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Research Article

The total economic valuation based on several resources and livestock contributions to determine the management strategy in Bunaken National Marine Park, North Sulawesi, Indonesia

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ABSTRACT

The estimation of total economic valuation and environmental damages analysis can be used to analyze the tourism impacts. This study aimed to estimate the total economic value and damage, the management design, and analyze the degradation level of coral reef habitat in Bunaken National Park, North Sulawesi, Indonesia. The research was conducted in Bunaken National Park of North Sulawesi, including 5 major islands: Bunaken, Mantehage, Nain, Siladen, and Manado Tua Islands. The water quality measurement was observed on 4 different sites, based on the environmental condition. The variables measured including turbidity, water temperature, salinity, BOD, COD, pH, oil and fat. Total economic value and economic value of ecosystem service analysis were also determined. The study showed that the total valuation of several resources was estimated to be Rp. 57.99 trillion, and the low contribution of the livestock sector is Rp. 1.6 billion, with the natural forest resources, indicated the high economic values. The current trend of increasing the growth area prior to the damaged area indicating successful maintainability. The damages are mainly caused by poverty and not strictly regulated policy and need to be reformulated to find the best fit management in Bunaken National Park.

Key words: Damage, economic value, management strategy, Bunaken National Park

INTRODUCTION

The increasing national and regional economic development in the tourism sector is an essential source of income by foreign exchange, employment expanse, and business opportunities (Stauvermann & Kumar, 2017). Bunaken National Marine Park on North Sulawesi represents the Indonesian tropical water ecosystem, such as coral reefs, seagrass and mangrove. Bunaken National Marine Park has the tourism potential on the diversity and high economic value with the coral reefs as its main components (Tangian *et al.*, 2015; Ario *et al.*, 2021). Coral reefs are the main subject of increasing attention from conservation agencies and scientists. In many countries, 70% of coral reefs provide an important ecosystem service (Laurans *et al.,* 2013). However, 88% of coral reefs in Southeast Asia are damaged and categorized as high risk (Haya & Fujii, 2020; Renggong *et al.,* 2022). This National Park consists of 5 major islands divided by its native ecosystems and zone differentiation that are mainly used for research, education, and tourism (Attamimi & Saraswati, 2019a). In 2009, the status of coral reefs in Bunaken National Marine Park was moderate (Kusen & Tioho, 2009). The previous study found that the degraded condition of coral reefs has increased by 2017 (Attamimi & Saraswati, 2019a). However, the present status of coral reefs condition in the Bunaken National Marine Park is still unknown.

Until recently, several damaging severe problems have been noted, posed a threat to the natural resources of Bunaken National Park (Attamimi & Saraswati, 2019b). Amongst these were environmentally destructive practices, including blast and cyanide fishing, deforestation of mangrove and tropical forest, coral mining, poorly planned coastal development, a booming of the tourist industry, poor waste management systems, and conflicts between locals and tourists (Tangian *et al.*, 2015; Attamimi & Saraswati, 2019a; Kholil *et al.*, 2017), exaggerated by ineffective enforcement systems and lack of coordination among authorities (Kalalo, 2017; Santoso *et al.*, 2015). Furthermore, the local community lacks the motivation to participate in law enforcement and conservation at Bunaken National Park (Kalalo, 2017). As a matter of fact, the government did not receive any direct income from the park management.

The regional government is responsible for making any integrated decisions on tourism, regional development, and popularising national identity or culture while also keeping the quality biodiversity and environment (Santoso *et al.*, 2015; Rompas *et al.*, 2015). Rompas *et al.* (2015) suggest an alternative strategy for managing Bunaken National Park, including the involvement of the local community and addressing waste. Tourism is one of the invisible export commodities, is being developed and benefited now by various tourism enterprises that are small and large (Jeyacheya & Hampton 2016). Without baseline data, it would be difficult to compose any crucial decision according to the basic principles of national park management (Coccossis & Mexa, 2017).

The proper development of the Bunaken tourism industry can be assessed by the maximum carrying capacity (based on spatial analysis) (Coccossis & Mexa, 2017) and maximum

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environmental capacity (Van Riper *et al*., 2017) through the approach of damage and economic values (Jerath *et al*., 2016). The calculation of total economic values and the analysis of the environmental damages can be used to indicate the impacts of tourism. Hereby we provide the information to determine the total economic value, the management design, and analyze the degradation level of coral reefs habitat in Bunaken National Park.

MATERIALS AND METHODS

Study Area

The research was conducted in Bunaken National Park of North Sulawesi, including 5 major islands which are Bunaken (704.33 ha), Mantehage (726.40 ha), Nain (166.00 ha), Siladen (45.34), and Manado Tua (1,040.66 ha) Islands, also a coast of Molas Wori, and Arakan Wawontulap (13,800 ha) (North Sulawesi Regional Planning and Development Agency, 2019). The location consists of 4 districts and 19 urban villages. This research was carried out for 4 (four) months from September 2017 to January 2018.

Sampling

The water quality measurement was observed on 4 different sites, based on the environmental condition that utilised the best possible resources maintained. The measurement was conducted based on the following: The station I, indicate pollution caused by coastal residents in Siladen Island, Bunaken, and surrounding areas; Station II, pollution caused by maritime transport of oil spills (a common boat pathway to transport tourist; Station III, the pollution caused by port activities of Manado, and "Bersehati market"; Station IV, a blank sample far from human activity. The variables measured including turbidity, water temperature by stem thermometer, salinity by refractometer, BOD by Winkler method, COD by spectrophotometry, pH of water by pH meter, and oil and fat by gravimetrical analysis and compared to the national standards for marine life (Kep.02/MENKLH/1/1998).

Total Economic Value Analysis

An approach to the price (a proxy for price) manifested in money units was used. Such measurements can indicate changes in environmental quality that can be interpreted quantitatively to compare the value of the benefits and the damage (cost and benefit). To calculate the total economic value of the Bunaken National Park formulated as follows:

$$TEV=(DUV+IUV+OV)+(EV+BV) \quad (1)$$

$$UV=DUV+IUV \quad (2)$$

$$NUV=EV+BV \quad (3)$$

Notes:

TEV (Total Economic Valuation), Conclude of the sum of the economic value of environmental, economic benefits of direct use, indirect use, option value, and intrinsic value; DUV (Direct Use Value), Count taken on fishing conservation zone, tourist expenditures into local revenues; Use of water of residents and tourists, and seaweed harvesting; IUV (Indirect Use Value), Assuming the values of waves (for mangrove forests) and the value of tropical forests; OV (Option Value), A loss biodiversity due to human utilization by set per hectare per year.

The Economic Value of Ecosystem Service Analysis

To obtain the economic value of ecosystem services on the respondent by the visit costs to the Bunaken National Park, calculated by the following formulas:

$$TE = Nt \times L \times E$$

Notes:

TE: Number of tourism revenue; Nt: The sum of tourists; L: Length of stay; E: The average tourist expenditure/ person/ day.

The damage on Natural Park is calculated by Remote sensing LANSAD-5 T interpretation in 2011, HRVIMLA SP2 using Bands 1,2,3 in 2011 and Spot data in 2011, projected by IPS (Image Processing System) ArcView and ArcInfo (Tim Ormsby, 2004). We observed the damage on coral reefs, coral reefs growth, mangrove & tropical forest projected by ArcGIS (Lee & Wong, 2001).

RESULTS

Manado Tua Island (altitude 800 m) has a classic design featuring a volcanic crater, with a slope of 250 until 450. In the western and central of Bunaken (altitude 71 m), there is generally flat land, with an altitude of 50 m from the sea surface. Nain Island, with an altitude of 139 m and a slope of about 20 to 40 Mantehage and Siladen, is generally flat. Bunaken National Park commonly has two seasons, namely wet season and dry season. The wet season occurs from October to March, with cool northwesterly winds and heavy rains fall. The dry season occurs from May until August with southwest winds and drier winds. Based on Meteorological Office and Geophysics Manado, the highest monthly rainfall occurs in January (427.18 mm), and the lowest occurs in August (73.12 mm). While, the average annual rainfall every year was 212 days and the highest rainfall days occurred in January with 24 days of rain, whereas the lowest number of rainy days occurred in August with 11 days of rain.

The average air temperature is 27^0 C with monthly fluctuations between 1 – 2^0 C. The minimum average monthly temperature is 19^0 C, and the maximum average monthly temperature is 34^0 C. The soil types in the Bunaken National Park area is relatively heterogeneous. Some terrain is Entropepts, Dystrandepts, on the hills is Eutrandepts, and of the top on mountainous area Tropodults (Bakorsultanal, 1988). Most of the land area in the Bunaken National Park was used for agriculture. These lands status are not private property, only the customary land, or a legacy that is generally limited only by the signs of nature such as bamboo or large trees. Public property is determined based on the agreement of the predecessor and retained. There is seaweed cultivation and coral reef near to the village, which is still common property.

Based on our estimation of the total economic valuation of Bunaken National Park, this year can be divided into terrestrial and coastal marine resources. The summary of total economic values of both terrestrial, marine and coastal resources of Bunaken National Park can be seen below (Table 1). Our spatial analysis identified the damage and growth area from 7 several sites located in Bunaken National Park. After identifying the damaged and growth area, subsequently, we estimate the total economic value. The projected damage and growth area can be seen below (Figure 1).

Table 1. Total economic valuation on terrestrial, marine and coastal resources in Bunaken National Park.

I	Terrestrial resources	Billion (in IDR)
1	Recreation	
	a. Foreign tourist expenditure	408.30
	b. Domestic tourism expenditure	1.62
2	Livestock resources	1.69
3	Plantation resources	1.19
4	Water resources	
	a. Community needs	1,985
	b. Tourist needs	0.005
5	Tropical forest resources	1,254,982.5
6	Mangrove forest resources	
	a. Mangrove as breaking waves	1,446.54
	b. Biodiversity of the mangrove forest	35.838975
	c. The value of the medicine of mangrove forest	244.817
II	**Coastal and marine resources**	
1	Seagrass ecosystem	10.80
2	Coral reef ecosystem	
	a. The beach of coral reef as controlling waves	886.64775
	b. The value of coral reefs as a tourist attraction	1,693.4125
	c. Economic value of fish	55.783
	Total	**5,799,336.5100**

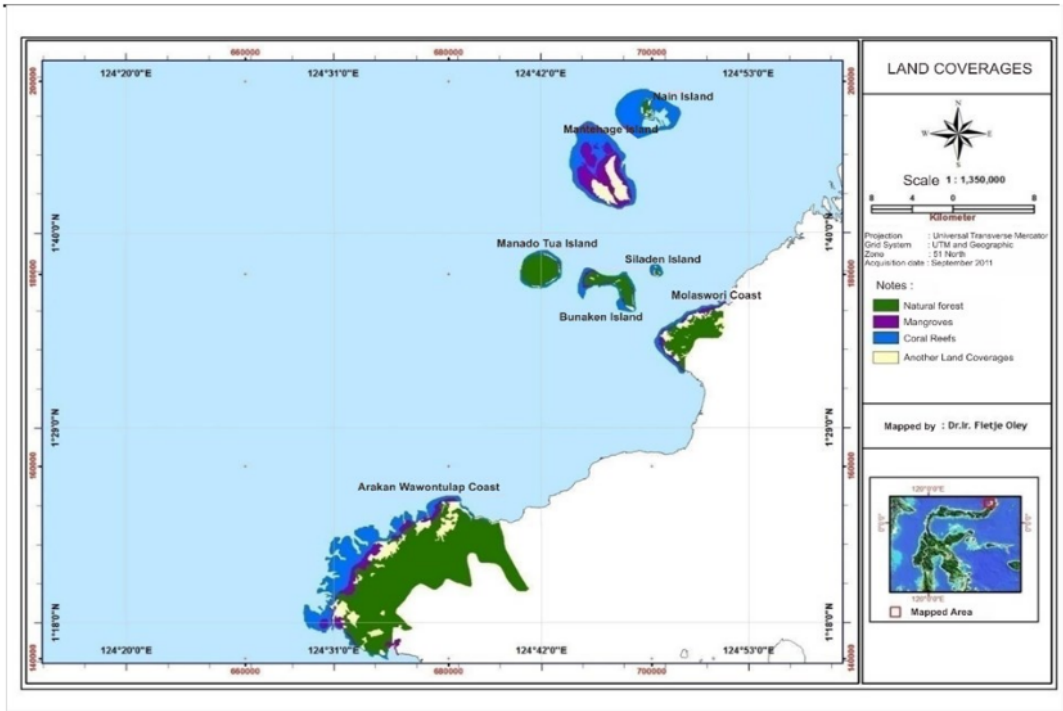

Figure 1. Spatial analysis of the damaged and growth from 7 sites location in Bunaken National Park.

The environmental conditions in Bunaken National Parks are mismanaged, regardless of the aspect of conservation. Here we present our calculation based on the damage and growth area of natural forests, including coral reefs, mangrove forests, and tropical forests in 2011 and in 2017. The summary of damage, growth and economic values can be seen below (Table 2).

The environmental variables show a slight variation between each station. However, the oil and grease from Station IV have a very low concentration (252 mg/l). However, the COD level is recorded beyond beyond the threshold level. The measurement of 7 environmental variables from each site can be seen below (Table 3).

Bunaken National Park has a population of cattle that adopting the traditional culture in the "Bersehati Manado" market. Cattle significantly contributes to the livestock resources (Rp. 241,315,200) than other types of livestock. Overall, the contribution of livestock resources is considered lower than other types of resources. The detailed estimation of livestock value can be seen below (Table 4).

Table 1. Economic valuation on the damage and growth area of tropical forest in Bunaken National Park.

No.	Location	Damage Area (ha) 2011	Economic Value, Billion (in IDR)	Growth Area (ha) 2017	Economic Value, Billion (in IDR)
1	Manado Tua Island	39	36.125	223	201.397
2	Bunaken Island	124	111.987	555	501.23
3	Nain Island	36	33.512	83.6	75.501
4	Mantehage Island	270	243.843	-	-
5	Siladen Island	21	18.965	28.7	25.196
6	Arakan Wawontulap Coast	333	291.709	658.6	594.798
7	Molas Wori Coast	22	19.868	67.2	60.69
	Total	845	755.012	1, 616.1	**1,458.8175**

Table 3. The measurement of 7 environmental variables from four differents sites on Bunaken National

No.	Location	**Station I** (coastal resident)	**Station II** (boat pathways)	**Station III** (port activities)	**Station IV** (blank sample)
1	Turbidity (NTU)	0.2	0.5	0.4	0.4
2	Water Temperature (^oC)	27	28	29	27
3	Salinity (Ppt)	25.7	26.4	28.0	27.8
4	BOD (mg/l)	11	17	16	17
5	COD (mg/l)	251	206	246	291
6	pH	7.81	7.82	7.85	7.88
7	Oil and Grease (mg/l)	350	531	607	252

Table 4. The economic value of livestock products in Bunaken National Park

No.	Type of Livestock	Individual	Weight (kg)	Price/kg (in IDR)	Economic value (in IDR)
1	Cattle	84	31.920	90.000	241.315.200
2	Goat	760	28.120	70.000	1.495.984
3	Pig	891	28.735	60.000	1.536.173
4	Chicken	7.320	8.768	20.000	1.283.635

DISCUSSION

The total economic valuation on the natural forest resources is Rp. 5,799,336,510 for this year. However, the animal husbandry sector (livestock resources) shows a low contribution with a value of Rp. 1.6 billion that may serve as the basis for developing the management strategies. If the resources are not well preserved properly, it will not be surprising that it would be diminished over time (Jerath *et al*., 2016). Strategies that aim to improve the quality of the damaged resource is alternative ways to maintain the economic value (Moharramnejad *et al*., 2017). Decisions on that improvement proved to be expensive (Bayraktarov *et al*., 2016), and likely to be avoided in regard to unnecessary cost and expenditure to maintain and sustain the damaged area.

Several factors that may be caused the damaged of natural forests including storm, water pollution, fish bombing, frequent diving activity, the used of coral as materials, and souvenirs (Towner, 2016). Unfortunately, we found no damage to coral reefs, indicating a successful campaign to conserve by the dive services and also the officials (Kamagi *et al*., 2016). Most importantly, the local community is starting to appreciate the beauty of coral reefs diversity, thus learning to understand, look over, and conserve their marine and coastal ecosystems.

Our observation showed no damage on coral reefs from 2011 to 2017, by the growth as much as 3,222 ha or 98.7%, due to strict regulation by the government. Despite the growth of coral reefs, there also has been damage and growth in several areas for the past 11 years. Our spatial analysis acquired the destruction of the tropical forest area of Manado Tua and Bunaken Island and has also been recorded before (Rindengan *et al*., 2019). It is caused by the local resident's poverty and land conversion. The forests policy is categorized to "open access", resulting in the local to maximize profits, regardless of the

sustainability factors. In this case, the government policy on the rehabilitation of these areas is not entirely successful.

The environmental analysis on 7 variables shows a precaution on several sites that may indicate a threat to marine life. Turbidity dramatically affects the process of photosynthetic algae that live within coral polyps (Carlson *et al*., 2019). However, when compared with existing quality standards, the turbidity in Bunaken National Park is still in good condition. The temperature range is still within the limits of coral reef growth requirement, but it should be noted that a sudden change in temperature of only 4 – 6 ^{0}C may reduce the coral reef growth rate (Guan *et al.,* 2015). The salinity is also still within the ranges between 27 – 40 Ppt, which is optimum for coral reef growth (Chui & Ang, 2017). However, the slow growth of coral reefs may be affected by freshwater from estuaries zones. The BOD level is also in good condition for the growth of corals and marine life. Unfortunately, a low concentration on BOD may indicate aerobic microorganisms that cannot live and reproduces as seen (Payandeh *et al.,* 2017) on Station I. The COD level is above the threshold level compared to the existing quality standard (Reskiwati *et al*., 2018). It may be caused by the amount of oxygen that can be chemically oxidized (Aniyikaiye *et al*., 2019). The pH rate does not significantly differ on each site (Reskiwati *et al.,* 2018), and is still on the tolerance limit to sustain marine life. However, the Oil and Grease level shows a striking result, below their carrying capacities, especially on stations II and III. Based on the quality standard, it can be concluded that each site is no longer feasible for marine life. According to Hafeez *et al*. (2018), the suspension of oils and fats can last to several months and threaten aquatic biological resources. Although many tourists or anthropogenic activities may contribute to economic benefits, it dramatically affects the abiotic factors if not managed properly. These activities may lead to declining in the quality and functionality of the coastal and marine ecosystem.

Our estimate on the economic value and spatial analysis of Bunaken National Park can be used as a reference to formulate the coral reefs, mangrove forests, and tropical forest policy. Hence, good communication and coordination need to be developed between national park management and stakeholders to conserve and sustain the coral reefs. The benefits of a protected area on the national park need to be widely known as a tool to manage marine resources through collaborative management (Sterner & Coria 2013). The carrying capacity of water quality also needs to be monitored to sustain the coral reefs habitats (Attamimi & Saraswati, 2019b; Coccossis & Mexa, 2017; Ampou *et al*., 2018).

.Mangrove forests should be sustainably managed to meet human needs and resources as well as to conserve their values (Jerath *et al*., 2016; Djamaluddin, 2019). A few guidelines to be considered to rehabilitate the damaged mangrove as follows: (1) swamp areas along the coastal line need to be planted by appropriate mangrove species; (2) sandy beaches need to be planted by another suitable and viable species; and (3) the follow up to monitor and evaluate the reforestation effort must be carried out.

The needed policy of Management in Bunaken National Park could develop good communication and coordination of park management activity among stakeholders, including dispute resolution, and support the development of sustainable financing for BNP management. The benefits of National Park can be used to manage marine resources through collaborative management with multi-stakeholders, including local communities, in resource management and monitoring and check the carrying capacity of water quality to maintain the life of coral reef habitat (Zhang *et al.,* 2022). Forest resources and forest lands should be sustainably managed to meet the social, economic, cultural and spiritual human needs of present and future generations. These needs are for forest products and services, such as wood and -wood products, water, food, fodder, medicine, fuel, shelter, employment, recreation, habitats for wildlife, landscape diversity, carbon sinks and reservoirs, and other forest products. Appropriate measures should be taken to protect forests against harmful effects of pollution, including air-borne pollution, fires, pests and diseases, to maintain their total multiple values (UNCED, 1992).

A few guidelines needed to be considered for successfully implementing the mangrove replant in the damage area in National Park Bunaken: swamp and areas along the coastal line and the damaged area should be planted using appropriate mangrove plants. Sandy beaches must be planted with other suitable and viable species. To follow up with necessary maintenance monitoring and evaluation programs after planting activities must be carried out. Laws and regulations comprising forest legislation are the legal instruments essential to effect many of the objectives of a forest policy. The legislation permits the translation of policy objectives into specific legal provisions affecting forest use and forest land and the way forest resources enter into the life and development of communities and countries.

Forest legislation enacted by the government should reflect the principle of sustainability to support the implementation of forest policy. Depending upon social needs and prevailing ecosystems in a country, the objectives of forest law may cover a range of forest management issues. Points concerning sustainable tropical forest utilization and management that should be included in forest legislation are maintaining or enlarging the amount and regional distribution of forest cover needed to secure a stable environment and provide a basis for sound economic and social forest development (Levers *et al.,* 2021). Protecting in a network of protected areas represents an example of all natural forest ecosystems to maintain an acceptable level of biological and landscape diversity. Management plans were prepared for all state forest land and forest lands in non-state tenure. The establishing and supporting a viable and multi-functional forest economy, combining ecological conservation and economic resource utilization. Identify suitable areas for restoration (low-risk area and free from conflicting issues, especially on land status) whereby all necessary measures have been taken. Using conventional and other sophisticated technology such as GIS and Satellite Images will be used for site identification (Zápotocký & Koren, 2022). Implement restoration programs such as planting activities, planting schedule, and monitoring activities. Furthermore, it takes into account the boundary demarcation, research activities, and evaluation program.

Overall, the tropical forest policy is necessary regarding the forest used and how the resources are maintained for the local communities. Several points concerning the sustainable tropical forest utilization and management which should be included are: (1) maintaining also enlarging the forest cover to secure a stable environment and provide a basis for economic and forest development; (2) sustain the well-managed representative of natural park management to set a standard to an acceptable level of biological and landscape diversity as well as preparation of management plan for another protected forest; (3) establishing a viable and multi-functional forest economy combining ecological conservation and economic resource, and to identify suitable areas for continual restoration.

In conclusion, the total economic valuation from several resources is highly indicated by natural forests that need to be preserved to avoid unnecessary costs and expenditures to maintain the damaged areas. The current trend of increasing the growth area before the damaged area indicates successful maintainability, even though the damage still occurs in several sites. The damages that are mainly caused by poverty and not strictly regulated policy need to be reformulated to find the best fit management in Bunaken National Park.

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REFERENCES

Ampou, E.E., Ouillon, S., Iovan, C. and Andréfouët, S. 2018. Change detection of Bunaken Island coral reefs using 15 years of very high-resolution satellite images: A kaleidoscope of habitat trajectories. Marine Pollution Bulletin 131(B): 83-95. https://doi.org/10.1016/j.marpolbul.2017.10.067

Aniyikaiye, T.E., Oluseyi, T., Odiyo, J.O. and Edokpayi, J.N. 2019. Physico-Chemical Analysis of Wastewater Discharge from Selected Paint Industries in Lagos, Nigeria. International Journal of Environmental Research and Public Health 16 (7): 1-17. https://doi.org/10.3390/ijerph16071235

Ario, D., Karuniasa, M., Patria, M.P. and Roeroe, K.A. 2021. Assessment of Bunaken Island for sustainable tourism destination using the rapid appraisal for fisheries. IOP Conferences Series: Earth and Environmental Science 716: 1-12. https://doi.org/10.1088/1755-1315/716/1/012094

Attamimi, N.R. and Saraswati, R. 2019a. Coral reefs degradation pattern and its exposure towards climate change in Bunaken National Park. International Journal of GEOMATE 17(60): 170-175. http://dx.doi.org/10.21660/2019.60.8342

Attamimi, N.R. and Saraswati, R. 2019b. Spatial analysis of coral reefs and its degradation patterns in Bunaken National Park. E3S Web of Conferences 76: 01001-01006. https://doi.org/10.1051/e3sconf/20197601001

Bayraktarov, E., Saunders, M.I., Abdullah, S., Milis, M., Beher, J., Possingham, H.P., Mumby, P.J. and Lovelock, C.E. 2016. The cost and feasibility of marine coastal restoration. Ecological Applications 26(4): 1055-1074. https://doi.org/10.1890/15-1077

Carlson, R.R., Foo, S.A. and Asner, G.P. 2019. Land Use Impacts on Coral Reef Health: A Ridge-to-Reef Perspective. Frontiers in Marine Science 6: 1-19. https://doi.org/10.3389/fmars.2019.00562

Chui, A.P.Y. and Ang, P.Jr. 2017. High tolerance to temperature and salinity change should enable scleractinian coral Platygyra acuta from marginal environments to persist under future climate change. PLoS One 12(6): e0179423. https://doi.org/10.1371/journal.pone.0179423

Coccossis, H. and Mexa, A. 2017. The challenge of tourism carrying capacity assessment: Theory and practice. Routledge, London.

Djamaluddin, R. 2019. Growth pattern in tropical mangrove trees of Bunaken National Park, North Sulawesi, Indonesia. Biodiversitas 20(6): 1713-1720. https://doi.org/10.13057/biodiv/d200630

Guan, Y., Hohn, S. and Merico, A. 2015. Suitable environmental ranges for potential coral reef habitats in the tropical ocean. PLoS One 10: e0128831. https://doi.org/10.1371/journal.pone.0128831

Hafeez, S., Wong, M.S., Abbas, S., Kwok, C.Y.T., Nichol, J., Lee, K.H., Tang, D. and Pun, L. 2018. Detection and Monitoring of Marine Pollution Using Remote Sensing Technologies. IntechOpen, London, UK. https://doi.org/10.5772/intechopen.81657

Haya, L.O.M.Y. and Fujii, M. 2020. Assessment of coral reef ecosystem status in the Pangkajene and Kepulauan Regency, Spermonde Archipelago, Indonesia, using the rapid appraisal for fisheries and the analytic hierarchy process. Marine Policy 118: 1-11. https://doi.org/10.1016/j.marpol.2020.104028

Jerath, M., Bhat, M., Rivera-Monroy, V.H., Castaneda-Moya, E., Simard, M. and Twilley, R.R. 2016. The role of economic, policy, and ecological factors in estimating the value of carbon stocks in Everglades mangrove forests, South Florida, USA. Environmental Science & Policy 66: 160-169. https://doi.org/10.1016/j.envsci.2016.09.005

Jeyacheya, J. and Hampton, M.P. 2016. Dive Tourism and the Entrepreneurial Process in the Perhentian Islands, Malaysia. In Sustainable Island Tourism: Competitiveness and Quality of Life. (eds Modica, P. and Uysal, M.), CABI, UK. p. 135-150.

Kalalo, F.P. 2017. Law enforcement and conservation at Bunaken National Park, North Sulawesi, Indonesia as perceived by the local coastal communities. AACL Bioflux 10(6): 1413-1420.

Kamagi, J.W., Schaduw, J.N. and Lasut, M.T. 2016. Management strategies for dive sites in Bunaken Island (North Sulawesi, Indonesia), based on stakeholder's perceptions. Aquatic Science & Management 4(2): 47-51. https://doi.org/10.35800/jasm.4.2.2016.14449

Kholil, N.S., Sukamdani, N. and Sulistyadi, Y. 2017. The best strategy for ensuring sustainability of Bunaken National Park, North Sulawesi Indonesia. Journal of Tourism and Hospitality Management 5(2): 78-85. http://dx.doi.org/10.17265/2328-2169/2017.04.004

Kusen, J.D. and Tioho, H. 2009. The present status of coral reef condition in Bunaken National Park and Manado Bay, North Sulawesi, Indonesia. Galaxea, Journal of Coral Reef Studies 11: 219-222. http://dx.doi.org/10.3755/galaxea.11.219

Laurans, Y., Pascal, N., Binet, T., Brander, L., Clua, E., Davis, G., Rojat, D. and Seidl, A. 2013. Economic valuation of ecosystem services from coral reefs in the South Pacific: Taking stock of recent experience. Journal of Environmental Management 116: 135-144. https://doi.org/10.1016/j.jenvman.2012.11.031

Lee, J. and Wong, D.W. 2001. Statistical analysis with ArcView GIS. John Wiley & Sons, New York.

Levers, C., Romero-Munoz, A., Baumann, M. and Kuemmerle, T. 2021. Agricultural expansion and the ecological marginalization of forest-dependent people. PNAS 118(44): 1-9. https://doi.org/10.1073/pnas.2100436118

Moharramnejad, N., Rahnamai, M.T. and Dorbeiki, M. 2017. Application of a'wot method in strategic management of sustainable tourism in a national park. Environmental Engineering and Management Journal 16(2): 471-480. http://dx.doi.org/10.30638/eemj.2017.047

North Sulawesi Regional Planning and Development Agency. 2019. Statistik Wilayah Sulawesi Utara, 2019. http://bappeda.sulutprov.go.id/.

Payandeh, P.E., Mehrdadi, N. and Dadgar, P. 2017. Study of Biological Methods in Landfill Leachate Treatment. Open Journal of Ecology 7 (9): 568-580. https://doi.org/10.4236/oje.2017.79038

Renggong, R., Hamid, A.H. and Yulia, Y. 2022. Investigating law enforcement for coral reef conservation of the Spermonde Archipelago, Indonesia. Asian Journal of Conservation Biology 11(1): 3–11. https://doi.org/10.53562/ajcb.61904

Reskiwati, R., Lalamentik, L.T.X. and Rembet, U.N.W.J. 2018. Study on the Taxonomy of Genus Favia (Oken, 1815) at the Reef Flats of Kampung Ambong Village in Likupang Timur District, Minahasa Utara. Jurnal Ilmiah Platax 6 (1): 188-193. https://doi.org/10.35800/jip.6.1.2018.19584

Rindengan, A.J., Pinontoan, B., Latumakulita, L.A., Mongi, C.E., Montolalu, C.E.J.C., Langi, Y.A.R. 2019. Coral reef's healthy level measurement system design using digital image processing on Bunaken National Sea Park. IOP Conference Series: Materials Science and Engineering 567(1): 1-8. http://dx.doi.org/10.1088/1757-899X/567/1/012004

Rompas, M.D., Kusen, J.D. and Lasut, M.T. 2015. Alternative strategy for management of ecotourism in Bunaken Island, Bunaken National Park, North Sulawesi, Indonesia. Aquatic Science & Management 3(2): 55-57. http://dx.doi.org/10.35800/jasm.3.2.2015.14048

Santoso, H., Muntasib, E.K.S.H., Kartodiharjo, H. and Soekmadi, R. 2015. Implementation of Nature Tourism Use Regulations in Order to Development of Tourism Governance in Bunaken National Park. Social Sciences & Psychology 4(3): 42-52. http://dx.doi.org/10.11648/j.ss.20150403.13

Stauvermann, P.J. and Kumar, R.R. 2017. Productivity growth and income in the tourism sector: Role of tourism demand and human capital investment. Tourism Management 61: 426-433. https://doi.org/10.1016/j.tourman.2017.03.006

Sterner, T. and Coria, J. 2013. Policy instruments for environmental and natural resource management. Routledge, London.

Tangian, D., Djokosetiyanto, D., Kholil, K. and Munandar, A. 2015. Model of Ecotourism Management in Small Islands of Bunaken National Park, North Sulawesi. Journal of Indonesian Tourism and Development Studies 3 (2): 75-80.

Tim Ormsby. 2004. Getting to know ArcGIS desktop: basics of ArcView, ArcEditor, and ArcInfo. ESRI Inc, California.

Towner, N. 2016. How to manage the perfect wave: Surfing tourism management in the Mentawai Islands, Indonesia. Ocean & Coastal Management 119: 217-226. http://dx.doi.org/10.1016/j.ocecoaman.2015.10.016

UNCED (United Nations Conference on Environment and Development). 1992. The Convention on Biological Diversity. Rio de Janeiro, Brazil.

Van Riper, C.J., Kyle, G.T., Sherrouse, B.C., Bagstad, K.J. and Sutton, S.G. 2017. Toward an integrated understanding of perceived biodiversity values and environmental conditions in a national park. Ecological Indicators 72: 278-287. https://doi.org/10.1016/j.ecolind.2016.07.029

Zápotocký, M. and Koren, M. 2022. Multipurpose GIS Portal for Forest Management, Research, and Education. ISPRS International Journal of Geo-Information 11(7): 1-15. https://doi.org/10.3390/ijgi11070405

Zhang, Y., Xu, J., Yao, Y., Yan, Z., Teng, M. and Wang, P. 2022. What Is the Relationship between Natural Protected Areas and Stakeholders? Based on Literature Analysis from 2000–2021. Forest 13: 1-20. https://doi.org/10.3390/f13050734

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