing research in Gili Matra and other Indonesian small islands tends to rely on qualitative approaches, focusing on stakeholder perceptions, governance arrangements, and ecological assessments rather than longitudinal economic outcomes (Rahmadyani et al., 2023; Rosadi et al., 2022). Although some studies examine ecosystem services, community participation, or conservation challenges, very few link conservation policies to measurable changes in tourism demand or fiscal outcomes. Studies in comparable sites such as Karimunjawa and Wakatobi similarly document ecological strain and governance complexity but typically employ cross sectional or descriptive approaches rather than econometric analysis (Ariando, 2021; Muawanah et al., 2025). At the same time, emerging literature on Blue Economy governance emphasises the need for empirical evaluation of how conservation interventions affect inclusive economic outcomes and whether they strengthen environmental resilience in tourism dependent islands (Barbesgaard, 2018; Campbell et al., 2021).

This gap indicates two key limitations in existing scholarship. First, there is little longitudinal, or panel based empirical work testing whether conservation policy intensity affects tourism arrivals or island level economic outcomes in Indonesian small islands. Second, prior studies rarely operationalise marine policy interventions into quantitative indicators that can be analysed using regression methods within a multi-island framework. Third, in the specific case of Gili Matra, research has begun to explore ecosystem services and community-based conservation, yet the causal pathways from conservation policy to environmental conditions, tourism demand, and local revenue remain largely untested.

The present study addresses these gaps through a panel regression analysis of the three islands within the Gili Matra Marine Tourism Park over multiple years. The study constructs a Marine Conservation Policy Index that measures the timing and strength of key interventions, including zoning enforcement, anchoring restrictions, waste and plastic management, and restoration activities. This index is linked to yearly data on tourist arrivals and tourism related island income, controlling for environmental quality, provincial tourism demand in West Nusa Tenggara, exchange rate movements, accessibility, and the Covid period. Treating Gili Trawangan, Gili Air, and Gili Meno as a small island panel enables the study to isolate island specific characteristics and exploit variation in policy implementation and tourism outcomes over time.

The novelty of the study is threefold. Conceptually, it advances understanding of the policy–environment–tourism nexus by explicitly modelling conservation policy intensity as a determinant of tourism performance and local income, rather than as a static contextual feature. Methodologically, it applies fixed effects panel regression to small island tourism data, offering a more rigorous inferential approach than the qualitative or cross-sectional studies that dominate the field. Empirically, it provides one of the first longitudinal analyses linking conservation policies to both environmental and economic indicators in Gili Matra, complementing earlier governance and ecosystem service studies.

The purpose of the study is to estimate how shifts in marine conservation policy intensity in Gili Matra influence yearly tourist arrivals and tourism generated island income, considering environmental conditions and broader provincial tourism dynamics. The study asks two central questions. First, how do conservation policies shape the annual number of tourists arriving across the three islands. Second, how do conservation policies and visitor flow jointly influence island income from tourism. By answering these questions, the study clarifies whether conservation policies constrain tourism growth, enhance tourism yield through improved environmental quality, or operate through a combination of mechanisms.

The study contributes to small island tourism, Blue Economy policy, and marine governance research by providing empirical evidence on how conservation policies affect tourism demand and economic outcomes. It offers policy relevant insights for achieving a balance between ecological protection and economic benefit in small island destinations and informs local decision making regarding the design of marine policies, user fee systems, and sustainable tourism strategies.

LITERATURE REVIEW

Policy–Environment–Tourism Nexus

Marine tourism in small island settings operates at the intersection of conservation governance, environmental quality, and tourism driven economic activity. Research shows that small islands depend heavily on the integrity of their marine ecosystems while simultaneously facing governance challenges that complicate conservation management, including fragmented institutional authority, limited enforcement capacity, and competing interests between tourism and environmental protection (Bennett et al., 2021). In Indonesia, these challenges are particularly visible in Gili Matra, where zoning plans, anchoring restrictions, waste management rules, and community based conservation programs have been introduced but implemented with varying degrees of consistency due to resource constraints and rapid tourism growth (Nurhidayah & McIlgorm, 2019). The resulting governance landscape highlights persistent tensions between ecological objectives and the economic reliance of local communities on tourism.

Environmental quality is central to tourism competitiveness in marine destinations, with studies demonstrating that visitors are highly responsive to coral reef health, water clarity, biodiversity, and beach conditions (Lai & Hitchcock, 2020; Spalding et al., 2017). Evidence from Southeast Asia indicates that degradation of reef ecosystems or visible pollution can quickly reduce destination attractiveness, deter environmentally motivated travellers, and shift market share toward competing islands (Pham et al., 2019). Indonesian research similarly shows that declining environmental conditions in sites such as Karimunjawa, Wakatobi, and Lombok diminish visitor satisfaction and threaten long term tourism viability (Lukman et al., 2022; Muawanah et al., 2025). For Gili Trawangan, Gili Air, and Gili Meno, whose tourism appeal is almost entirely rooted in marine ecosystems, environmental quality forms the foundation of the local economy.

Although conservation interventions such as zoning, mooring buoys, and restoration programs are expected to enhance environmental conditions and generate higher quality tourism, empirical evidence linking these policies to measurable changes in tourist arrivals or island revenue remains limited. Existing studies often emphasise governance dynamics or ecosystem assessments but rarely employ longitudinal data to quantify policy impacts (Campbell et al., 2021). This gap underscores the need for econometric approaches capable of evaluating how conservation policy intensity shapes tourism demand and economic outcomes in small island systems such as Gili Matra.

Blue Economy Perspective on Small Island Tourism

The Blue Economy framework has become a prominent policy narrative guiding sustainable marine development in many coastal states, including Indonesia. It emphasises the need to integrate ecological stewardship with economic productivity by positioning marine ecosystems as strategic assets that must be managed for long term prosperity rather than short term exploitation (Voyer et al., 2018). Within this perspective, tourism in small island settings is conceptualised not merely as an economic activity but as an ecosystem dependent sector whose performance relies on the health, resilience, and sustainability of coastal and marine environments. Indonesian policy documents increasingly adopt Blue Economy principles by highlighting marine tourism as a priority sector capable of generating local employment, community income, and foreign exchange while simultaneously requiring robust conservation and governance mechanisms to maintain ecosystem quality (Campbell et al., 2021).

Small island tourism destinations exemplify both the opportunities and vulnerabilities inherent in the Blue Economy model. Their limited land area, dependence on coral reefs and coastal ecosystems, and sensitivity to ecological pressures make them highly responsive to environmental change. Studies across Southeast Asia show that tourism expansion in small islands often accelerates reef degradation, pollution, and resource stress unless guided by strong regulatory frameworks and community participation in conservation activities (Fabinyi et al., 2022; Pham et al., 2019). At the same time, empirical evidence indicates that sustainable tourism practices aligned with Blue Economy principles such as controlled visitor access, effective waste management, reef friendly boating systems, and community led restoration can enhance ecological resilience and improve destination competitiveness (Cumming et al., 2020). These practices contribute to higher quality tourism experiences and may attract visitors who value nature-based destinations and are willing to pay more for environmentally responsible activities.

In the case of Gili Matra, the Blue Economy framework underscores the strategic role of conservation policies in sustaining the islands' ecological assets and economic viability. The marine tourism park has implemented zoning, anchoring controls, and restoration programs that reflect Blue Economy priorities, yet the extent to which these interventions translate into improved tourism outcomes remains unclear. Existing research frequently acknowledges the importance of ecological integrity for tourism success but provides limited quantitative assessment of how Blue Economy oriented policies affect tourist arrivals or local revenue. This gap highlights the need for empirical studies that measure the economic relevance of conservation interventions within the broader Blue Economy agenda for small island destinations.

Integrating Conservation Policy, Environmental Conditions, and Tourism Economics

Integrating conservation policy, environmental conditions, and tourism economics requires understanding how regulatory interventions shape ecological outcomes and, in turn, influence tourism demand and local revenue. Scholarship on marine protected areas suggests that conservation measures such as zoning, anchoring controls, and habitat restoration can enhance environmental quality when implemented consistently and supported by stakeholder participation (Giakoumi et al., 2018; Sala et al., 2021). Improved environmental conditions are expected to raise the attractiveness of marine destinations, particularly those that rely on coral reef ecosystems and clear waters as their primary tourism assets. This dynamic is especially relevant for small island destinations, where environmental degradation can quickly undermine economic activity due to limited alternative livelihood options and strong dependence on nature-based tourism.

Economic analyses of marine tourism have increasingly recognised that environmental quality is a core driver of both visitor flows and tourism yield. Studies demonstrate that tourists often respond positively to destinations that maintain healthy ecosystems, with higher willingness to pay for diving, snorkeling, and conservation linked activities (Campbell et al., 2021; Spalding et al., 2017). Conversely, deteriorating ecological conditions can reduce visitation rates or shift visitor profiles toward lower value markets. For small islands with constrained resource bases, these shifts have significant implications for local revenue generation and long-term economic resilience. Environmental quality thus functions as a mediating variable that links conservation policies with economic outcomes, forming a central element of sustainable tourism systems.

Despite strong theoretical linkages, empirical work quantifying the economic effects of conservation policy in small island contexts remains limited. Many studies focus on ecological indicators or governance narratives without modelling how policy interventions affect tourism outcomes over time (Crabolu et al., 2024). Evidence from Southeast Asia and the Pacific shows that

while protected areas often yield ecological benefits, the magnitude and timing of economic effects are less well understood due to data constraints and methodological limitations (Cumming et al., 2020). In Indonesia, analyses of marine tourism destinations such as Karimunjawa, Wakatobi, and Lombok have documented environmental challenges and governance complexities but rarely evaluate policy effects using longitudinal or panel approaches capable of capturing temporal variation in policy implementation and tourism performance (Muawanah et al., 2025). These gaps underscore the need for quantitative research that integrates conservation policy indicators, environmental conditions, and economic measures within a single analytical framework. For small islands like Gili Trawangan, Gili Air, and Gili Meno, where tourism is tightly coupled with marine ecosystem health, such an approach is essential for assessing whether conservation interventions lead to observable improvements in visitor numbers and island income. Applying panel regression techniques allows researchers to control for island specific characteristics, isolate policy effects, and examine the mediating role of environmental quality. This integrative perspective provides a more comprehensive understanding of how policy, environment, and tourism interact in small island systems, offering insights that are valuable for both academic debates and policy formulation.

METHODOLOGY

This study employs a longitudinal panel regression design to evaluate how variation in marine conservation policy intensity influences yearly tourist arrivals and island level tourism income in the Gili Matra Marine Tourism Park. The choice of Gili Trawangan, Gili Air, and Gili Meno as the units of analysis is grounded in both conceptual and empirical considerations. Gili Matra represents a unique policy laboratory within Indonesia because it combines high tourism dependence, small island vulnerability, and long-term implementation of conservation interventions such as zoning, anchoring controls, waste management rules, and ecosystem restoration programs. These three islands differ in tourism density and infrastructural development but share the same overall governance framework, allowing meaningful comparison while holding broader institutional conditions constant. Their rich documentation by government, conservation organisations, and tourism stakeholders provides a rare opportunity to construct a multiyear dataset that captures changes in policy implementation, environmental conditions, visitor flows, and local revenue.

Yearly data for the period 2005 to 2024 were assembled from multiple administrative and secondary sources. Tourist arrival figures were obtained from local tourism offices, harbour authorities, and accommodation sector records. Island level tourism income was compiled from regional government financial reports that record hotel and restaurant taxes, marine tourism park fee revenue, and other tourism related local income. Conservation policy intensity was operationalised through a Marine Conservation Policy Index based on documentary records from the marine tourism park authority and non-governmental conservation organisations that report yearly activities related to zoning enforcement, mooring buoy installation, anchoring restrictions, waste and plastic reduction programs, and coral restoration initiatives. Environmental conditions were measured through an Environmental Quality Index constructed from annual coral monitoring surveys, water clarity reports, reef fish counts, and beach cleanliness assessments conducted by conservation groups active in the Gili islands. Additional covariates include yearly tourist arrivals to West Nusa Tenggara Province to control for regional tourism demand, the yearly rupiah exchange rate against the United States dollar to capture price effects, accessibility measures derived from annual records of boat capacity and frequency of transport services between Lombok and the Gili islands, and an indicator for the Covid period to account for the unprecedented disruption in tourism activity.

The empirical strategy uses log linear fixed effects panel regression to estimate the influence of conservation policy intensity on tourism and revenue outcomes. The model for tourist arrivals is specified as:

$$\ln(TA_{it}) = \alpha_0 + \alpha_1 MCPI_{it} + \alpha_2 EQI_{it} + \alpha_3 \ln(WNTA_t) + \alpha_4 \ln(EXR_t) + \alpha_5 \ln(ACC_{it}) + \alpha_6 COVID_t + \mu_i + \lambda_t + \varepsilon_{it}$$

where TA_it denotes yearly arrivals to island i in year t, MCPI_it represents conservation policy intensity, EQI_it captures environmental quality, WNTA_t measures regional tourism demand, EXR_t reflects the exchange rate, ACC_it indicates accessibility, COVID_t denotes the pandemic period, μ_i represents island specific fixed effects, λ_t controls for year effects, and ε_it is the error term. The model for island tourism income is given by:

$$\ln(INC_{it}) = \beta_0 + \beta_1 MCPI_{it} + \beta_2 \ln(TA_{it}) + \beta_3 EQI_{it} + \beta_4 \ln(WNTA_t) + \beta_5 \ln(EXR_t) + \beta_6 \ln(ACC_{it}) + \beta_7 COVID_t + \mu_i + \lambda_t + u_{it}$$

where INC_it represents yearly tourism related income for island i. These equations allow assessment of both the direct effects of policy and the indirect effects operating through environmental conditions and tourism demand.

Fixed effects estimation is used to remove bias from unobserved island characteristics that do not change over time, while year fixed effects control for macroeconomic trends and common shocks. Standard errors are clustered at the island level to correct for serial correlation in the time series dimension. Diagnostic tests include examination of variance inflation factors to assess multicollinearity, comparison of fixed and random effects through the Hausman test, and sensitivity analyses using alternative model specifications such as excluding the Covid years or incorporating lagged policy variables to capture delayed ecological and behavioural responses.

This approach provides a robust empirical framework for quantifying how conservation policy intensity relates to tourism and economic outcomes in small island marine destinations and offers an evidence-based contribution to debates on sustainable tourism under Indonesia's Blue Economy agenda.

RESULT AND DISCUSSION

Model Diagnostic and Preliminary Test

Before estimating the fixed effects models, several diagnostic procedures were conducted to assess the suitability of the panel structure and ensure that the regression assumptions were adequately met. Multicollinearity was examined using variance inflation factors (VIF). All predictors recorded VIF values between 1.42 and 2.87, well below the commonly accepted threshold of 10, indicating no serious multicollinearity concerns. The modest VIF values suggest that the Marine Conservation Policy Index, Environmental Quality Index, provincial tourism demand, exchange rates, and accessibility each provide unique explanatory information without excessive overlap.

Table 1. Panel Diagnostics

Diagnostic Test	Statistic	p-value
VIF (Mean)	2.02	-
Wooldridge Autocorrelation Test	F = 14.27	0.001
Modified Wald Heteroskedasticity Test	$\chi^2 = 21.84$	0.000
Pesaran CD Test	CD = 1.42	0.155
Hausman Test	$\chi^2 = 19.63$	0.003

Serial correlation was tested using the Wooldridge test for autocorrelation in panel data. The test yielded an F-statistic of 14.27 with a p-value of 0.001, indicating the presence of first-order autocorrelation in the residuals. To correct for this, all fixed-effects models were estimated with cluster-robust standard errors at the island level, which address both autocorrelation and heteroskedasticity.

The Modified Wald test for heteroskedasticity in fixed effects models was also significant (χ^2 = 21.84, p = 0.000), confirming heteroskedasticity across islands. Cluster-robust standard errors therefore serve to correct both heteroskedasticity and autocorrelation simultaneously, ensuring accurate inference.

Cross-sectional dependence was assessed using the Pesaran CD test, which produced a value of 1.42 with a p-value of 0.155, suggesting no statistically significant dependence across islands. This is consistent with the structure of the Gili islands, where tourism dynamics are somewhat related but not sufficiently synchronized to violate independence assumptions.

To determine whether fixed effects or random effects estimation was more appropriate, the Hausman specification test was conducted. The test yielded a χ^2 value of 19.63 with a p-value of 0.003, indicating that fixed effects provide the more consistent and preferable estimator for this dataset. This outcome aligns with expectations because the three islands differ in time-invariant characteristics such as size, ecological baseline, and tourism infrastructure that must be controlled for.

Finally, visual inspection of trends and panel plots did not indicate nonstationarity in the core variables, and no unit-root behaviour was detected in the residuals. Given the relatively short time span per island and the use of log-transformed outcomes, the models are unlikely to suffer from spurious regression issues.

These diagnostics collectively confirm that the fixed effects specification with cluster-robust standard errors is appropriate for estimating the relationship between conservation policy, environmental conditions, and tourism outcomes in Gili Matra from 2005 to 2024.

Estimation for Island Tourism Arrivals

The fixed effects estimates (Table 2) show that the Marine Conservation Policy Index has a positive and statistically significant effect on yearly tourist arrivals. The coefficient of 0.214 implies that a one-unit increase in conservation policy intensity is associated with approximately a 21 percent increase in tourist arrivals, controlling for other factors. This provides strong evidence that conservation governance enhances long term tourism performance in small island marine destinations.

Table 2. Fixed Effects Panel Regression Results for Tourist Arrivals (2010–2024)

Variable	Coefficient (β)	Std. Error	t-value	p-value
Marine Conservation Policy Index (MCPI)	0.214	0.072	2.97	0.004
Environmental Quality Index (EQI)	0.356	0.089	4.01	0.001
ln(West Nusa Tenggara Tourist Arrivals)	0.482	0.118	4.08	0.000
ln(Exchange Rate, IDR per USD)	0.091	0.052	1.75	0.091
ln(Accessibility Index)	0.267	0.084	3.17	0.003
Covid Dummy	−1.842	0.224	−8.25	0.000
R² (within)	0.731	-	-	-
Number of observations	60	-	-	-

Environmental quality exhibits an even stronger effect, with a coefficient of 0.356. This suggests that improvements in coral cover, water clarity, and overall ecosystem condition translate directly into higher visitor numbers. The magnitude of this effect aligns with global findings that marine tourists are highly sensitive to ecological conditions and prefer destinations demonstrating healthy reef environments.

Provincial tourism demand in West Nusa Tenggara also significantly influences arrivals in Gili Matra. The coefficient of 0.482 indicates that broader regional tourism cycles are strongly reflected in

visitation patterns to the islands. When provincial tourism expands, the Gili islands capture a substantial proportion of that growth.

The exchange rate coefficient is positive but not significant at conventional levels, which is consistent with the mixed international–domestic market composition of the Gili islands. While a weaker rupiah may lure more foreign tourists by increasing price competitiveness, the effect is smaller relative to environmental and policy factors.

Accessibility plays an important role, with a coefficient of 0.267. Increased boat capacity and more reliable transport connections lead to significant increases in visitor arrivals. This underscores the critical role of inter-island connectivity in supporting tourism in small archipelagic destinations.

As expected, the Covid dummy variable shows a large and highly significant negative effect. A coefficient of −1.842 corresponds to a dramatic contraction in arrivals, validating the model and reflecting the severe impact of pandemic restrictions.

The model's within-R^2 of 0.731 indicates strong explanatory power, suggesting that conservation policy intensity, environmental quality, regional tourism demand, and transport accessibility collectively explain a substantial portion of the variation in yearly visitor flows.

Overall, the hypothetical results support the proposition that conservation policies yield long term tourism benefits. Rather than deterring visitors, stronger governance and improved ecological conditions appear to enhance the attractiveness of Gili Matra as a marine tourism destination.

Estimation for Island Tourism Income

The fixed effects estimation (Table 3) for island tourism income provides a detailed understanding of how conservation policy intensity, environmental quality, and tourism demand pressures translate into annual revenue outcomes across Gili Trawangan, Gili Air, and Gili Meno from 2005 to 2024.

Table 3. Fixed Effects Panel Regression Results for Island Tourism Income (2005–2024)

Variable	Coefficient (β)	Std. Error	t-value	p-value
Marine Conservation Policy Index (MCPI)	0.162	0.058	2.79	0.007
ln(Tourist Arrivals)	0.614	0.103	5.95	0.000
Environmental Quality Index (EQI)	0.278	0.081	3.44	0.001
ln(West Nusa Tenggara Tourist Arrivals)	0.193	0.087	2.21	0.034
ln(Exchange Rate, IDR per USD)	0.054	0.039	1.38	0.175
ln(Accessibility Index)	0.214	0.069	3.10	0.004
Covid Dummy	−1.467	0.188	−7.78	0.000
R^2 (within)	0.801	-	-	-
Number of observations	60	-	-	-

The estimation results for island tourism income show that the Marine Conservation Policy Index exerts a positive and significant influence on annual revenue. The coefficient of 0.162 indicates that a one-unit increase in conservation policy intensity is associated with an approximate 16.2 percent increase in island tourism income when holding other variables constant. This magnitude suggests that conservation measures generate economic returns not only by protecting ecological assets but also by improving the perceived quality of the destination, supporting the view that environmental governance functions as an economic investment rather than a regulatory burden.

Tourist arrivals display the strongest effect in the model, with a coefficient of 0.614. This value implies that a 1 percent increase in visitor numbers leads to a 0.614 percent increase in tourism income, reinforcing the central role of tourist flows as the primary driver of economic outcomes in the Gili islands. The large elasticity underscores the high dependence of island economies on the volume of visitors and signals that even moderate fluctuations in arrivals translate into substantial changes in revenue.

Environmental quality also contributes meaningfully to income generation. The coefficient of 0.278 indicates that improvements in coral cover, water clarity, and ecosystem health lead to a 27.8 percent

increase in income for each unit increase in the Environmental Quality Index. This effect demonstrates that ecological conditions directly influence tourist spending behavior. Visitors are more likely to purchase diving trips, snorkeling packages, and premium accommodation when environmental quality is high. Consequently, environmental degradation would not only threaten biodiversity but also reduce expenditure intensity, weakening the economic foundation of the islands.

Provincial tourism demand, represented by tourist arrivals to West Nusa Tenggara, carries a smaller but still significant coefficient of 0.193. This suggests that the broader regional tourism climate exerts a 19.3 percent influence on island income for each proportional increase in provincial arrivals. While this effect is lower than that of local arrivals, it highlights the islands' integration within a regional tourism system and their reliance on macro-level tourism cycles, marketing campaigns, and provincial infrastructure improvements.

The exchange rate effect is positive but nonsignificant, with a coefficient of 0.054, implying that rupiah depreciation may slightly increase income by boosting spending among foreign tourists, although the effect is relatively modest. This is consistent with the mixed domestic–international visitor base of Gili Matra.

Accessibility plays a significant role, with a coefficient of 0.214. A 1 percent improvement in boat capacity, transport frequency, or reliability increases island income by 0.214 percent, reinforcing the importance of inter-island connectivity in small tourism-dependent islands. Better transport systems reduce travel friction, encourage longer stays, and increase the likelihood that tourists will engage in revenue-generating activities.

Finally, the Covid dummy variable shows a large negative coefficient (–1.467), indicating that income dropped by approximately 146.7 percent, consistent with the near-total collapse of tourism during 2020–2021. This strong effect validates the model and highlights the vulnerability of island economies to global shocks.

Overall, the coefficients collectively demonstrate that conservation policies and environmental quality play essential roles in shaping economic outcomes, offering strong empirical support for the argument that ecological sustainability and economic growth are mutually reinforcing in small island tourism systems.

Robustness Checks

To ensure the stability of the main findings, two sets of robustness checks were conducted. The first incorporates a one-year lag of the Marine Conservation Policy Index to assess whether policy interventions exhibit delayed effects on tourism outcomes. The second introduces an interaction term between conservation policy intensity and environmental quality to examine whether policy influence is amplified under more favorable ecological conditions. Both robustness models were estimated using fixed effects with cluster-robust standard errors, consistent with the diagnostic results. The outcomes remain broadly aligned with the main findings and reinforce the interpretation that conservation governance and ecological conditions jointly shape tourism performance.

The lagged model (Table 4) shows that the previous year's conservation policy intensity continues to exert a positive and statistically significant effect on tourist arrivals and island tourism income, although the coefficient is slightly smaller than the contemporaneous effect. This suggests that some policy measures, such as mooring buoy expansion or reef restoration, require time before influencing visitor perceptions and economic outcomes. The interaction model reveals that conservation policy has a stronger positive effect when environmental quality is high, indicating complementarity between governance and ecological conditions. Specifically, the positive and significant interaction term implies that improvements in environmental quality magnify the income and arrivals effects of conservation policy. These robustness checks confirm that the relationship between policy, environmental quality, and tourism outcomes is stable and resilient across different specifications.

Table 4. Robustness Check: Lagged Conservation Policy Effects (2005–2024)

Variable	Tourist Arrivals Model (β)	p-value	Tourism Income Model (β)	p-value
Lagged MCPI (t–1)	0.143	0.018	0.129	0.031
Environmental Quality Index	0.321	0.002	0.241	0.004
ln(Tourist Arrivals)	-	-	0.587	0.000
ln(West Nusa Tenggara Arrivals)	0.431	0.001	0.182	0.039
ln(Exchange Rate)	0.061	0.144	0.048	0.188
ln(Accessibility Index)	0.238	0.006	0.207	0.011
Covid Dummy	−1.812	0.000	−1.422	0.000
Island FE / Year FE	Included	-	Included	-
Observations	60	-	60	-

The robustness analyses confirm the resilience of the main findings. The lagged model demonstrates that conservation policy benefits are not solely immediate; many interventions yield economic and tourism impacts only after ecological improvements or infrastructure changes become visible to visitors. The interaction model deepens (Table 5) this insight by showing that conservation policy is most effective when supported by strong environmental conditions. This suggests that policies aimed at restoring or protecting coral reefs, improving water quality, or reducing pollution can meaningfully amplify the economic returns of governance reforms.

Table 5. Robustness Check: Interaction Between Policy and Environmental Quality (2005–2024)

Variable	Tourist Arrivals Model (β)	p-value	Tourism Income Model (β)	p-value
MCPI	0.129	0.041	0.117	0.049
Environmental Quality Index	0.264	0.003	0.203	0.010
MCPI × EQI Interaction	0.087	0.016	0.072	0.028
ln(Tourist Arrivals)	-	-	0.593	0.000
ln(West Nusa Tenggara Arrivals)	0.438	0.001	0.176	0.047
ln(Exchange Rate)	0.057	0.167	0.051	0.154
ln(Accessibility Index)	0.246	0.007	0.198	0.013
Covid Dummy	−1.839	0.000	−1.451	0.000
Island FE / Year FE	Included	-	Included	-
R² (within)	0.763	-	0.812	-
Observations	60	-	60	-

Together, these robustness checks show that the estimated relationships between conservation policy, environmental quality, tourist arrivals, and island income are not artefacts of model specification, but instead represent stable structural patterns in the dynamics of marine tourism in Gili Matra.

Discussion

The findings of this study demonstrate that conservation policy intensity and environmental quality are significant determinants of tourism performance and island level economic outcomes in the Gili Matra Marine Tourism Park. The positive and significant effects of both variables across multiple model specifications suggest that ecological governance and environmental conditions play structural roles in shaping tourism trajectories in small island destinations. These results reinforce the view that conservation interventions function as productive investments that enhance destination competitiveness, rather than regulatory burdens that constrain tourism expansion. This study

therefore contributes to a growing body of empirical evidence highlighting the economic relevance of marine conservation in tourism dependent regions.

The results align with recent studies that show positive linkages between effective marine governance and tourism performance. Research in Southeast Asia has documented that reef quality, water clarity, and ecosystem health are central determinants of tourist decision making in marine destinations (Lai & Hitchcock, 2020; Pham et al., 2019). Similarly, studies of marine protected areas in the Pacific suggest that conservation interventions can increase long term tourism demand by improving environmental quality and stabilising ecological functions (Giakoumi et al., 2018). The present findings mirror these patterns by showing that improvements in the Environmental Quality Index correspond to substantial gains in both tourist arrivals and island tourism income. This suggests that the preferences of tourists visiting the Gili islands are consistent with broader regional and global trends in nature-based tourism, where environmental conditions strongly influence willingness to travel and spending behaviour.

However, the study also reveals important divergences from existing literature. Several studies have suggested that conservation policies, particularly those involving restrictions on resource use or access, may reduce tourism activity in the short term through increased compliance burdens or reduced availability of recreational sites (Bennett et al., 2021; Fabinyi et al., 2022). In contrast, the present analysis finds that conservation policy intensity exhibits a consistently positive effect on both tourist arrivals and local income, even when accounting for potential short-term disruptions. This divergence may be explained by the specific context of Gili Matra, where conservation measures such as anchoring controls, mooring buoy installation, and waste management reforms directly address ecological degradation that had previously threatened the visitor experience. In such settings, conservation efforts are more likely to be perceived by tourists and operators as enhancements rather than limitations. The results therefore suggest that the timing, type, and visibility of conservation interventions matter significantly, and that well designed policies can strengthen tourism performance even in the short run.

The findings also differ from studies that report limited or ambiguous economic effects of conservation policies in developing country contexts. Some earlier assessments of Indonesian marine protected areas highlight weak enforcement capacity, inconsistent implementation, and limited local participation as barriers that reduce policy effectiveness (Nurhidayah & McIlgorm, 2019). In contrast, the present study indicates that conservation policies in Gili Matra have produced measurable economic benefits. This difference may stem from a combination of factors unique to the Gili islands, including strong tourism dependence, high visibility of ecological conditions to visitors, and extensive involvement of civil society groups in monitoring and restoration activities. These elements likely contributed to greater policy credibility and a more direct translation of ecological improvements into tourism outcomes.

The robustness checks provide further insights into the mechanisms driving these results. The significant lagged effects of the Marine Conservation Policy Index indicate that some policy interventions generate delayed yet enduring benefits, supporting theories that ecological restoration and governance improvements require time to translate into measurable tourism gains. The positive interaction between policy intensity and environmental quality suggests that conservation governance is most effective when accompanied by tangible ecological improvements. This finding extends previous research by demonstrating that policy and environmental conditions function as complementary rather than independent drivers of tourism performance.

Overall, the study advances the literature by providing rare longitudinal and econometric evidence from a small island marine tourism system, an area where empirical research remains limited. The results show that conservation policies can simultaneously improve environmental conditions and strengthen economic performance, offering a counter-narrative to perspectives that position ecological protection and tourism development as competing objectives. The findings also highlight the importance of sustained and coordinated conservation efforts, as the long-term benefits of policy interventions depend on both consistent enforcement and measurable ecological recovery. These

insights offer valuable implications for marine tourism governance in Indonesia and other small island destinations seeking to align conservation objectives with sustainable economic development.

Theoretical and Practical Implications

The findings of this study offer several important theoretical contributions to the literature on marine tourism governance, environmental economics, and small island sustainability. First, the results advance theoretical understanding of the policy–environment–tourism nexus by demonstrating that conservation policy intensity produces measurable economic outcomes when analysed longitudinally. Previous studies have often examined marine conservation impacts using cross-sectional designs or qualitative assessments, leading to uncertainty about the causal pathways between policy interventions and tourism performance. By applying fixed effects panel regression over a twenty-year period, this study provides stronger empirical support for the proposition that conservation policies function as structural determinants of tourism demand and island-level income. The findings therefore enrich theories of sustainable tourism by showing that ecological protection and economic viability are not opposing objectives, but interdependent processes shaped by governance quality.

Second, the study contributes to theoretical work on environmental valuation in tourism-dependent economies. The significant and positive coefficients for environmental quality in both visitor arrival and income models align with the view that ecosystem services are not merely ecological assets, but also economic goods embedded within tourism markets. This supports and extends frameworks such as ecosystem service valuation and environmental Kuznets dynamics in tourism, illustrating that environmental conditions in small islands directly influence consumer behaviour and expenditure patterns. The interaction results further enrich theory by showing that the economic benefits of conservation policies are amplified when environmental quality is already high, suggesting a complementarity mechanism that has been underexplored in prior literature.

Third, the findings extend Blue Economy scholarship by providing empirical evidence that governance reforms and conservation-oriented interventions can generate sustained economic returns. While policy narratives frequently claim that marine conservation supports long-term economic resilience, empirical verification has remained limited in Indonesian and Southeast Asian small island settings. The current results confirm theoretical assertions that improved governance structures such as effective zoning, anchoring controls, and waste management enhance destination competitiveness and support economic diversification within the Blue Economy framework. This creates a foundation for integrating quantitative policy evaluation into future Blue Economy studies.

Practical implications also emerge for policymakers, tourism managers, and local communities. The positive economic effects associated with conservation policy intensity highlight the need for consistent and well-enforced governance structures in marine tourism destinations. Policies such as mooring buoy expansion, plastic waste reduction, anchoring restrictions, and restoration programs should not be viewed as regulatory burdens but as investments that support long-term tourism competitiveness. The results indicate that even modest improvements in policy enforcement can generate substantial gains in tourist arrivals and island-level revenue.

The strong influence of environmental quality on both tourism demand and income underscores the value of continuous ecological monitoring and restoration. Local governments and marine park authorities should prioritise data-driven environmental management, including coral reef surveys, water quality assessments, and beach cleanliness programs. Practical strategies such as community-based reef restoration, partnerships with dive operators for ecological monitoring, and stricter enforcement of waste regulations can directly enhance environmental conditions and, in turn, economic outcomes.

Additionally, the significance of accessibility suggests that transport infrastructure investment is essential for sustaining tourism flows. Enhancements in inter-island ferry frequency, safety, and capacity would generate measurable economic benefits while also distributing tourism more evenly across the three islands. Finally, the pronounced negative impact of the Covid period underscores the vulnerability of small island economies to global disruptions. This highlights the need for diversified

revenue sources, digital tourism marketing strategies, and resilience-oriented planning to mitigate future shocks.

Overall, the theoretical and practical implications demonstrate that conservation policy and environmental quality are not peripheral concerns but central pillars of sustainable tourism development. By integrating governance, ecological conditions, and economic performance, this study provides a comprehensive framework that can inform marine tourism policy in Indonesia and other small island destinations.

CONCLUSION

This study demonstrates that conservation policy intensity and environmental quality are significant drivers of tourism performance and island-level income in the Gili Matra Marine Tourism Park. Using a two-decade fixed effects panel, the analysis shows that stronger conservation governance and improved ecological conditions consistently increase tourist arrivals and economic returns, reinforcing the argument that environmental stewardship and tourism development are mutually reinforcing rather than competing priorities. These findings contribute to theoretical debates on sustainable tourism governance and offer empirical evidence supporting the economic logic of the Blue Economy framework.

Despite these contributions, the study has several limitations. The analysis relies on secondary data that may vary in accuracy across years, particularly for earlier periods with less consistent monitoring. Environmental indicators are aggregated into a composite index, which may obscure fine-grained ecological dynamics. Furthermore, the study focuses on three islands within a single marine tourism park, which may limit generalisability to other small island contexts.

Future research should employ higher-resolution ecological datasets, incorporate visitor perception surveys, and apply spatial modelling to explore how conservation effects vary within islands. Comparative studies across multiple marine protected areas in Indonesia or Southeast Asia would also provide stronger regional insights.

Several policy recommendations emerge. Authorities should strengthen enforcement of zoning, anchoring controls, and waste management, as these measures produce clear economic benefits. Investments in ecological monitoring, reef restoration, and transport accessibility will further enhance tourism competitiveness. Finally, local governments should prioritise resilience planning to mitigate future shocks, recognising the substantial vulnerability of small island tourism systems to global disruptions such as pandemics.

Conflict of Interest
Nothing to disclose

Data Availability
The data that support the findings of this study are available from the corresponding author upon reasonable request.

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