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ANALYSIS OF BLUE ECONOMY STRATEGY IN MAINTAINING CORAL REEF BALANCE: A CASE STUDY IN AMED WATERS, BALI

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ABSTRACT

Amed Waters, Bali, is one area that utilizes coral reefs in economic development. However, climate change, human activities and other factors have threatened the condition of coral reefs in Amed Waters. This study aims to determine the condition and social and economic potential of coral reefs and examine the appropriate blue economy strategy in maintaining the balance of coral reefs in Amed Waters, Bali. This research was conducted in September-November 2024. This research used direct field data collection methods such as Underwater Photo Transect (UPT), interviews and the Analytical Hierarchy Process (AHP). Based on the percentage of coral cover and the interviews' results, the results showed that coral reefs in Amed Waters can be classified as poorly damaged, so conservation efforts and sustainable management are needed to maintain the balance of coral reefs. Coral reefs have social and economic potential in the fisheries sector, with a fishing group of 19 people and marine tourism in the form of diving and snorkelling. The main focus of community economic development is the tourism sector. The blue economy strategy that can be applied in the conservation of coral reefs in Amed Waters, Bali, focuses on environmental aspects of coral reef health, economic aspects of increasing community income, and social aspects of community participation.

Keywords: Coral Reefs, Amed Waters, Blue Economy Strategy

1. INTRODUCTION

With its vast coastline and abundant marine wealth, Indonesia has great potential to develop a marine-based or blue economy. The concept of a blue economy, which emphasizes the sustainable use of marine resources, is important to maintain the balance of marine ecosystems and improve the community's welfare. However, the coral reefs in Indonesia face various threats, such as physical damage due to mining, destructive fishing, and coastal infrastructure development. Pollution from domestic, industrial and agricultural waste entering the sea seriously threatens coral reefs. In addition, climate change is having a negative impact in the form of increasing seawater temperatures, ocean acidification, and rising sea levels. These conditions threaten the sustainability of coral reefs and negatively impact biodiversity, tourism and the jobs and livelihoods of coastal communities[1].

The waters of Amed, Bali, are one of Indonesia's areas with high coral reef potential. Amed waters have long been known as a popular tourism destination, especially for divers interested in exploring underwater beauty. This can be seen in the number of tourists, which increased from 157,150 in 2003 to 423,740 in 2014[2].

Blue economy, as initiated by Gunter Pauli, is an economic model approach that can boost the development of community welfare through sustainable aspects[3]. In realizing the blue economy, there needs to be an application that is taken by protecting and preserving. The blue economy strategy in the context of coral reef management emphasizes an integrative approach that

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involves various stakeholders such as the government, community and private sector. Blue economy strategies to maintain the balance of coral reefs can include conservation and fishing restrictions[4].

In addition, coral reef-based economic development through increasing economic value can be achieved by developing sustainable economic activities such as ecotourism, mariculture, and environmentally friendly capture fisheries. Increasing the community's active role in coral reef management and the blue economy can be done through educational programs, empowerment and development of coral reef-based businesses initiated by the government[5].

2. RESEARCH METHOD

Time and Place

This research was conducted in September - November 2024 in Amed Waters, Abang District, Karangasem Regency, Bali Province.

Method

The research method used is the survey method or direct field data collection. This method is a systematic method for collecting information needed in the field of research. This research starts from the location determination stage, the field data collection stage, and then the data analysis stage using CPCe software and secondary data. The final stage is formulating a blue economy strategy using the analytical hierarchy process (AHP) method.

Procedures

Determination of Research Stations

The research site is in Amed Waters, Abang District, Karangasem Regency, Bali Province. This study used the Underwater Photo Transect (UPT) method with three stations to collect measurements and data. Station positions were determined using GPS (Global Positioning System), while interviews were conducted with local communities and fishing groups in the Amed Waters. Station I is located at 8^{o}20'16.02 "N and 115^{o}39'36.91 "E, where tourists start diving activities. Station II 8$^{(o)}$20'15.22 "N and 115^{o}39'41.77 "E, which is where fishermen catch fish and station III 8^{o}20'10.83 "N and 115^{o}39'34.12 "E, which is a residential area. Thus, data collection in this study was carried out using a purposive sampling method.

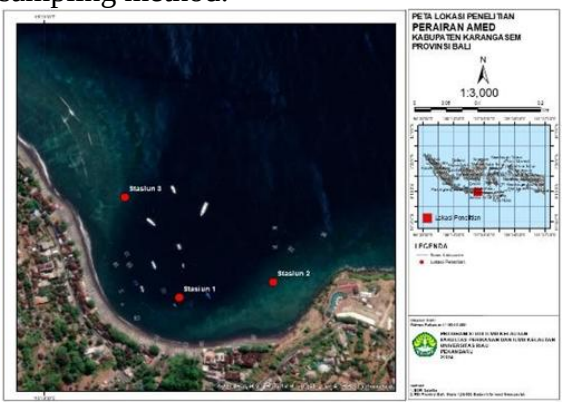

Figure 1. Research location

Percentage of Coral Reef Cover and Coral Growth Forms

Each station has 2 (two) depths, namely 3 m and 10 m. Data was collected using transects drawn as far as 50 m at each depth. The withdrawal of the transect line is parallel to the shoreline. Shooting starts from the 1st meter to the 50th meter. Shooting at the 1st, 3rd, 5th and subsequent meters with odd numbers was carried out to the left of the transect line, while even numbers such as at the 2nd, 4th, 6th and so on were taken to the right of the transect line.

The percentage categories of live coral cover are based on the Minister of Environment Decree No. 4 Year 2001, presented in Table 1.

Table 1. Coral reef categories

Coral Reef Category		Percentage (%)
Broken	Bad	0 - 24,9
	Medium	25 - 49,9
Good	Good	50 - 74,9
	Excellent	75 - 100

Area Supportability

Data regarding the area's carrying capacity was collected through surveys and secondary data related to this research. This secondary data was obtained through the Karangasem Regency website. The carrying capacity is calculated to know the maximum number of tourists that can be physically accommodated in the available area at a certain time without causing disturbances to nature and humans. Data on the carrying capacity of the area is obtained by calculating the ecological potential of visitors per unit area (K), the area or length of the area that can be utilized (Lp), the unit area for certain categories (Lt), the time provided by the area for tourist activities (Wt) and the time spent by tourists for each tourist activity (Wp). According to Panigoro et al.[6], the calculation of the carrying capacity of this area can be done with the following formula:

$$DDK=K \text{ X } \frac{Lp}{Lt} \text{ X } \frac{Wt}{Wp}$$

Assessment of the Social and Economic Potential of Coral Reefs

This study aimed to evaluate the socio-economic potential coral reefs provide to local communities in Amed Waters. In addition, the research also aimed to understand community attitudes towards coral reef protection and the impact of damage to the community. The number of respondents in this interview was 15 people. During the interview process, it was necessary to identify key participants with in-depth knowledge of the benefits of coral reefs to the community and those who use coral reefs. The data obtained from the interviews will be used to formulate conclusions and policy recommendations that the local government can adopt.

Data analysis

The data that has been obtained in the form of coral reef conditions described through data on the percentage of live coral cover, percentage of dead coral cover, percentage of biotic and abiotic coral growth forms, as well as the results of the study of the social and economic potential of coral reefs are put together and analyzed using the Analytical Hierarchy Process (AHP) method to formulate blue economy strategies to produce sustainability efforts in maintaining coral reefs in Amed Waters, Bali.

Blue Economy Strategy for Coral Reef Balance in Amed Waters, Bali

The use of the Analytical Hierarchy Process (AHP) method in analyzing blue economy strategies to maintain the balance of coral reefs in the waters of Amed, Bali, is a structured and measurable step. AHP is designed to rationally capture the perceptions and preferences of various factors related to blue economy strategies in the context of coral reef preservation. By decomposing these complex issues into a hierarchy, AHP helps to simplify the critical aspects that must be considered.

The first thing to do in the AHP method is to map the main objectives, such as coral reef preservation and blue economy sustainability. Furthermore, the determinants of the blue economy strategy include the type of sustainable economic activities, the impact on the environment, and economic benefits. The sustainability of the blue economy will integrate the triple bottom line of sustainability development, which includes environmental, social, and governance (ESG). Next in the AHP method is the assessment of criteria and alternatives, which is carried out by making pairwise comparisons for various problems by creating a scale.

Then, the priority for each criterion and alternative done in a pairwise comparison is determined according to Table 2. Weights and priorities will be calculated using matrix or equation solving. The matrix calculation begins with consistency (grouping similar objects with uniformity and relevance, as well as the level of relationship between objects based on specific criteria). In decision-making, knowing how good the consistency is is important to produce the right decision. This

AHP method requires the value of (eigenvalue), n (number of matrices), CI (Consistency Index), CR (Consistency Ratio), and IR (Index Random Consistency). The list of IR (Index Random Consistency) can be seen in Table 3.

Table 2. AHP method criteria scale

Intensity	Description
1	Both elements are equally important
3	One element is less important than the other.
5	One element is more important than the other.
7	One element is more absolute than the other.
9	One element is more important than the other.
2, 4, 6, 8	Values between two adjacent considerations.

Calculation of Consistency Index (CI) and Consistency Ratio with the formula:

$$CI = \frac{\lambda - n}{n - 1} \qquad CR = \frac{CI}{IR}$$

Table 3. List of IR (Index Random Consistency)

Matrix Size	IR Value
1	0,00
2	0,00
3	0,58
4	0,90
5	1,12
6	1,24
7	1,32
8	1,41
9	1,45
10	1,49

Thus, the data generated from the AHP analysis of coral reef blue economy strategies in Amed Waters, Bali, can be a strong foundation for formulating practical strategic steps in coral reef conservation efforts that are important for the socio-economic sector of the community. The resulting efforts are expected to be more efficient and positively impact the sustainability of coral reefs in Amed Waters, Bali.

3. RESULT AND DISCUSSION

Coral Reef Condition

The percentage value of coral reef cover in Amed Waters, Bali, is presented in Table 4. If the percentage of live coral cover is seen based on the research station, then the highest rate is found at station III at 10 m depth. The lowest rate of live coral cover is found at station I at a depth of 3 m. Each station with a depth of 10 m has a higher percentage of live coral cover than 3 m depth. The condition of coral reefs in Amed Waters, Bali, at stations I, II and III at a depth of 3 m is included in the category of poor damage and station III at a depth of 10 m is included in the category of moderate damage.

In addition to live corals, there is also a value of dead coral cover dominated by Dead Coral Algae (DCA). The highest percentage of DCA is found at station III at 10 m depth. The highest rate of sand substrate is found at station I, 3 m depth of 63.61% and rubble at station I, 10 m depth of 48.20%. Station II, at a depth of 10 m, has a higher percentage of other biota than other stations, which is 3.15%. The results also show other values obtained, such as soft coral, sponge, fleshy seaweed, silt, rock and tape, wand, and shadow.

Based on the results showed that the percentage of live coral cover in Amed Waters, Bali, for each depth of each station in order, namely station I (7.84% and 10.43%), station II (7.13% and 18.42%) and station III (13.49% and 39.05%). The criteria for determining the condition of coral reefs were determined by the Minister of Environment Decree No. 4 of 2001 based on the percentage of coral cover. The condition of coral reefs in Amed Waters, Bali, at stations I, II and III at a depth of 3 m is included in the category of poor damage and

station III at a depth of 10 m is included in the category of moderate damage. The highest percentage of live coral cover is found at station III at 10 m depth. This can occur because station III is representative of a residential area, so it is thought that there is very little activity around the area. Human activity can be a significant factor in damage to coral reefs[7].

Table 4. Percentage of coral cover of Amed Waters, Bali, in 2024

	Station	I		II		III	
	Depth (m)	3	10	3	10	3	10
Percentage (%)	Coral	7,84	10,43	7,13	18,42	13,49	39,05
	Recent Dead Coral	0,47	0,87	0,07	2,08	-	0,67
	Dead Coral with Algae	12,87	7,22	12,13	7,30	9,22	17,82
	Soft Coral	0,13	0,07	-	0,13	-	1,07
	Sponge	8,51	8,82	5,20	5,69	8,75	7,34
	Fleshy Seaweed	4,29	0,40	5,47	13,66	0,40	1,13
	Other Biota	1,74	0,07	2,00	3,15	0,47	0,60
	Rubble	0,54	48,20	39,33	39,52	43,35	16,49
	Sand	63,61	23,93	28,67	10,05	24,32	15,82
	Silt	-	-	-	-	-	-
	Rock	-	-	-	-	-	-
	Tape, Wand, Shadow	0,40	0,27	-	0,47	0,20	0,13

A depth of 10 m also has a high percentage value at each station. This can occur because the water temperature at a depth of 10 m tends to be more stable and does not need to be influenced by temperature changes at the water's surface. This provides better conditions for live corals[8], and shallower depths can be less ideal for coral growth due to greater waves and sedimentation[9]. Thus, the coral reefs in Amed Waters, Bali, are in poor conditions, so rehabilitation efforts are needed to return to produce coral reefs that are classified as good.

An increase in sea surface temperature can cause bleaching of corals. The decrease in the percentage of coral cover is also thought to be due to increased human activities, such as diving activities that support the tourism sector in these waters. Isdianto et al.[10] said that human activities such as environmentally unfriendly fishing, physical damage caused by tourists and increased pollution can damage coral reefs.

The research of Widiastuti et al.[11] also explained that there are ship transportation activities in Amed Waters, Bali, both landing and anchoring. Anchor-throwing activities carried out accidentally can hit coral reefs, so it is suspected that it can also trigger damage that occurs over time. This is also supported by not all waters having mooring buoys (facilities to tie ships as a substitute for anchors).

Based on the results of the study, coral growth forms found in Amed Waters, Bali, include Acropora species (branching, digitating, encrusting, sub-massive, and tabulate) and non- Acropora species (Coral branching, Coral encrusting, Coral foliose, Coral massive, Coral mushroom, and Coral sub-massive). From the three stations of live coral cover, the percentage of this coral growth form can be seen in Table 5. Coral growth forms at each station's depth found Coral with branching, encrusting, massive, and sub-massive types. The highest coral growth form is found at station III at a depth of 10 m, where sub-massive coral dominates.

Table 5. Percentage of coral growth from Amed waters, Bali, in 2024

Percentage (%)	St. I (3m)	St. I (10 m)	St. II (3 m)	St. II (10 m)	St. III (3 m)	St. III (10 m)
Acropora branching	0,07	0,13	-	4,09	0,07	-
Acropora digitate	1,07	-	-	1,34	-	-
Acropora encrusting	0,20	-	-	0,20	-	-
Acropora sub-massive	0,34	-	-	0,54	-	-
Acropora tabulate	-	-	-	4,96	-	-
Coral branching	0,20	0,33	-	2,55	0,94	3,20
Coral encrusting	1,01	4,75	0,13	0,33	6,75	15,55
Coral foliose	-	-	-	0,20	0,60	0,47
Coral heliopore	-	-	-	-	-	-
Coral massive	2,41	2,27	3,60	1,34	2,07	3,14
Coral millepore	-	-	-	-	-	-
Coral mushroom	-	1,87	0,07	0,27	0,67	-
Coral sub-massive	2,55	1,07	3,33	2,61	2,40	16,69
Coral tubipora	-	-	-	-	-	-

Coral growth forms found at each station's depth are Coral branching, Coral encrusting, Coral Massive and Coral sub-massive, as shown in Table 5. These four types of corals indicate a relatively high diversity of coral species in Amed waters. However, the distribution and abundance of each coral species that varies at each station and depth can allegedly occur due to influencing factors. Environmental factors include depth, light intensity, substrate, and current[12].

Area Supportability

The environment generally accommodates human resources based on its natural conditions. This is because nature has a limited capacity for tourists or others. The calculation of the carrying capacity of the area is critical in knowing the limits of nature in accommodating tourists. Amed waters are used as tourist areas for snorkelling and diving, so these activities can threaten Amed waters if they can no longer tolerate the pressure exerted by the number of tourists visiting. The results of the calculation of the area's carrying capacity for Amed waters can be seen in Table 6.

Resource conditions and the type of activities developed can determine the ecological potential of visitors. The area that visitors can use is adjusted to nature. Visitor activity time (Wp) is calculated based on how long visitors spend on tours to carry out their travel activities. The time provided for the area (Wt) is the total time the area is open in one day, with an average of 6 hours of working time (09.00 - 15.00), as seen in Table 7.

Table 6. Potential visitors and activity area

Activity Type	K	Lp	Lt	Description
Dive tourism (snorkelling and diving)	1 person	2.350 m^2	250 m^2	1 person within 250 m^2

Table 7. Time required during the activity

Activities	Wp	Wt
Diving (snorkelling and diving)	3 hours	6 hours

Table 8. Carrying capacity of Amed waters, Bali, in 2024

No.	Parameters	Results
1	Amed water area (Lp)	2.350 m^2
2	Unit area for tourism activities (Lt)	250 m^2
3	Time spent on tourism activities (WT)	3 hours
4	Time spent by visitors in the activity (Wp)	6 hours
5	Ecological potential of visitors (K)	1 person
6	Area carrying capacity (DDK)	19 people/day

Based on the calculation results, Area Support Capacity (DDK) Amed waters with an area of 2,350 m^2 can support tourism activities in the area. Thus, the number of visitors that can be received reaches 19 people/day or is equivalent to 5,700 people/year (calculated 300 days).

The carrying capacity of the tourist area in Amed waters, Bali, with 19 visitors/day and an area of 2,350m^2, must be studied further to ensure environmental sustainability and visitor satisfaction. The data indicates a relatively low visitor density. However, the analysis of the area's carrying capacity does not only depend on visitor density alone but also considers several aspects, especially ecological, social and economic aspects.

According to Nugraha et al.[13], attention is needed regarding the carrying capacity of the marine environment for water tourism activities in the form of snorkelling or diving and its impact on aquatic ecosystems such as coral reefs, marine biota, and water quality. Sustainable management requires determining the area's carrying capacity as a consideration for the implementation of activities[14]. This aims to prevent environmental degradation and ensure sustainability in the tourism sector in Amed waters.

Social and Economic Potential of Coral Reefs

Interviews were conducted with three groups of 15 respondents: local communities, fishermen groups, and tourism businesses. The target of the local community was the traders. The local community interviewed consisted of several aspects of work, namely peddlers and restaurant owners. The target tourism businesses are those that play a role in offering a variety of diving experiences, including dive equipment rentals, dive training courses, rescue tours and other similar things. The target of the fishermen group itself is the fishermen group in Amed Waters, Bali. There is one fishing group in the research location with 19 members. The head of the fishermen's group is Mr. I Gede Sudirga, who works as a fisherman and owns a seafood restaurant on the coast of Amed waters, Bali.

The data presented in this sentiment analysis includes the role of coral reefs, changes in the current condition of coral reefs and the influence of changes that occur for the economic sector, as well as other livelihoods besides the current one as a response and form of preparation for the condition of coral reefs that are damaged. In addition, factors that can damage coral reefs, both natural events and human activities, were obtained. Respondents also explained how the current impact of coral reef damage they feel and its influence on the work they are currently engaged in. The results of the interviews can be seen in Figures 2 - 6.

The interview results represent the influence of coral reefs on the community, including the social and economic sectors of the local community. Based on the results obtained, most respondents complained about the condition of the increasingly damaged coral reefs. This is because most respondents, especially fishermen and tourism businesses, depend on the benefits of coral reefs.

Based on the results of interviews, the role of coral reefs is categorized as a home for fish habitat/marine life, tourism assets,

and coastal protection, and some do not know the role of coral reefs. One of the interview questions asked whether there were changes in the condition of coral reefs over time. The interviews showed that 93% of respondents stated there were changes in the coral reefs.

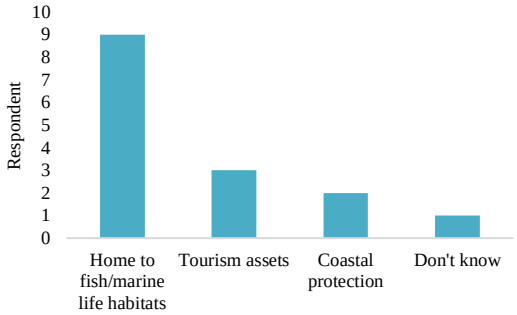

Figure 2. Role of coral reefs in Amed waters in 2024

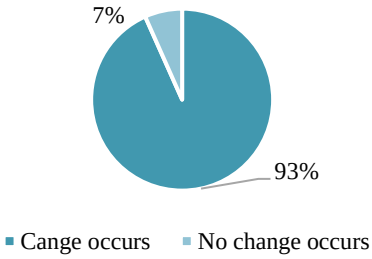

Figure 3. Changes in coral reef condition in Amed waters in 2024

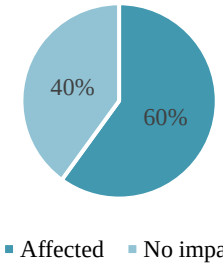

Figure 4. Influence of changes in coral reef conditions on the economy of local communities in Amed waters in 2024

60% of respondents stated that changes in the condition of coral reefs in Amed waters affected the economic sector. The respondents noted that the changes that occurred resulted in a change in the amount of fish income, so it was thought that the selling price of fish could also be high due to the lack of fish income. In addition, there has also been a decrease in underwater beauty in the tourism sector.

Respondents who stated that there was no effect emphasized that whether or not coral conditions were damaged, they could still run the economy by finding other alternatives. Restaurant owners can change the raw materials from fish to other dishes, and respondents from local community groups stated that there was no connection between their work and coral reefs (civil servants and the like).

The interview results show that those who have other livelihoods, 33%, which includes the head of the fishermen group who said that "if other jobs as income are from restaurants" (I Gede Sudirga, personal communication, November 26, 2024) and other respondents who have other jobs as economic support from tourism businesses who also work as photographers/ videographers and swimming and diving teachers/trainers.

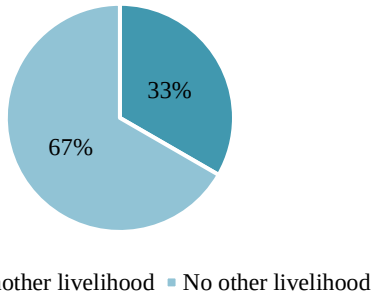

Figure 5. Other livelihoods of respondents in Amed waters in 2024

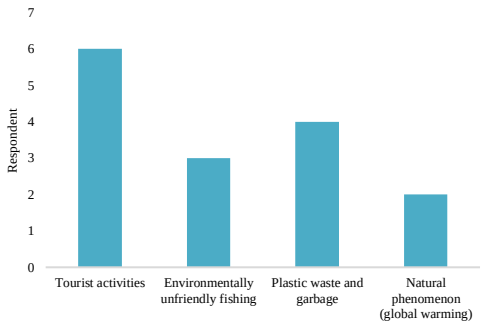

Figure 6. Activities that can damage coral reefs in Amed waters in 2024

Based on the results of the interview, it was found that the occurrence of coral reef damage in Amed waters, Bali, is thought to

be due to tourism activities, fishing that is not environmentally friendly, the presence of industrial, domestic and plastic waste and from natural phenomena in the form of global warming which results in rising sea surface temperatures.

The interview results show that coral reefs are the life support of marine biota, which is one of the economic producers of the community. Healthy coral reefs can be the main livelihood for fishermen, tourism businesses, snorkelling and diving activities, and restaurant owners. However, based on the results obtained both from interviews and data on the percentage of live coral cover, the current condition of coral reefs can be said to be threatened. This condition can harm the amount of community income. Changes in coral reef conditions can be seen from the presence of damage, and a decrease in biodiversity will directly affect fishermen's catch and underwater beauty, which is the primary sector in the tourism sector[16]. Action is needed to increase the community's income. Lack of public awareness of the environment is also a factor in the economic decline. Activities realized or not can damage coral reefs but only stand by without any action, worsening the situation.

Based on data on the area's carrying capacity and the results of interviews about the study of the social and economic potential of coral reefs in Amed waters, Bali, it shows that coral reefs are supporting the economy in the region. Local communities generally have livelihoods as fishermen and business actors in tourism, services or opening restaurants. Amed waters are the main focus of the economy, and they are divided between the fisheries sector and marine tourism. Although there is still a sizable fishing group, the marine tourism sector is increasingly becoming the main focus as a higher income and significant economic opportunity. This is because many community groups depend on the number of tourists. The community groups consist of tourist business groups, services, restaurants, souvenir shops, Balinese accessories shops and other traders. The fishermen also have additional income through this tourism sector by renting out their boats as transportation to the dive points.

Blue Economy Strategy

AHP Calculation

Three criteria were determined to support the Analytical Hierarchy Process (AHP) analysis based on the research results obtained from some of the data above. The three criteria are environmental (L), economic (E) and social (S). Environmental criteria include the value of coral reef health (L1), preservation of biodiversity (L2) and maintaining environmental quality (L3). Economic criteria include local community income through sustainable economic activities (E1), promoting economic diversification to reduce dependence on a single sector (E2) and increasing the competitiveness of business products and services (E3). Social criteria include empowering local communities in marine resource management (S1), increasing community participation in decision-making and conservation activities (S2) and ensuring fair and equitable distribution of benefits to local communities (S3).

Table 9. Pairwise comparison of criteria

Criteria	L	E	S
L	1	2	1,5
E	1/2	1	0,75
S	2/3	4/3	1

Table 10. Pairwise comparison of environmental sub-criteria

Sub-Criteria	L1	L2	L3
L1	1	3	2
L2	1/3	1	1/2
L3	1/2	2	1

Table 11. Pairwise comparison of economic sub-criteria

Sub-Criteria	E1	E2	E3
E1	1	3	5
E2	1/3	1	3
E3	1/5	1/3	1

Table 12. Pairwise comparison of social sub-criteria

Sub-Criteria	S1	S2	S3
S1	1	1/2	1/3
S2	2	1	2
S3	3	1/2	1

After calculating the pairwise comparison of each criterion, normalization and weighting will be carried out with the results shown in Table 13.

Table 13. Weighting of criteria

Criteria	Sub-Criteria Weight	Criteria Weight	Final Weight
L1	0,55	0,46	0,25
L2	0,15	0,46	0,07
L3	0,30	0,46	0,14
E1	0,63	0,23	0,14
E2	0,27	0,23	0,06
E3	0,10	0,23	0,02
S1	0,17	0,31	0,05
S2	0,48	0,31	0,15
S3	0,35	0,31	0,11

Based on Table 13, it can be seen that the order of sub-criteria with the highest weight is: L1 (Coral reef health): 0,25; S2 (Community participation): 0,15; E1 (Increase in community income): 0,14; L3 (Environmental quality): 0,14; S3 (Social justice): 0,11; L2 (Biodiversity preservation): 0,7; E2 (Diversification promotion): 0,06; S1 (Community empowerment): 0,05; E3 (Product business competitiveness): 0,02.

The results obtained may experience inconsistencies that can be influenced by subjectivity in judgment. Thus, it is necessary to calculate the Consistency Ratio (CR) by starting from the calculation of the eigenvalue (λ) to take the maximum λ value, which is part of the Consistency Index (CI) calculation. The eigenvalue calculation results from multiplying the criteria matrix with the priority weight calculation matrix. The calculation results are shown in Table 14.

After the eigenvalue is obtained, then the maximum eigenvalue is sought. The calculation is obtained by dividing the eigenvalue by the weight of the sub-criteria. Thus, the maximum eigenvalue is obtained by averaging the division results. Therefore, the maximum eigenvalue obtained is 0.328.

Furthermore, the Consistency Index (CI) calculation is carried out as follows:

$$CI=\frac{\lambda \max - n}{n-1}=\frac{0,328-9}{9-1}=\frac{-8,672}{8}=-1,084$$

Then, find the CR value with the following formula:

$$CR=\frac{CI}{IR}=\frac{-1,084}{1,45}=-0,75$$

The CR value obtained is (-0.75). This shows that the data obtained is consistent because the value is <0.1.

Formulation of Blue Economy Strategy

Based on the results of the AHP calculation, the final calculation graph of the weight of each sub-criteria can be seen in Figure 9 to formulate a blue economy strategy in achieving coral reef balance in Amed waters, Bali.

Table 14. Calculation of eigenvalue (λ)

Sub-Criteria Weight		Criteria Weight		Eigenvalue (λ)
0,55		0,46		0,25
0,15		0,46		0,07
0,30		0,46		0,14
0,63		0,23		0,14
0,27	x	0,23	=	0,06
0,10		0,23		0,02
0,17		0,31		0,05
0,48		0,31		0,15
0,35		0,31		0,11

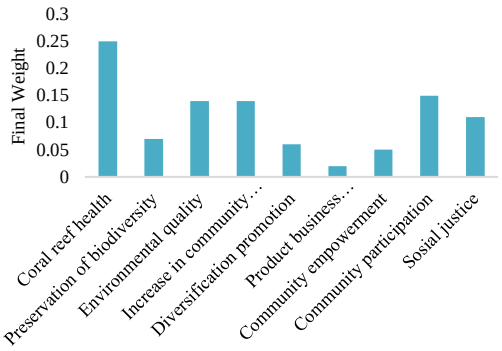

Figure 7. Analytical hierarchy process sub-criteria weight chart

This graph shows that the environmental criteria in the coral reef health section are the top priority for the blue economy strategy to maintain sustainability. The second is the social criteria part of community participation. Community participation is important to balance coral reefs in Amed waters, Bali. Third is the economic sector part of increasing income as a form of sustainability value from continuing to maintain the balance of coral reefs with the value of sustainability together with a compact community and care for environmental sustainability will undoubtedly get good results, which can be used to improve the economy of the local community. Thus, it can be determined that Bali can maintain the balance of coral reefs in Amed waters with a sustainable value (blue economy) strategy, as seen in Tables 15-17.

Table 15. Coral Reef Health Blue Economy Strategy

No.	Strategy
1	Efforts to increase conservation area
2	Coral reef rehabilitation
3	Pollution control efforts
4	Monitoring coral reef health regularly and consistently
5	Efforts to use environmentally friendly fishing gear

Table 16. Blue economy strategy for community participation

No.	Strategy
1	Conduct education and socialization on preserving coral reefs and the economic benefits of a healthy marine ecosystem.
2	Establish a coral reef awareness community group.
3	The government provides space for local communities to make decisions related to managing marine resources and conservation areas in their region.

Table 17. Blue economy strategies to increase community income

No.	Strategy
1	Economic development efforts with mariculture
2	Efforts to improve the economy with sustainable marine tourism
3	Efforts to increase the added value of seafood through the processing and marketing of seafood products
5	Efforts to provide access to capital and markets

Based on the results of data processing and calculations, steps can be taken by the local community, government, and stakeholders who care about the sustainability of marine life and the community. The steps determined are strategies that efforts are proposed as a form of concern. The application of blue economy strategies in Amed waters, Bali, by considering the percentage value of coral cover, carrying capacity of the area and socio-economic benefits, can be formulated as the main/priority strategy by focusing first on the recovery of coral reefs to continue to

maintain and improve coral reef health. This is because coral reefs can be the primary economic support, so it is necessary to focus on sustainable economic development while maintaining the balance of coral reefs. Then, if the coral reefs are stable, efforts can be made to develop and improve the economy by paying attention to environmental, social and economic aspects. The strategy can be in the form of ecotourism (the development of marine tourism that is environmentally friendly has a controlled visitor capacity, and still focuses on maintaining coral reef sustainability).

In addition to efforts to improve the tourism sector's economy, sustainable mariculture can also be carried out. This also requires strategies for community participation through social and education related to the importance of coral reefs and the potential generated, especially in the economic sector, and the creation of integrated groups to be part of the environmental quality control team. In addition, the government is also expected to provide space for the community to make decisions on the management of conservation areas or marine resources. This is necessary because the community feels both positive and negative impacts. By implementing the blue economy strategy with integrity, it is hoped that the balance between marine resource utilization and coral reef conservation in Amed waters can be maintained and stable.

4. CONCLUSION

This research concludes that coral reefs in Amed waters, based on the percentage of coral cover and the results of interviews, can be classified as poor damage, so conservation efforts and sustainable management are needed to maintain the balance of coral reefs. Coral reefs have social and economic potential in the fisheries sector, with 19 fishing groups and marine tourism in the form of diving and snorkelling. The main focus of community economic development is the tourism sector. The blue economy strategy that can be applied in coral reef conservation in Amed waters, Bali, focuses on environmental aspects of coral reef health, economic aspects of increasing community income and social aspects of community participation.

From the study results, it can be suggested that further and in-depth research on the condition of coral reefs and economic turnover in Amed waters, Bali, be conducted to get data regularly. It is hoped that permanent transects can be used in the subsequent study.

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