Available online at: http://ejournal-balitbang.kkp.go.id/index.php/ifrj
e-mail:ifrj.puslitbangkan@gmail.com
INDONESIAN FISHERIES RESEARCH JOURNAL
Volume 31 Number 2 June 2025
p-ISSN: 0853-8980
e-ISSN: 2502-6569
Accreditation Number RISTEK-BRIN: 85/M/KPT/2020

NUSA PENIDA: LAND USE, TOURISM, AND SUSTAINABILITY

Alin Fithor[1*], Beni Sabdo Nugroho[1], Donny Juliandri Prihadi[2], Chusnul Firaqie Ainni[2], Frida Purwanti[3]

[1]Faculty of Fisheries and Marine Sciences, Pancasakti University, Tegal, Indonesia,
[2]Department of Marine Science, Faculty of Fisheries and Marine Sciences, Padjadjaran University, Bandung, Indonesia
[3]Faculty of Fisheries and Marine Sciences, Diponegoro University, Semarang, Indonesia.

ABSTRACT

Nusa Penida's coastal communities rely on its rich marine resources for livelihoods, primarily through fishing and tourism. This study analyzes land use changes in Jungut Batu Village, Nusa Lembongan, using secondary data and Google Earth Pro, revealing a significant shift from seaweed cultivation to tourism development between 2009 and 2020, with a temporary reversion. This transformation highlights evolving economic dynamics and environmental impacts. While the shift towards ecotourism represents a potential evolution in sustainable land use, the adverse effects of mass tourism necessitate a transition to eco-friendly and sustainable practices. Effective collaboration among communities, tourism stakeholders, and the government, as well as further research, is crucial to developing a genuinely sustainable ecotourism model for Nusa Penida, with the contribution of society being accepted at the last moment.

Keywords: **Land use, Changes, Ecotourism, Marine ecosystem.**

INTRODUCTION

Coastal areas, which are the spaces between land and sea, possess enormous biological and non-biological potential (Bengen, 2001). As an area with a high level of accessibility, it encompasses various environmental service activities, including transportation, industry, and tourism. As an archipelagic country, Indonesia relies heavily on tourism as a central component of its economy (Cook, 2021). The Nusa Penida area is situated off the southeast coast of the island of Bali, Indonesia. It covers 200 km^2 of coastal waters surrounding the three main islands of Penida, Lembongan, and Ceningan, which are home to important marine ecosystems, including seagrass beds, mangrove forests, and coral reefs (Jubaedah & Anas, 2019).

A marine biodiversity assessment in 2008 found 298 coral species and 576 fish species, including five new species (Allen, 2008; Turak & De Vantier, 2009). Much of the island's coral reefs are covered with economic farming, which also provides a reliable source of income for many local households. Most tourists head to Nusa Lembongan, renowned among divers for its reliable schools of manta rays and mola-mola, which they visit yearly, along with other activities such as farming, marine tourism, and small pelagic fish capture fisheries that form in the strong currents (Of & The, 2023). As a result, Nusa Penida receives over 200,000 visitors annually, making it one of Bali's most popular destinations for marine tourism (Jubaedah & Anas, 2019).

Due to the intensive use (conflicts that often arise in tourism and fisheries) of coastal resources in small coastal areas, there is a high risk of conflict between these activities and local communities. Changes in the region continue to be implemented annually in response to changes in the times (Fauzi, Susilo, & Mayasari, 2009). Economic considerations are often prioritized over sustainability and land carrying

correspondence author:
e-mail: alinfithor@upstegal.ac.id
DOI: http://dx.doi.org/10.15578/ifrj.31.1.2025.23-30

capacity (land suitability) in land use planning for coastal areas. Before maximizing land use, Harjadi (2016) emphasized the importance of evaluating land suitability. There is a need for research on the management and direction of the use of digitally mediated coastal areas (Sanjaya, Merit, & Astarini, 2022).

Research location is in Jungut Batu Village, Nusa Lembongan, Bali, was chosen because all the areas in Nusa Penida, Nusa Lembongan experience higher regional changes every time following the development of the times (A Susano, S Sutrisno, A Darmawan, P Pujiastuti, D Novita, 2019; Prasetyo, 2017; Wibawa et al., 2021).

DATA ANALYSIS

The research was conducted through a survey, which involved environmental change improvements, starting with management planning and then continuing with field studies. Area estimate was made using Google Earth Pro. The area was then defined as an initial boundary, serving as a benchmark for subsequent changes in the area. The area of 340 m2 is not the actual area (Purnomo, Asitah, Latukismo, Rosyidah, & Kurniawan, 2021; Yulianda, 2021).

The study was conducted using Google Earth Pro software. Taking Nusa Lembongan as an example of land changes, an analysis was conducted to examine the changes in the area each year. After data collection, quantitative modeling techniques were applied to collect and analyze data (Fauzi et al., 2009). Explain at figure 1.

However, in this study, it is assumed that the area of changes in the seaweed cultivation area should be determined in an area for tourism activities. Using the *historical imagery feature*, we can visualize changes in the area each year as desired, primarily employing Google Earth Pro and focusing on the period from 2009 to 2020 to assess annual changes in land area. Using Google Earth Pro's historical imagery feature, annual changes in this delineated area could be tracked and compared against the 2009 baseline. Quantitative modeling techniques were then applied to analyze the collected data (Pongponrat, 2022).

Due to the unavailability of precise historical data on base agricultural activities with cultivation areas, Google Earth Pro was used to estimate these areas (Khan, Chang, & Bibi, 2024). The study uses this area as a proxy, assuming that changes in society's contribution, particularly in tourism-related activities (Blok, van Buuren, & Fenger, 2023; Hidayat & Agusliani, 2020).

RESULTS AND DISCUSSION

Land use change

Jungut Batu Village is one of the villages on the island of Nusa Lembongan that has continued to grow over time. This growth is evident in land use changes, from idle land to built-up areas, and in the transition from residential areas to trading areas (Febrianty, 2021; Rami, Faiq, Aziz, & Muhamad, 2021). Based on field observations, coastal areas are used for tourism, trade, industry, and seaweed cultivation. The Jungut Batu area, as outlined in the MPA zoning, is designated for seaweed cultivation and tourism (Figure 2).

Based on the analysis of regional changes, notable shifts have occurred over the last decade. According to *historical imagery,* it was found that in 2009, the

Figure 1. Map of Jungut Batu Village Area (source data: Google

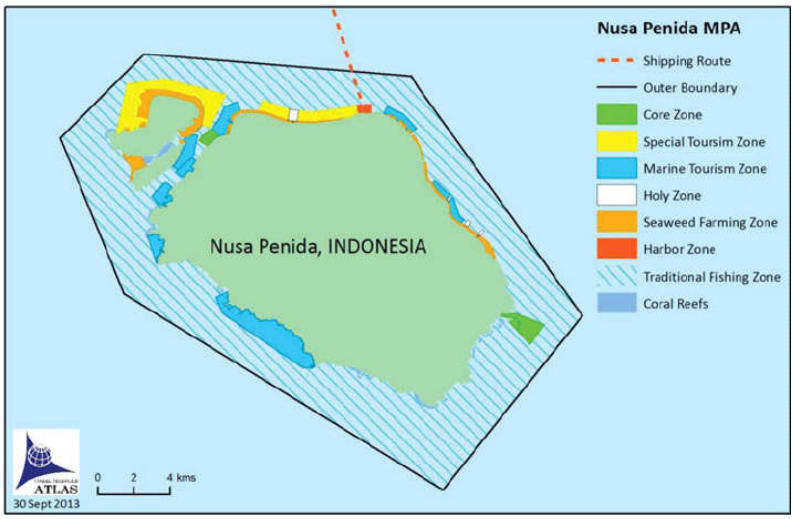

Figure 2. Nusa Penida MPA Zoning (Source: data analysis, 2023)

residents of Jungut Batu Village were primarily seaweed farmers. Over time, many villagers switched professions to the tourism sector following the decline of seaweed cultivation from 2016 to 2019. In 2020, the land reverted to seaweed cultivation due to the pandemic (Anna, Djuari, & Khan, 2021). The absence of tourists visiting the Nusa Lembongan area is why the land has reverted to seaweed cultivation.

Based on the analysis of regional changes, notable shifts have occurred over the last decade. According to *historical imagery,* it was found that in 2009, the residents of Jungut Batu Village were primarily seaweed farmers. Over time, many villagers switched professions to the tourism sector following the decline of seaweed cultivation from 2016 to 2019. In 2020, the land reverted to seaweed cultivation due to the pandemic (Anna, Djuari, & Khan, 2021). The absence of tourists visiting the Nusa Lembongan area is why the land has reverted to seaweed cultivation.

The results of the analysis of changes in the Jungut Batu Village area are shown in Figure 3. Nusa Penida is divided into seven large areas: seaweed cultivation, sacred temples, ports, sustainable fisheries, marine tourism, and unique marine tourism (Giovani, Damayanti, & Susiloningtyas, 2018). These conservation areas can be utilized sustainably to improve the local economy (Wuwung et al., 2022). In addition, the creation of conservation areas is also an effort to improve the standard of living of local people (Jin, He, Gong, & Wang, 2018; Wagey, Boneka, & Mantiri, 2020). Land suitability, natural phenomena, climate change, and environmental pollution will all be affected by changes in land over time. If land is exploited without sustainable conservation efforts to ensure sustainability, the impact will be very severe (Jubaedah & Anas, 2019).

Due to human activities and natural disasters, densely populated coastal areas experience a range of adverse impacts. Coastal areas are also vulnerable to disasters caused by humans. Sea level rise, abrasion, tsunamis, and earthquakes are some natural disasters that threaten coastal areas (Anna et al., 2021; Bambang & Wijayanto, 2020). The risk matrix arising from sustainable use without a regional rehabilitation area requires further research (Hidayah & Suharyo, 2018).

A case can be seen from the statements of residents that abrasion has occurred because, in the past, the sea level and coastline were wider than they are now. The type of land use in an area or region correlates with activity and population growth. As a result, the rate of land use change increases in areas with more intense population growth and activity (Kong, Xue, & Zhang, 2012; Rynio & Adamiczka, 2023). From an economic perspective, this change in land use can provide benefits. However, from an environmental perspective, this poses a threat to the sustainability and carrying capacity of coastal resources if not properly managed (Jubaedah & Anas, 2019).

The transition from seaweed farming to ecotourism areas illustrates how our understanding of sustainable land use has evolved. On the other hand, the negative impacts of mass tourism on ecosystems are increasingly evident. As a result, ecotourism and sustainability have emerged as alternative types of travel (Tegar & Saut Gurning, 2018). Three main aspects — development methods, general characteristics, and visitor behavior —can describe this change in tourism ideas (Yulianda, Susanto, Ardiwidjaja, & Widjanarko, 2018).

Ecotourism is a unique endeavor that combines

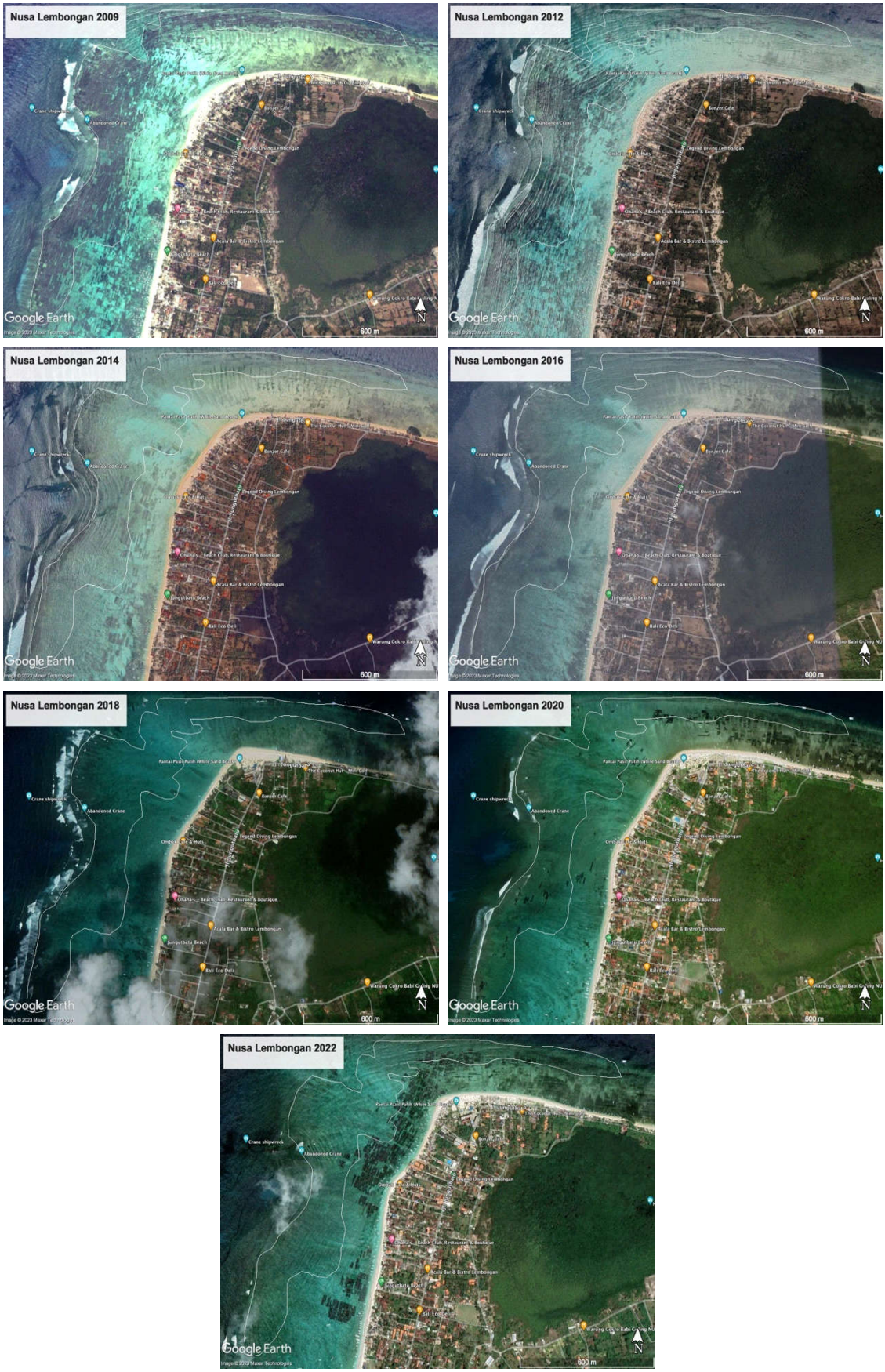

Figure 3. Changes in the Jungut Batu Village Area (Source: Google Earth)

many conservation efforts. Combining tourism and conservation is a great idea that will benefit all *stakeholders*. However, these benefits will be realized if clear principles, legal frameworks, financial and economic planning, and ecological impact assessments are established and enforced. Ecotourism is a creative, sustainable, and financially successful method of conservation efforts (Yulianda et al., 2018).

Coastal and marine environments, encompassing physical, biological, chemical, social, cultural, political, economic, and legal aspects, are closely linked to the development of ecotourism (Basuki et al., 2022; Sowman, Mbatha, & von Holdt, 2023). Effective communication between the community and parties involved in the tourism industry is accompanied by adequate community development (Fauzi et al., 2009). Further research is also needed on the risk matrix that will occur if additional changes are made to the area so that they can be anticipated.

Society Contribution

Evaluation of indicator measurements with meaningful contributions how to contribute to the new paradigm of society 5.0; in this measurement, measurements are made on the contribution of the community to be studied (the number of answers accepted is added up based on the results of the responses from the community surveyed).

Table 1. Community contribution

No.	Category	Indicator
1.	Many individuals and organizations contribute to society by donating time, money, or resources.	Philanthropy and charity
2.	Voluntary form can be found in the lives of its citizens.	Volunteering and community service
3.	Social entrepreneurs create and lead businesses that primarily address social and environmental challenges.	Social entrepreneurship
4.	Contributing to society by mobilizing public support, lobbying for policy change, and starting conversations that lead to positive societal change.	Advocacy and activism
5.	Scientists, researchers, and innovators contribute to society.	Research and innovation
6.	Educators, mentors, and knowledge-sharing platforms contribute to society by empowering individuals through education and skills.	Education and knowledge sharing
7.	Individuals and organizations contribute to society by preserving and promoting cultural heritage, traditions, arts, and languages.	Preservation and promotion of culture

Source: Results Analysis (2023)

Then explained in the following figure:

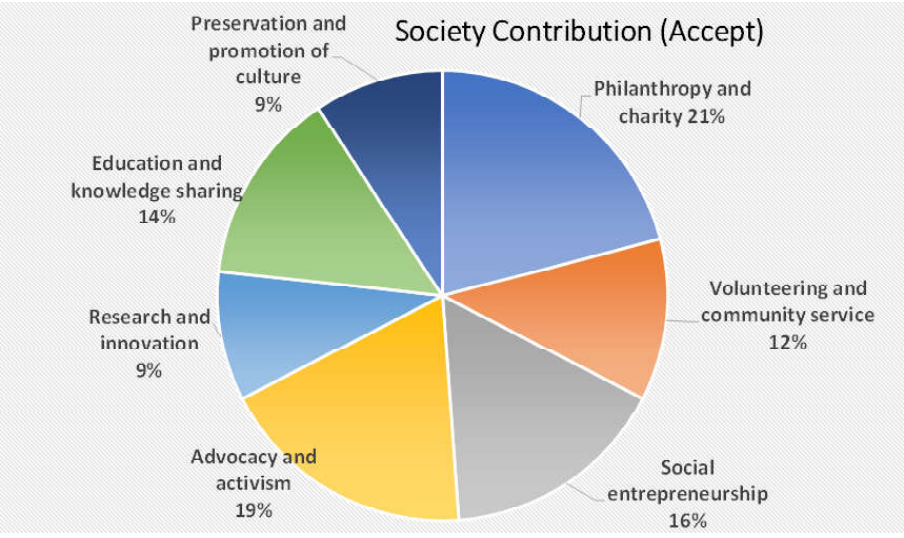

Figure 4. Results of receiving from the perspective of community contribution

Ecotourism presents a unique opportunity, integrating conservation efforts with economic development to benefit all stakeholders. This synergistic approach, however, requires careful planning and implementation to be truly effective. Realizing ecotourism's whole potential hinges on establishing and rigorously enforcing clear guiding principles, robust legal frameworks, sound financial and economic planning, and thorough ecological impact assessments. As Yulianda et al. (2018) noted, ecotourism offers a creative, sustainable, and financially viable pathway to achieving conservation goals.

The complex interplay of coastal and marine environments – encompassing physical, biological, chemical, social, cultural, political, economic, and legal dimensions – is intrinsically linked to the successful development of ecotourism (Basuki et al., 2022; Sowman, Mbatha, & von Holdt, 2023). Consequently, policy development for ecotourism must adopt a comprehensive and long-term perspective, recognizing the interdependence of these factors. Effective two-way communication between local communities and all stakeholders in the tourism industry, coupled with robust community development initiatives, is essential (Fauzi et al., 2009).

CONCLUSIONS

Nusa Penida's zoning covers several areas, including seaweed farming and tourism. This transformation demonstrates efforts to conserve and utilize land sustainably, supporting the local economy and enhancing community welfare. However, this change in land use also has significant environmental impacts, such as coastal abrasion and threats to coastal resources.

Meanwhile, mass tourism hurts the environment, prompting the development of environmentally friendly and sustainable tourism practices. Ecotourism is a solution that combines conservation and tourism for the good of all parties. However, strong collaboration between the community, tourism actors, and the government is necessary, as well as further research to anticipate potential regional changes that may occur in the future.

ACKNOWLEDGMENT

Thanks to the residents and internal research funding from Pancasakti University Tegal (March 2024).

REFERENCES

A Susano, S Sutrisno, A Darmawan , P Pujiastuti, D Novita, S. S. and A. M. (2019). Determination system of designing the best beach object in bali by using AHP method Determination system of designing the best beach object in bali by using AHP method. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/1175/1/012053

Anna, Z., Djuari, J., & Khan, A. M. A. (2021). Covid-19 impacts on small-scale tuna fisheries operation in eastern Indonesia/ : a preliminary snapshot study of pole-and-line and handline tuna fishers ' perceptions. *AACL Bioflux*, *14*(3), 1778–1785.

Bambang, A. N., & Wijayanto, D. (2020). The perceptions and aspirations of purse seine fishermen toward the prohibition of ' cantrang ' (Danish seine) in Bajomulyo , Pati Regency-Indonesia. *AACL Bioflux*, *13*(3), 1606–1613.

Basuki, T. M., Nugroho, H. Y. S. H., Indrajaya, Y., Pramono, I. B., Nugroho, N. P., Supangat, A. B., … Simarmata, D. P. (2022). Improvement of Integrated Watershed Management in Indonesia for Mitigation and Adaptation to Climate Change: A Review. *Sustainability (Switzerland)*, *14*(16), 1–41. https://doi.org/10.3390/su14169997

Bengen, D. G. (2001). Ekosistem dan Sumberdaya Pesisir dan Laut serta Pengelolaan Secara Terpadu dan Berkelanjutan. *Prosiding Pelatihan Pengelolaan Wilayah Pesisir Terpadu. 29 Oktober-3 November 2001*, (November), 28–55.

Blok, S., van Buuren, M. W., & Fenger, H. J. M. (2023). The Public Value of Citizens' Initiatives: Evidence from a Dutch Municipality. *American Review of Public Administration*, 1–17. https://doi.org/10.1177/02750740231175162

Cook, L. L. (2021). Insight into the millennial mind-set: Impact of 4IR and Society 5.0 on the real estate, construction and other industries. *IOP Conference Series: Earth and Environmental Science*, *654*(1), 0–7. https://doi.org/10.1088/1755-1315/654/1/012030

Fauzi, Y., Susilo, B., & Mayasari, Z. M. (2009). Analisis Kesesuaian Lahan Wilayah Pesisir Kota Bengkulu melalui Perancangan Model Spasial dan Sistem Informasi Geografis (SIG). *Forum Geografi*, *23*(2), 101. https://doi.org/10.23917/forgeo.v23i2.5002

Febrianty, I. (2021). Public perception of catfish aquaculture ponds in Banjar District , South Kalimantan , Indonesia. *AACL Bioflux*, *14*(1), 227–232.

Giovani, C., Damayanti, A., & Susiloningtyas, D. (2018). Coastal Typology of Landform in Pelabuhan Ratu Bay, Sukabumi Regency, Jawa Barat Province. *E3S Web of Conferences*, *73*, 0–4. https://doi.org/10.1051/e3sconf/20187304012

Harjadi, B. (2016). Aplikasi Penginderan Jauh dan Sig Untuk Penetapan Tingkat Kemampuan Penggunaan Lahan (KPL) (Studi Kasus di DAS Nawagaon Maskara, Saharanpur-India). *Forum Geografi*, *21*(1). https://doi.org/10.23917/forgeo.v21i1.1818

Hidayah, Z., & Suharyo, O. S. (2018). Analisa Perubahan Penggunaan Lahan Wilayah Pesisir Selat Madura. *Rekayasa*, *11*(1), 19. https://doi.org/10.21107/rekayasa.v11i1.4120

Hidayat, A. S., & Agusliani, E. (2020). Beach tourism, whether benefit or disaster for coastal fishermen of tanah laut regency, South Kalimantan Province. *AACL Bioflux*, *13*(3), 1383–1393.

Jin, J., He, R., Gong, H., & Wang, W. (2018). Role of risk preferences in explaining the public ' s willingness to pay for marine turtle conservation in China. *Ocean and Coastal Management*, *160*(April 2017), 52–57. https://doi.org/10.1016/j.ocecoaman.2018.04.006

Jubaedah, I., & Anas, P. (2019). Dampak Pariwisata Bahari Terhadap Ekosistem Terumbu Karang di Perairan Nusa Penida, Bali. *Jurnal Penyuluhan Perikanan Dan Kelautan*, *13*(1), 59–75. https://doi.org/10.33378/jppik.v13i1.124

Khan, M., Chang, Y. C., & Bibi, A. (2024). Navigating Pakistan's Maritime Industry potential in context of blue economy: An analysis of the necessity for ratification of maritime labour convention 2006. *Marine Policy*, *165*(May), 106150. https://doi.org/10.1016/j.marpol.2024.106150

Kong, H., Xue, X., & Zhang, X. (2012). Applying SWOT-AHP Analysis in Sustainable Marine Development Plan/ : Case Study in Shantou Municipality. *Advanced Materials Research*, *527*, 3741–3745. https://doi.org/10.4028/www.scientific.net/AMR.524-527.3741

Of, S., & The, A. A. T. (2023). Visual Assessment of Landscapes At the South Kuta Coast, Bali. *Journal of Southwest Jiaotong University*, *58*(3). https://doi.org/10.35741/issn.0258-2724.58.3.55

Pongponrat, K. (2022). Stakeholder Engagement Process in Water Saving Initiatives for Sustainable Tourist Destination in Samui Island, Thailand. *Pertanika Journal of Social Sciences and Humanities*, *30*(3), 1341–1363. https://doi.org/10.47836/pjssh.30.3.22

Prasetyo, W. (2017). Politik Indonesia Beyond Protest Voting/ : Membaca Pesan Tersembunyi di Balik Suara Tidak Sah. *Politik Indonesia/ : Indonesian Political Science Review*, *2*(2), 179–200.

Purnomo, A., Asitah, N., Latukismo, T. H., Rosyidah, E., & Kurniawan, B. K. (2021). Society 5.0 publication mapping using a scientometric perspective. *IOP Conference Series: Earth and Environmental Science*, *729*(1), 0–9. https://doi.org/10.1088/1755-1315/729/1/012141

Rami, A. A., Faiq, M., Aziz, A., & Muhamad, N. A. (2021). Characteristics and Success Factors of Rural Community Leadership in Malaysia/ : A Focus Group Analysis. *Pertanika Journal of Science and Technology*, *29*(3), 1591–1609.

Rynio, D., & Adamiczka, H. (2023). The role of rivers in creating a blue-green city economy on the example of Wroclaw and Gdansk. *Economics and Environment*, *85*(2), 140–153. https://doi.org/10.34659/eis.2023.85.2.557

Sanjaya, I. D. K. W., Merit, I. N., & Astarini, I. A. (2022). Strategi Pengelolaan Efektif Ekosistem Terumbu Karang Di Kawasan Konservasi Nusa Penida. *ECOTROPHIC/ : Jurnal Ilmu Lingkungan (Journal of Environmental Science)*, *16*(2), 122. https://doi.org/10.24843/ejes.2022.v16.i02.p01

Sowman, M., Mbatha, P., & von Holdt, J. (2023). Strategies for addressing conflicts arising from blue growth initiatives: insights from three case studies in South Africa. *Maritime Studies*, *22*(4), 1–16. https://doi.org/10.1007/s40152-023-00341-1

Tegar, D., & Saut Gurning, R. O. (2018). Development of Marine and Coastal Tourism Based on Blue Economy. *International Journal of Marine Engineering Innovation and Research*, *2*(2). https://doi.org/10.12962/j25481479.v2i2.3650

Wagey, B. T., Boneka, F. B., & Mantiri, R. (2020). Status of marine biodiversity and community perception on marine conservation in Mantehage Island , Bunaken National Park , North Sulawesi , Indonesia. *AACL Bioflux*, *13*(6), 3830–3839.

\

Wibawa, B., Fauzi, I., Novianti, D. A., Shabrina, N., Saputra, A. D., & Latief, S. A. (2021). Development of Sustainable Infrastructure in Eastern Indonesia. *IOP Conference Series: Earth and Environmental Science*, *832*(1). https://doi.org/10.1088/1755-1315/832/1/012045

Wuwung, L., Croft, F., Benzaken, D., Azmi, K., Goodman, C., Rambourg, C., & Voyer, M. (2022). Global blue economy governance – A methodological approach to investigating blue economy implementation. *Frontiers in Marine Science*, *9*(November), 1–17. https://doi.org/10.3389/fmars.2022.1043881

Yulianda, F. (2021). Coastal rehabilitation efforts through community perception/ : A case study in Karawang Regency , Indonesia. *AACL Bioflux*, *14*(1), 72–90.

Yulianda, F., Susanto, H. A., Ardiwidjaja, R., & Widjanarko, E. (2018). *Kriteria Penetapan Zona Ekowisata Bahari*. https://doi.org/10.5281/zenodo.1412165