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Developing mangrove ecotourism in Nusa Penida Sacred Island, Bali, Indonesia

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Abstract
One of the famous tourism sites in Bali Province Indonesia is Nusa Penida Island. Located in the eastern part of the Bali, the small island is very famous tourist destination attracting more than two hundred thousand people per year. Nusa Penida, however, is not only designated as tourist destination but also designated as conservation buffer zone for the island of Bali. Therefore, balancing economic benefits of tourism and conservation function of the island is a challenging issue in the tourism management of the small island. This study attempts to address such an issue by analyzing the potential of mangrove forest in the island as sacred ecotourism destination. The tourist suitability index and carrying capacity of mangrove forest were carried to assess the potential development of the area and developing sustainable strategies for mangrove ecotourism management in Nusa Penida Sacred Island. By doing so, this study begins with determining carrying capacity of the mangrove ecotourism, as well as the ecological suitability of the mangrove ecosystem for tourism. In addition, SWOT analysis was conducted to analysis development strategies of the ecotourism in the area. The results showed that conformity index for tourism (CTI) is 74.36 percent, implying that the mangrove forest area in Nusa Penida Island is appropriate to be developed as an ecotourism site. The carrying capacity of the mangrove tour route is calculated at 360 tourist per day. Based on SWOT analysis, the average of total IFAS and EFAS analysis score is 2.89 and 3.09, respectively, with internal external matrix is witin the second quadrant of SWOT matrix. Several strategies recommendation are proposed. These include improving tourist infrasructure, stakeholder cooperation, improving tourist services, promoting nusa penida sacred ecotourism to public and tourists, supervising tourist activities, and carrying out conservation-based tourist activities.

Keywords Conformity index for tourism · Mangrove ecotourism · Sacred Island · SWOT analysis

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1 Introduction

Mangrove forests, especially those in the tropical countries, play an important role both in terms of ecological function they provided and source of livelihood for coastal communities whereby millions of people depend on them. In terms of ecological function and blue economy paradigm, mangrove forests provide coastal protection and enhance costal fisheries productivities, source of carbon sink, as well as nutrient cycle. As for their economic role, mangrove provide source of raw materials such as firewood, food, and construction materials (Richards & Friess, 2016, Cannicci et al., 2008). In addition, mangrove ecosystem also provides social and cultural values in the form of recreational uses (Giri et al., 2011).

Despite their critical role both ecologically and economically, mangroves forests, especially in Southeast Asia, have been experiencing extensive deforestation due to increase in demand for aquaculture and other land conversion for different purposes (FAO, 2007). Richards and Friess (2016) estimated that during period of 2000–2012, mangrove forests in Southeast Asia were lost at an average of 0.18% per year with aquaculture accounting for 30% of this total forest change. In response to such a problem, government in many developing countries has developed various measures to protect mangrove forests such as mangrove conservation, establishing marine protected areas, or designating mangrove forests as ecotourism areas. Such a measure has been implemented in Nusa Penida mangrove forest in Bali Indonesia.

Nusa Penida island in Bali Province has been designated as Marine Protected Area by local Klungkung regency in 2010 (Daulat et al. 2018). The measure was supported by the Ministry of Fisheries and Marine affairs as an effort to protect mangrove forest in the area from anthropogenic pressures and other source of mangrove degradation. Mangrove forest in this island is mostly concentrated in Jungutbatu Village of Nusa Penida islands covering an area of 194 hectares. The mangrove forest is known for its pristine environment and attract tourists to visit the area. Based on survey conducted by Tania (2011), the number of foreign tourists visiting Nusa Penida reached 200,000 people per year but decrease in 2018 to 133, 848 people per year (Sudipa et al., 2020). This provides an opportunity to develop and manage the mangrove area as ecotourism area, so that the conservation and economic purposes of the mangrove management could be achieved. Unfortunately, mangrove ecosystems in Nusa Penida have not been managed as tourist destinations, so that it is necessary to study the condition of various aspect related to suitability, carrying capacity, and priority strategy.

One of the challenging issues of managing mangrove ecotourism, however, is how to develop a comprehensive assessment strategy to develop mangrove as tourism destination. Up until now, such a management is lacking. The institutional arrangement of the ecotourism has not been developed yet. In addition, analysis of carrying capacity, which is essential for mangrove ecotourism, is not sufficiently available. The last study related to carrying capacity of this area was carried out using data from 2012–2013 (Bato et al., 2013). In 2020, there is only research on environmental management models which is available in this island without carrying capacity analysis and also not formulating a mangrove forest management strategy as a tourism destination (Sudipa et al., 2020).

Considering these issues, this study attempts to fill the gaps, by developing sustainable strategies for mangrove ecotourism management in Nusa Penida sacred island. By doing so, this study begins with determining carrying capacity of the mangrove ecotourism, as well as the ecological suitability of the mangrove ecosystem for tourism. The results of

the study could be used as policy guidelines for local government in managing ecotourism in sacred island of Nusa Penida Bali, as well as other similar ecotourism management elsewhere.

2 Literature review

Mangrove forest is a tropical beach vegetation community, dominated by several types of mangrove trees which are able to grow and develop in strong tides and/or muddy beaches (Bengen, 2002). Vegetation of mangrove forest and its existence is determined by the influence of land and sea. Therefore, mangrove ecosystem can be found in many shallow bay beaches, delta, and estuaries.

Mangrove forests have enormous potential to be developed as ecotourism sites. Definition of ecotourism was first introduced by Ceballos-Lascurain in the late 1980s. Ecotourism is used to describe trips to remote natural location for the purpose of enjoying and learning the nature and culture of local population. In 1996, Ceballos-Lascurain added the use environmentally friendly technology concepts in explaining ecotourism development.

There are numerous activities which can be developed in mangrove ecotourism area such as tracking, marine activities, bird watching, education, and research (Putra et al., 2015; Hu et al., 2020). Utilization of mangrove forest for recreation is a very rational new breakthrough needs to apply considering economic benefits which can be obtained without exploiting the mangrove itself and achieve SDG (Kusmana and Istomo, 1993; Lee et al., 2020).

Ecotourism is a tourist activity in an unspoiled area managed by natural rules, which aims to enjoy the beauty of scenery and promote some elements of education in order to understand and support the environmental conservation efforts and the involvement of local communities in the ecotourism destination areas for its management (Arida et al., 2014).

Thickness level of mangrove forest refers to the distance of the mangrove forest from its outer line or the area which directly surrounded by sea water to mainland or association area. Findings of a research show that mangrove forest with a thickness level of 200 m and a density of 30 trees per 100 m^2 with 15 cm trees diameter can reduce about 50% of tsunami wave energy (Dahuri et al., 1996). Density is the number of trees per unit area.

Studies on managing degradation of mangrove ecosystem by designating the mangrove forest as ecotourism sites have been found in many literatures. Swangjang and Kornpiphat (2021), for example, using SWOT and DPSIR (Drive Pressure State Impact and Response) found that ecotourism could be used as a vehicle for sustainable mangrove forest in Thailand. They also found that carrying capacity and stakeholder engagement are key factors in sustainable ecotourism management. In addition, their analysis of sustainable tourism also found that to be sustainable, ecotourism should economically be viable, environmentally appropriate, and take into account sociocultural considerations.

Environmental carrying capacity refers to the capacity or ability of an ecosystem to support healthy organism life while maintain productivity, adaptability, and ability to renew itself. According to Yulianda (2007), carrying capacity of an area is the maximum number of visitors which can be physically accommodated by the area provided at a certain time without causing disruption to both nature and humans.

The importance of carrying capacity as one of sustainability factors for ecotourism management can also be found in Liabastre and Rieder (2022). In their analysis of ecotourism of Coron and El Nido in the Philippine, they found that a key management tool

for sustainable tourism is the concept of carrying capacity. Similar to findings by Swangjang and Kornpiphat (2021), stakeholder engagement is also one of important variables to determine the number of carrying capacity for tourists in the ecotourism sites. They also emphasized that determining carrying capacity requires requires a combination of a science based assessment at specific sites, an understanding of the current impact on the biophysical environment.

The density of mangrove forest is one of indicators in assessing the quality of mangrove forest ecosystem itself. In addition, the density of mangrove forest is used as a parameter in determining whether or not a mangrove forest should be used as an ecotourism site (Yulianda, 2007). Ecotourism activities planning should be tailored to the potential of natural resources and their allocation. An ecological suitability index can identify whether the ecosystem is highly suitable (*S*1), appropriate (*S*2), conditional (*S*3), or inappropriate (*N*) to be a tourist attraction. There are five assessment parameters on the suitability of mangrove tourism (Yulianda, 2007). These parameters are (1) thickness level of mangrove; (2) types of mangrove; (3) mangrove density; (4) sea wave; and (5) biota.

Other factors that drive the ecotourism as sustainable solution to prevent mangrove degradation are the consideration of benefits derived from ecotourism. Friess (2017) noted that mangrove ecotourism has a number of potential benefits to local communities. These include direct financial benefits from ecotourism as well as livelihood diversification providing different employment opportunities. Mangrove ecotourism would also encourage the growth of local entrepreneurship and increase local skill and training due to demand from tourism activities. In addition to economic benefits, mangrove ecotourism would also promote local culture as well as empower marginalized section of the coastal communities.

In the development of an ecotourism site, support and participation from the local community are obviously needed. This idea is in line with the concept of tourism development where ecotourism development should rely on the development of local communities. A form of ecotourism management needs to consider is community-based natural resource management. In its implementation, the community is involved starts from planning to supervision stage (Tahir, 2002).

Managing mangrove ecotourism sustainably requires a comprehensive strategic assessment. There numerous approaches to address this issue. One of the most popular ones is to use qualitative method such as SWOT analysis combined with other methods. For example, Murtini et al. (2018) use SWOT analysis to develop ecotourism strategies in Wonorejo, Surabaya Indonesia. Their findings are in line with other studies that emphasize strong commitment from both the government and the communities to support sustainable tourism. According to Rangkuti (2006), a strategy is a comprehensive master planning which explains how to achieve the predetermined goals. Strategies are classified as activities to seek conformity between internal forces (strengths and weaknesses) and external forces (opportunities and threats). Although this method relatively simple, it can provide initial information regarding strategy that must be formulated in remote area.

3 Research methods

3.1 Research location and timetable

The research was conducted in Nusa Penida Island, Klungkung Regency, Bali (Fig. 1). The research object was 194 hectares of mangrove forest area. Meanwhile, the sampling

Fig. 1 Nusa Penida Island, Bali, Indonesia

method used was purposive sampling where participants were determined intentionally for a particular purpose local resident, village government staff and tourist who lived while the research was carried out. The study has been conducted for 12 months, starting from November 2017 to October 2018. The interview process was done at Nusa Penida Island. Deep interview used questioner for guiding the discussion.

3.2 Analysis of ecological suitability of mangrove forest

The analysis of ecological suitability of mangrove forest as an ecotourism site was conducted through examining some parameters such as thickness level of mangrove, mangrove density, types of mangrove, sea wave, and biota. The ecological suitability of mangrove forest as an ecotourism site was analyzed using matrix of conformity for mangrove tourism (Table 1).

The formula used to calculate the conformity index for tourism can be seen in the following part:

$$\mathrm{CIT} = \Sigma\left[\frac{N_i}{N_{\max}}\right] \times 100\%$$

where CIT is the conformity index for tourism; N_i is the value of ith parameter (weight × score); and $N_{\max}$ is the maximum value of a tour category (39)

Classification of conformity index for mangrove ecotourism:

$S1$ = highly suitable, with the value ranging from 83 to 100%

$S2$ = appropriate, with the value ranging from 50 to < 83%

$S3$ = conditional, with the value ranging from 17 to < 50%

N = inappropriate, with the value ranging from < 17%

3.3 Analysis of area carrying capacity (CC)

Using the concept of area carrying capacity, the maximum number of visitors that can be accommodated in an area at a certain time without harming the nature and humans is

Table 1 Matrix of conformity for mangrove tourism (CIT). Source: Manan and Haryanto (2018) and Yulianda (2007)

No	Parameter	Weight	Category *S*1	Score	Category *S*2	Score	Category *S*3	Score	Category *N*	Score
1	Thickness level of mangrove (m)	5	> 500	3	> 200–500	2	50–200	1	< 50	0
2	Types of mangrove	3	> 5	3	3–5	2	1–2	1	0	0
3	Mangrove density (100 m^2)	3	> 15–25	3	> 10–15	2	5–10	1	< 5	0
4	Sea wave (m)	1	0–1	3	> 1–2	2	> 2–5	1	> 5	0
5	Biota	1	Fish, shrimps, crabs, mollusk, reptile, birds	3	Fish, shrimps, crabs, mollusk	2	Fish, mollusk	1	One of water biota	0

shown in Table 2. Further, the analysis form of the CC calculation is as follows (Yulianda, 2007):

$$CC = K \times \frac{Lp}{Lt} \times \frac{Wt}{Wp}$$

where CC is the area carrying capacity (people per day); K is the ecological potential of visitors per area unit (people); Lp is the area (length and width) which can be utilized (m^2 or m); Lt is the area unit for certain category (m^2 or m); Wt is the time provided by the region for tourism activities in 1 day (hours); and Wp is the time spent by visitors for each particular activity (hours)

3.4 Analysis of development strategies for mangrove ecotourism

The technique used to create development strategy for mangrove ecotourism was SWOT analysis. This analysis is a systematic identification of strategic factors to formulate a strategy (Rangkuti, 2006). SWOT analysis is a strategic planning method used to evaluate strengths, weaknesses, opportunities, and threats in a speculation to determine strategies by identifying internal and external factors.

(a) Analysis of internal factors (strengths and weaknesses);
(b) Analysis of external factors (opportunities and threats);
(c) Internal external matrix; This matrix contains nine cell (quadrant) of strategies, where the nine cells are principally grouped into three main categories, namely: (a) growth strategy or growth of the activities or enterprises themselves (cells #1, #2, and #5) or diversification efforts (cells #7 and 8) and (b) stability strategy or a strategy which is implemented without changing the direction of the predetermined strategy (cells #4 and 5);
(d) Retrenchment strategy or a way to minimize and reduce the effort (cell #3, #6, and #9).

4 Findings and discussion

4.1 General condition of the researched area

Administratively, Nusa Penida district belong to Klungkung Regency, which has an area of 397 hectares. In terms of land use, 221.06 hectares are used for farms (55.68%), 155 hectares for community forest (39.04%), 15 hectares for home garden (3.78%), and 5.94 hectares for others (1.50%). Jungutbatu village is located 12 kms from the sub-district and 20 kms from the city. The village consists of 6 (six) hamlets, namely "Kaja I", "Kaja II", "Kelod I", "Kelod II", "Kangin I", and "Kangin II".

Table 2 Criteria of carrying capacity for mangrove exploration

No	Types of activities	K ($\sum$ visitors)	Area unit (Lt)	Time needed Wp (hours)	Total duration in a day Wt (hours)
1	Sailing	5	100 m	0.5	8

The topography of this island is a coastal area with an altitude of 0–54 m above sea level (MASL), has a climate type E (Schmidt-Ferguson) with very less rainfall (rainy season ranging from December to March), and has a temperature of 26–32° C. The land condition in Jungutbatu village is less fertile with Mediterranean brown (calcareous) soil type, and its dominant soil depth is less than 30 cm (Agriculture, Plantion and Forestry office of Klungkng Regency, 2018a, b).

The total population of Jungutbatu village in 2018 was 3997 people, consisting of 1983 males and 2014 female with sex ratio of 98.46. In an area of 3.970 Km^2, Jungutbatu village had a population density of 1006.80 inhabitants/Km^2, where most of its residents work as private employees (1425 people). The education level of the population in Jungutbatu village was as follows: 1549 people (38.75%) were elementary school graduates, 973 people (24.34%) were junior high school graduates, 781 people (19%) were drop outs, 54 people (1.35%) were undergraduates or diploma graduates, and 3 people (0.08%) were graduates (Governance, 2014).

4.2 Conformity of mangrove ecotourism (CIT)

Before developing mangrove area as a tourism site, potential resources and their allocation should be measured and identified in advance. The conformity index for tourism (CIT) is identifiable in the development of mangrove ecotourism, whether the mangrove ecosystem is highly suitable (*S*1), appropriate (*S*2), conditional (*S*3), or inappropriate (*N*). The assessment parameter of mangrove ecotourism conformity is determined from thickness level of mangrove, mangrove types, mangrove density per 100 m^2, sea wave, and biota (Yulianda, 2007). The conformity of mangrove ecotourism in Nusa Penida is presented in Table 3.

Based on Table 3, it can be explained that the thickness of mangrove in Nusa Penida Island has a value of 10 with an CIT value of 25.64%. The existing mangrove types has a value of 9 with CIT value of 23.08%, indicating that the mangroves have a rich diversity (Yulianda, 2007). Similarly, the mangrove density per 100 m^2 has a value of 6 with CIT value of 15.38%. The sea wave is very volatile with the value of 1 and CIT value of 2.56, and thus, it has the category of "conditional." Its biota has the category of "highly suitable" with value of 7.60% where biodiversity is extremely rich. After the analysis, CIT results obtained were 74.36%, indicating that the mangrove forest area in Nusa Penida Island is in the category of appropriate or *S*2 (50 - <80%). The effort for developing mangrove area to be sustainable tourism should optimize natural resources use and respect the sociocultural characteristics of local communities. This result was supported by research result that

Table 3 The assessment of mangrove ecotourism conformity in Jungutbatu village

No	Parameter	Total weight	Score	Category	Score	CIT (%)
1	Thickness level of mangrove (m)	5	2	*S*2	10	25.64
2	Types of mangrove	3	3	*S*1	9	23.08
3	Mangrove density (100 m^2)	3	2	*S*2	6	15.38
4	Sea wave (m)	1	1	*S*3	1	2.56
5	Biota	1	3	*S*1	3	7.69
TOTAL						74.36

stated some mangrove area suitable to be ecotourism destination (Chasanah et al., 2017; Hermon et al., 2018; Opa et al., 2021; Swangjang & Kornpiphat, 2021)

4.3 Area carrying capacity (CC)

The results of measurement and observation in the field found that the length of sailing path were 450 m. The time required for sailing with a boat with the capacity of 5 people and 1 sailor was 30 min. The time provided for mangrove exploration activities in a day is 8 h.

Based on the area carrying capacity (CC), the maximum people joining the sailing path which can be accommodated are 360 people per day approximately for 8 h higher than previous study which only reach 122 people per day (Bato et al., 2013). Recently, the number of tourist visits, an average of 50 people per day, mangrove activity in Nusa Penida Island, can still be improved. This number of person below the capacity of Lembar mangrove ecotourism in Lombok Island reached 2337 people per day (Sukuryadi et al., 2020). On the other side, the limited capacity of Nusa Penida is due to the topography and its sacredness. Unfortunately, in pick season, as of July–September, the number of visits increased sharply until 400 tourists per day. This condition should get serious attention by the mangrove tour managers. If the number of visits exceeds the maximum carrying capacity, activities should be arranged shifting each other or turned into another activities such as snorkeling or diving. These efforts should be done to avoid negative impacts on mangrove ecosystem in this island. Figure 2 shows natural tourism destination in Nusa Penida.

The carrying capacity arrangement was intended to maintain the authenticity and sacredness of Nusa Penida. Exceeding the carrying capacity tends to cause congestion which reduces the comfort of tourist. The most important in mangrove tourism development is facilities, activities, and wildlife. Therefore, the comfort factor should be maintained.

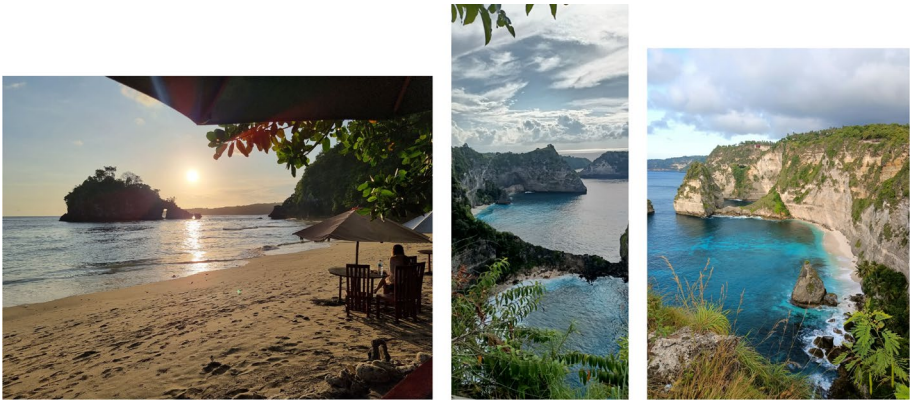

Fig. 2 The Sacred Natural Island Nusa Penida, Bali, Indonesia

4.4 The results of internal factor strategic analysis summary (IFAS) and external factor strategic analysis summary (EFAS)

The potential of the mangrove area in Nusa Penida Island has the opportunity to be developed as an ecotourism site, yet there are also various weaknesses or problems and threats in the implementation which need serious attention from the manager. The suitable strategy should develop based on existing condition involving elements of strengths, weaknesses, opportunities, and threats. In addition, the right strategy can avoid damage to natural and institutional resources.

The results of internal factor analysis summary (IFAS) consist of strengths and weaknesses of mangrove ecotourism development in Nusa Penida Island, where the highest strength factor gained by natural beauty, density, vegetation type, and biodiversity of mangrove forest with a score of 0.33. It shows that the panorama beauty of mangrove forest, its density, mangrove vegetation types, and existing biodiversity have dominant power in ecotourism development of mangrove ecotourism. It was also identified that the highest weakness factor is the inadequate supporting facilities and infrastructures for ecotourism activities with the score of 0.23. It indicates that among the existing weakness factors, supporting facilities and infrastructures are perceived to have the least disadvantage.

The results of external factor analysis summary (EFAS) which consist of opportunities and threat factors of mangrove ecotourism development discover that the highest probability factor is the opening of new job alternative to increase the income of local community and the festival of Nusa Penida with the score of 0.33. Tourism activities in Nusa Penida, especially in center of mangrove, Jungutbatu village, provide opportunities for new jobs and this condition has a positive impact the income of local community. The threat factor which gains the highest score is competition with other attractions with a score of 0.29. This finding showed that the existence of mangrove ecotourism potentially competes with other tourism objects in Bali.

Table 4 Internal external matrix

		TOTAL SCORE OF INTERNAL FACTORS		
	STRONG	AVERAGE	WEAK	
	4,0 – 3,0	2,0	1,0	
HIGH 3,0	I Growth Concentration through Vertical Integration	**II** **Growth** **Concentration through Horizontal Integration**	III Retrenchment Turn Around	
AVERAGE 2,0	IV Stability Carefulness	V Growth Concentration though Horizontal Integration Stability No Change of Strategic Profit	VI Retrenchment Captive Company or Divestment	
WEAK 1,0	VII Growth Concentric Diversification	VIII Growth Conglomerate Diversification	IX Retrenchment Bankrupt or Liquidation	

From the results of internal environmental factor analysis, it was found that the development of mangrove ecotourism is in the "average" position with an average score of 2.89. Meanwhile, the external factor analysis is in the "high" position with an average score of 3.09. The merger of these two analyses (IFAS and EFAS) results in the strategies shown in the IE Matrix (see Table 4).

Based on Table 4, the development of mangrove ecotourism is presented in cell II, namely growth (concentration through horizontal integration). This position illustrates that in order to develop mangrove ecotourism through exploring the opportunities and strengths, strategies need to be built are the following:

(a) Building cooperation with all stakeholders related to mangrove ecotourism development, including promotion, will involve local government of Klungkung regency, central government for improvement of human resource quality (e.g., education and training), and non-governmental organizations (NGOs) in the implementation and supervision of ecotourism activities and their promotion as a tourism area. This strategy supports previous study related to environmental management model in Nusa Penida that conducted by (Sudipa et al., 2020)
(b) Inviting investors to develop mangrove ecotourism especially to build its development facilities, to determine the pattern of ecotourism mangrove development including conducting study on environmental impacts of mangrove ecotourism development. However, upgrading environmentally infrastructure in coastal area in-line with mangrove restoration, these program-making coastal communities are more safe and suitable with IUCN (2017).
(c) Providing services to tourists in forms of facilities and infrastructures that supports the mangrove ecotourism: construct a walk board as a diversification of mangrove ecotourism, bird-watching towers, vehicle parking facilities, checkpoints, information post, and hygienic toilet facilities (Rusila et al., 1999).
(d) Designing plan and regulation of mangrove ecotourism management: arranging spatial plan of mangrove ecotourism management and making regulations about mangrove ecotourism management as well as stated that sustainable mangrove ecotourism should be based on local wisdom and designated by appropriate regulation and policies (Syaiful et al., 2016; Harto et al., 2021) and suitable with blue economy principle (Lee et al., 2020).
(e) Monitoring and carrying out conservation-based tourism activities: calculating the area carrying capacity, monitoring waste caused by tourism activities, imposing restrictions on tourist activities that could damage the mangrove ecosystem, rehabilitating degraded mangrove areas, and planting the mangrove areas that have less density.

5 Conclusions and recommendations

5.1 Conclusions

Developing mangrove forest as an ecotourism area could not only help to reduce degradation of forest ecosystem, but also could improve social and economic condition for the communities through the improvement in income and improvement of general well-being from ecosystem services derived from mangrove forest. This study shows that development

of ecotourism in Nusa Penida is feasible shown by the suitability index and carrying capacity of the forest area to accommodate more than 360 people per day.

To achieve sustainable ecotourism strategies of Nusa Penida Island, stakeholder engagement is factor that need to be strengthen along with continuing promotion of the ecotourism and inviting investors (Friess, 2017). In addition, the type of tourist services in terms of both variation of services and quality of services, as well as public infrastructure that support ecotourism in the area need to be improved. The results of this study also indicate that creating better design plan and regulation of mangrove ecotourism management and improvement in monitoring the tourist activities and implementing conservation-based tourist activities are factors that need to be considered for sustainable ecotourism in the area.

This study also demonstrates a novel research approach that combine quantitative and qualitative method in assessing mangrove forest development. However, the qualitative method used needs to be developed in order to determine the priority strategy.

5.2 Recommendations

Mangrove ecotourism is derived its benefit from the continuing services from nature. Therefore, it is recommended that assessment of potential fauna that attract more tourists in the area is needed. It is also important to consider that human resources are paramount factors for sustainable ecotourism. Therefore, investment in human resources to support ecotourism and to improve social-economic condition in other tourism related sectors is highly recommended.

References

Agriculture, Plantation, and Forestry Office of Klungkung Regency. (2018a). Forest Data of Klungkung Regency. Klungkung City. Bali

Agriculture, Plantation, and Forestry Office of Klungkung Regency. (2018b). Masterplan Planting Activities in Community Seed Farming. Klungkung City. Bali

Arida, I., Nyoman, S., Baiquni, M., Damanik, J., & Shri Ahimsa-Putra, H. (2014). Dinamika ekowisata tri ning tri dibali probematika dan strategi pengembangan tiga tipe ekowisata di bali. *Kawistara*, *4*(2), 111–128. https://doi.org/10.22146/kawistara.5666

Bato, M., & Yulianda Pengelolaan Pesisir Lautan Dramaga, F. A. F. S. S. D. (2013). Kajian manfaat kawasan konservasi perairan bagi pengembangan ekowisata bahari: Studi kasus di kawasan konservasi perairan Nusa Penida, Bali The study of benefit of marine protected areas for the development of marine ecotourism: A case study in themarine. *Agustus, 2*(2), 104–113.

Bengen, D. G. (2002). Ecosystem and Coastal Resource. Synopsis. Centre of Marine and Coastal Research. Institut Pertanian Bogor. Bogor

Cannicci, S., Burrows, D., Fratini, S., Smith, T. J., Offenberg, J., & Dahdouh-Guebas, F. (2008). Faunal impact on vegetation structure and ecosystem function in mangrove forests: A review. *Aquatic Botany, 89*, 186–200.

Chasanah, I., Purnomo, P. W., & Haeruddin, H. (2017). Analisis Kesesuaian Wisata Pantai Jodo Desa Sidorejo Kecamatan Gringsing Kabupaten Batang. *Jurnal Pengelolaan Sumberdaya Alam Dan Lingkungan (Journal of Natural Resources and Environmental Management), 7*(3), 235–243. https://doi.org/10.29244/jpsl.7.3.235-243

Dahuri, R., J. Rais, S.P. Ginting & Sitepu, M. J. (1996). Intergated management of coastal and marine. PT. Pradnya Paramita. Jakarta

Daulat, A., Pranowo, W. S., & Amri, S. N. (2018). Mangrove forest change in nusa penida marine protected area,bali - Indonesia using landsat satellite imagery. *International Journal of Remote Sensing and Earth Sciences (IJReSES)*, *15*(2), 141. https://doi.org/10.30536/j.ijreses.2018.v15.a2955

Desa, J. (2014). *Rencana pembangunan jangka menengah desa jungutbatu*. Nusa Penida, Klungkung Bali.
FAO. (2007). The World's Mangroves 1980–2005. Forest resources assessment working paper No. 153. Rome: Food and Agriculture Organization of The United Nations
Friess, D. (2017). Ecotourism as a tool for mangrove conservation. *Sumatra Journal of Disaster, Geography and Geography Education* ISSN: 2580–4030 (Print) 2580–1775 (Online) Vol 1, No. 1, (pp. 24–35), June, 2017 http://sjdgge.pp
Giri, C., Ochieng, E., Tieszen, L. L., Zhu, Z., Singh, A., Loveland, T., Masek, J., & Duke, N. (2011). Status and distribution of mangrove forests of the world using earth observation satellite data. *Global Ecology and Biogeography, 20*, 154–159.
Governance of Jungutbatu Villange. (2014). Middle Term Development Plan of Jungutbatu Village. 2014–2020. Village Government of Jungutbatu
Harto, S., Sidiq, R. S. S., & Karneli, O. (2021). Development strategy mangrove ecotourism based on local wisdom. *Sosiohumaniora, 23*(1), 115–123.
Hermon, D., Ganefri, P. A., & Oktorie, O. (2018). The model of mangrove land cover change for the estimation of blue carbon stock change in Belitung Island-Indonesia. *International Journal of Applied Environmental Sciences, 13*(2), 191–202.
Hu, W., et al. (2020). Mapping the potential of mangrove forest restoration based on species distribution models: A case study in China. *Science of The Total Environment, 748*, 142321. https://doi.org/10.1016/j.scitotenv.2020.142321
IUCN. (2017). Can restoring mangrove can achieve sustainabe development goals? https://www.iucn.org/news/forests/201703/can-restoring-mangroves-help-achieve-sustainable-development-goals
Kusmana, C. & Istomo. (1993). Guidance for Mangrove ecotourism management for recreation. Article on National Seminar in Coastal Management for Ecotourism. Bogor Agriculture Institute. Bogor
Lee, K. H., Noh, J., & Khim, J. S. (2020). The blue economy and the United Nations' sustainable development goals: Challenges and opportunities. *Environment International, 137*, 105528. https://doi.org/10.1016/j.envint.2020.105528
Liabastre, T., & L. Reider. (2022). Carrying Capacity Assessment for Tourism in Coron and El Nido: A Step toward Sustainable Management of Marine Ecosystems. ADB Brief No 212 Asian Development Bank Manila The PhilippinePons, LJ and Fisilier, JL. Sustainable Development of Mangrove. Landscape and Urban Planing. 20 (1–3):103–109. https://doi.org/10.1016/0169-2046(91)90098-7
Manan, A., & Haryanto, R. (2018). Conformity analysis of commercial space utilization as the tourism-supporting activities: A case study at Sosrowijayan Yogyakarta. *International Journal of Scientific and Research Publications (IJSRP), 8*(8), 303–313. https://doi.org/10.29322/ijsrp.8.8.2018.p8036
Murtini, S., Astina, I. K., & Utomo, D. H. (2018). SWOT analysis for the development strategy of mangrove ecotourism in Wonorejo Indonesia. *Mediterranean Journal of Social Science, 9*(5), 129–138.
Opa, E. T., Kepel, R. C., Lasabuda, R., Kusen, J. D., Paruntu, C. P., Djamaluddin, R., Boneka, F. B., & Mantiri, D. M. H. (2021). Ecological suitability of mangrove tourism in Mantehage island as the outermost small island in north Sulawesi Indonesia. *AACL Bioflux, 14*(1), 120–129.
Putra, A. C., Anggoro, S. and Kismartini. (2015). Ecotourism development plan based on mangrove ecosystem analysisi in Pramuka Island, Seribu Archipelago. *Jurnal Saintek Perikanan (Indonesian Journal of Fisheries Science and Technology),* https://ejournal.undip.ac.id/index.php/saintek/index 10 (2), pp. 91–97
Rangkuti. F. (2006). Analisis SWOT. Bisnis Case Study Techniqe. PT Gramedia Pustaka Utama. Jakarta
Richards, D.R., & D.A Friess. (2016). Rates and Drivers of Mangrove deforestation in Southeast Asia 2000–2012. PNAS 113(2).344–349. www.pnas.org/cgi/doi/https://doi.org/10.1073/pnas.1510272113
Rusila, N. Y., Khazali, M. and Suryadiputra, I N. N. (1999). Guidance for Learning of mangrove in Indonesi. PHKA/WI-IP. Bogor
Sudipa, N., Sudiana Mahendra, M., Sandi Adnyana, W., & Pujaastawa, I. B. (2020). Model Pengelolaan Lingkungan Di Kawasan Pariwisata Nusa Penida Bali. *ECOTROPHIC : Jurnal Ilmu Lingkungan (Journal of Environmental Science), 14*(1), 1. https://doi.org/10.24843/ejes.2020.v14.i01.p01
Sukuryadi, Harahab, N., Primyastanto, M., & Semedi, B. (2020). Analysis of suitability and carrying capacity of mangrove ecosystem for ecotourism in Lembar Village, West Lombok District, Indonesia. *Biodiversitas*, *21*(2):596–604. https://doi.org/10.13057/biodiv/d210222
Swangjang, K., & Kornpiphat, P. (2021). Does ecotourism in a mangrove area at Klong Kone, Thailand, conform to sustainable tourism? A case study using SWOT and DPSIR. *Environment, Development and Sustainability, 23*, 15960–15985. https://doi.org/10.1007/s10668-021-01313-3
Syaiful, E, et al. (2016). Community-based mangrove forest conservation for sustainable fisheries. *Jurnal Silvikultur Tropika*, Volume 07. No 3. Suplemen December 2016, Page S42-S47. ISSN: 2086–8227

Tahir, A., & Baharudin. (2002). Conservation management area. In M. A. Darmawan (Ed.), *Integrated Management for Coastal and Small Island.* Faculty of Fisheries and Ocean Science. Bogor Agriculture Institute. Bogor: Workshop Modul for Planner and Decision Maker Faculty.

Tania, W. & Muljadi. (2011). Willingness to Pay Kawasan Konservasi Perairan Nusa Penida, Klungkung Regency, Bali. *Coral Triangle Centre (CTC),* Bali

WWF. (2017). Mangrove ecotourism helping to reduce the risk of natural disaster in Vietnam Delta. https://wwf.panda.org/?291130/World-Wetlands-Day-Mangrove-Ecotourism-Protects-Vulnerable-Vietnam-Delta. Posted on 31 Januari 2017

Yulianda, F. (2007). Coastal ecosystem as alternatif for managing marine resources. Presented at Seminar Sains on 21th February 2007. Bogor: Departement of Marine Resources Faculty of Marine and Ocean Science. Bogor Agriculture Institute. Bogor