Valuation of Fisheries Resource Utilization in Coral Reef Ecosystems of the Thousand Islands National Park

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Abstract
The Thousand Islands National Park, located in the Java Sea, harbors significant coral reef ecosystems that support artisanal fisheries and tourism. This study aims to assess the economic value of fisheries resource utilization in this area, integrating both market and non-market valuation methods. A combination of bioeconomic modeling and contingent valuation was used to estimate the sustainable economic yield and the willingness to pay (WTP) for conservation. Results indicate that the total annual economic value of reef-associated fisheries is approximately IDR 45 billion, with significant potential for enhanced sustainable income under improved management. Policy recommendations include ecosystem-based management, community-based monitoring, and improved enforcement mechanisms. Originality produces new knowledge without repeating what has already been done by others.

Keywords: Coral Reef, Fisheries Valuation, Bioeconomic Model, Ecosystem Services, Marine Protected Area, Indonesia

1. Introduction

Coral reef ecosystems are among the most productive marine habitats, offering ecological, social, and economic benefits. In Indonesia, the Thousand Islands National Park (Taman Nasional Kepulauan Seribu, TNKS) represents a critical area for biodiversity conservation and resource use, especially by coastal communities relying on fisheries. However, overexploitation and environmental degradation threaten the sustainability of these services.

The aim of this study is to assess the economic value derived from the utilization of fisheries resources in TNKS and to explore policy options for sustainable management. By understanding the monetary value of these resources, stakeholders can better justify conservation efforts and develop appropriate management frameworks. Coral reef ecosystems are among the most biologically diverse and economically valuable marine environments globally. They provide critical ecosystem services such as food provision, coastal protection, habitat for marine species, and opportunities for recreation and tourism (Moberg & Folke, 1999; Spalding et al., 2017). In tropical archipelagic countries like Indonesia, coral reefs contribute significantly to the livelihoods of coastal communities, particularly through artisanal fisheries and small-scale marine enterprises (Burke et al., 2012).

The Thousand Islands National Park (Taman Nasional Kepulauan Seribu, TNKS), located in the Java Sea, north of Jakarta, encompasses over 100 small islands and extensive coral reef

systems. As one of Indonesia's designated marine protected areas (MPAs), TNKS plays a vital role in biodiversity conservation, fisheries productivity, and the local economy (KKP, 2020). Nevertheless, the park faces escalating anthropogenic pressures, including overfishing, destructive fishing practices, unregulated tourism, and pollution from Jakarta Bay, which have contributed to coral reef degradation and declining fish stocks (Wiryawan et al., 2019; Cleary et al., 2008).

Despite its ecological and economic significance, the full value of coral reef-associated fisheries in TNKS remains poorly understood and underappreciated in policy and management frameworks. Economic valuation, particularly of ecosystem services, has emerged as a strategic tool to quantify the benefits derived from natural resources in monetary terms, thereby supporting more informed and sustainable resource management (Barbier et al., 2011; Brander et al., 2015). Valuation also plays a critical role in justifying investments in marine conservation and in designing effective financing mechanisms such as payment for ecosystem services (PES) and conservation trust funds (Wunder, 2005; Lau, 2013).

This study aims to assess the economic value of fisheries resource utilization in the coral reef ecosystems of TNKS by employing both market-based and non-market valuation methods, with the objectives of estimating the direct economic value of reef-associated fisheries, analyzing the sustainability of current fishing practices using bioeconomic modeling, and assessing local community willingness to pay (WTP) for reef conservation and improved fisheries management.

2. Research Method

Primary data were collected through field surveys, including catch and effort data from artisanal fishers, household surveys on income from fisheries, contingent valuation surveys to assess willingness to pay for conservation, and focus group discussions with key stakeholders. Secondary data were obtained from the Ministry of Marine Affairs and Fisheries (MMAF), TNKS management reports, and previous academic studies.

The valuation methods consisted of market valuation, which was estimated using catch volume, average prices, and fishing effort; bioeconomic modeling, which employed the Gordon–Schaefer model to assess Maximum Economic Yield (MEY); and contingent valuation, which was applied to estimate willingness to pay (WTP) for improved reef management and biodiversity conservation.

3. Results and Discussions

The economic valuation shows that the estimated annual direct use value of reef fisheries in TNKS reaches approximately IDR 45.3 billion, with demersal fish contributing 55%, ornamental fish 25%, and reef invertebrates 20%. The average income of artisanal fisher households is around IDR 3.75 million per month or IDR 45 million per year, although seasonal fluctuations occur due to monsoonal weather patterns and limitations in fishing effort. Despite relatively high productivity, declining catch-per-unit-effort (CPUE), particularly near densely populated islands such as Pramuka and Tidung, indicates increasing pressure on reef fishery

resources, a pattern consistent with broader regional observations in Indonesian reef fisheries (Pauly et al., 2002; Fauzi & Anna, 2005).

Bioeconomic analysis using the Gordon–Schaefer model reveals that the Maximum Sustainable Yield (MSY) is approximately 2,600 tons per year, while the Maximum Economic Yield (MEY) is about 2,100 tons per year. Current harvest levels are estimated at around 3,000 tons per year, exceeding MSY by about 15% and MEY by roughly 43%, which reflects both ecological unsustainability and economic inefficiency. Adjusting exploitation levels toward MEY could increase net economic benefits by around IDR 12 billion annually and support stock recovery, in line with recommendations from previous bioeconomic studies in Indonesia and the Coral Triangle region (Pauly et al., 2002; Fauzi & Anna, 2005).

The contingent valuation results indicate that the community expresses a mean willingness to pay (WTP) of IDR 20,000 per person per month for coral reef conservation programs, including no-take zones, reef restoration, and fisheries patrols. When aggregated across approximately 20,000 residents and stakeholders, this potential contribution could generate between IDR 4.8 and 5.2 billion per year for conservation funding. These findings demonstrate strong public support for sustainable reef management and reinforce the feasibility of implementing local conservation finance mechanisms such as reef trust funds, voluntary tourism levies, and community-based payment for ecosystem services schemes (Wunder, 2005; Lau, 2013).

Overall, the findings emphasize the need to shift toward ecosystem-based fisheries management in TNKS. Aligning harvest rates with MEY targets would ensure both economic efficiency and ecological sustainability, while community-based co-management could enhance compliance and reduce illegal fishing through local participation in monitoring and enforcement. Integrating conservation finance mechanisms based on community WTP, together with marine spatial planning that establishes ecologically representative and socially acceptable no-take zones, will be essential to rebuild fish stocks and secure long-term benefits, in accordance with Indonesia's National Blue Economy Agenda and its commitment to expand effective marine protected areas by 2030 (KKP, 2021).

4. Conclusion

Fisheries resource utilization in the coral reef ecosystems of TNKS generates substantial economic benefits but is currently characterized by unsustainable exploitation. Economic valuation approaches, including bioeconomic and contingent valuation models, provide essential evidence for policy formulation by linking ecological conditions with economic outcomes. This study confirms that reef-associated fisheries contribute more than IDR 45 billion annually to local livelihoods and the regional marine economy, yet current harvest levels exceed both the Maximum Sustainable Yield (MSY) and Maximum Economic Yield (MEY), indicating ecological stress and economic inefficiency.

Bioeconomic analysis shows that restoring harvest levels to MEY would improve long-term profitability while ensuring resource sustainability, and contingent valuation results

demonstrate that local communities are willing to financially support conservation initiatives. These findings highlight the importance of integrating economic valuation into marine policy to design management strategies that are not only ecologically sound but also socially and economically equitable. Collaborative management involving local communities therefore becomes a crucial component in maintaining the resilience of reef fisheries in TNKS.

To achieve sustainable reef fisheries, policy actions should include the implementation of MEY-based harvest limits supported by effective monitoring and enforcement, the expansion of community-based co-management schemes to strengthen local stewardship, the development of conservation finance mechanisms such as voluntary contributions and tourism levies, and the integration of economic valuation data into marine spatial planning and decision-making processes. In conclusion, valuing ecosystem services such as reef fisheries is essential not only to understand their socio-economic contributions but also to ensure their long-term preservation, thereby supporting Indonesia's broader marine conservation and blue economy objectives.

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