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The Analysis of Carrying Capacity for Tourism Object in Melasti Beach Ungasan Bali

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ABSTRACT

Carrying capacity (DDK) is the ability of the environment to support human life, other living things, and maintain the balance of the ecosystem. Conditions that over-carrying capacity cause human discomfort and create environmental degradation. Melasti Beach is a tourism object that is in demand by tourists. The frequency of tourist visits continues to increase along with the risk of environmental damage. This study aims to determine the unit of the area, the duration of activities, furthermore to calculate the value of carrying capacity. The data used are primary data obtained by questionnaire method to 50 tourist respondents and secondary data derived from literature study based on conditions in Melasti Beach. The results showed that the average area for tourism activities (Lt) was 232.7 m2 and the duration of activities (Wp) was 2.4 hours/day. The total time provided by the beach manager for tourism activities is 12 hours/day and the total area is 94.632 m2. The DDK value at Melasti Beach uses the Lt and Wp values, namely 2.008 people/day, 60.227 people/month and 722.724 people/year. These conditions show that tourist visits to Melasti Beach do not exceed DDK throughout the month and the total number of visits in 2020.
Keywords: carrying capacity, tourism, environment, Melasti beach.

Introduction

The tourism sector in Bali is growing rapidly from time to time. The rapid development of tourism in Bali has encouraged the need for tourism objects, one of which is tourism objects in the coastal area. Melasti Beach has developed into a tourism object that is located in the Ungasan Village, South Kuta District, Badung Regency. This beach is given the name "Melasti" because it is used as a place for *melasti* ceremonies / self-purification by local residents which is usually carried out before the celebration of *Nyepi* in Bali. The geographical condition of the Melasti Beach area is that it has limestone cliffs, so tourists will be presented with views of the white limestone cliff before arriving at the beach. Melasti Beach has natural and cultural potential.

The development of Melasti Beach tourism has increased every year. Manager of Melasti Beach, Ungasan Village, I Made Wijana stated that during long holidays there was an increase in the number of tourist visits. The increase was even double the average daily visit since early October 2020, which was 1,850 people per day. It was recorded that on October 28-31th 2020, the number of tourist visits reached 7,400 people with an average of 1,850 people per day. This increase only occurs during the high season, while during the low season only around 750 people per day. If accumulated until the end of October, there were 35.409 tourists with details as many as 30,502 domestic tourists and 4.907 foreign tourists who came to Melasti Beach (Nusa Bali, November 2020). During January and February 2021, 86.214 visitors came to Melasti Beach. Total tourist visits were dominated by domestic tourists which reached 76.259 people (Nusa Bali, March 2021). Judging from the increasing number of tourists visiting Melasti Beach, it is necessary to make research about the Melasti Beach carrying capacity. According to Ketjulan (2010), the carrying capacity of the area can be interpreted as the ability of the environment or area to support human life or other living things. Conditions that over carrying capacity causing damage to the natural

environment (Dahuri, 2003). According to Karyono and Muttaqin (2003) in Artadana (2017), conditions that exceed carrying capacity cause discomfort in activities and cause environmental degradation.

Based on the definition of carrying capacity, it is considered very important for the sustainability of the beach environment. Carrying capacity is very important to give us information about the number of visitors that can be accommodated in tourism objects so it will not cause disturbance to both humans and the environment. Furthermore, carrying capacity also contributes to the strategy of developing sustainable tourism objects. It is hoped that this research can provide the necessary knowledge and information related to the carrying capacity of Melasti Beach and other tourism objects.

Research Methods

Preparation

Location and time

The location of this research is Melasti Beach, Ungasan Village, South Kuta District, Badung Regency, Bali. Research data collection is carried out from May 5th to August 20th, 2021, which is held 2-3 times a month. The boundaries of the Melasti Beach area such as: North is Jumana Restaurant; East is Green Bowl Beach; South is the Indian Ocean; West is Karma Kandara Beach. The Melasti beach site plan can be seen on Figure 1 below.

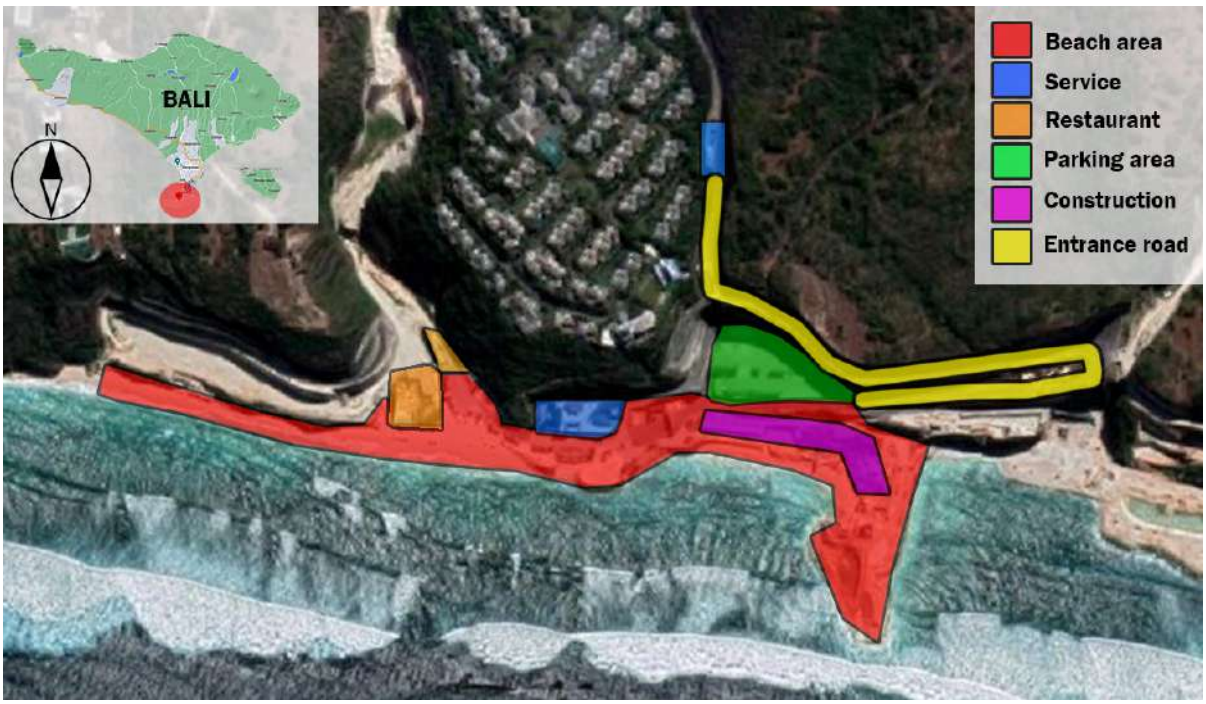

Figure 1. Melasti Beach site plan

Tools and research material

The tools used in this research such as: online questionnaires used to ask questions to respondents, roll meters are used to measure the length and width of the beach, GPS is used to determine sampling points, and cameras are used for documentation. The material in this study is secondary data in the form of the number of tourist visits to Melasti Beach.

Data collecting methods

The study used primary data and secondary data. Primary data was obtained from a direct survey to the research location, namely in the form of direct observation and interviews with respondents using the questionnaire. In this case, the respondents are tourists who visit Melasti

Beach, while secondary data is obtained from literature studies, books related to this research and literature. Data collection using the questionnaire method aims to obtain more information about the tourist activities. Interviews were conducted using the accidental random sampling method with 50 respondents being participated the questionnaire. Tourists who were interviewed carried out activities such as swimming, sightseeing, playing, eating, take a photo, and sunbathing. Field observations carried out are primary data collection by observing and measuring in situ parameters.

Analysis methods

Calculation of the activity area (Lt) and activities duration (Wp)

Activity area calculation and the duration needed by tourists for certain activities is carried out by the questionnaire method. The questions posed to tourists relate to the area, the time used to carry out a tourist activity and the total time used for 1 day so that tourists feel comfortable in traveling. Furthermore, after obtaining data from respondents, then the data is determined the average value of each tourist activity. The average value is the Lt, Wt and Wp of each tourism activity by following per under the conditions at Melasti Beach.

Calculation of the carrying capacity (DDK)

The method introduced to calculate the carrying capacity of natural ecotourism development is to use the carrying capacity concept. DDK calculation in formula is as follows (Yulianda, 2007) :

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

Annotation :
DDK : Carrying capacity (people/year)
K : Coefficient of visitor ecological potential per unit area (people)
Lp : The area or length of the area that can be utilized (m2)
Lt : Area unit for an activity category (m2)
Wt : The time provided by the area for tourist activities in one day (hour)
Wp : Time spent by visitors on each particular activity (hour)
According to Yulianda (2007), the ecological potential of visitors is determined by the condition of the resources and the type of activity to be developed (See Table 1).

Table 1. Coefficient of visitor ecological potential per unit area

Activities	***K (Σ Visitor)***	***Area unit (Lt)***	***Notes***
Beach recreation	*1*	*50 m*	*1 people per 50 m beach length*
Beach Sport	*1*	*50 m*	*1 people per 50 m beach length*
Swimming	*1*	*50 m*	*1 people per 50 m beach length*
Sunbathing	*1*	*50 m*	*1 people per 50 m beach length*

The DDK value is adjusted to the characteristics of the environment and functions of the area. Humans need space to move freely and not to be disturbed by others. For beach tourism activities, it is assumed that everyone needs a coastline of 50 meters because visitors will carry out various activities that require a large space, such as sunbathing, walking, swimming and others. Visitor activity time (Wp) is calculated based on the duration of time spent by visitors to carry out tourism activities. Visitor time (Wt) is calculated by the time allotted for the area (see Table 2). Regional time is the work hours of the area is opened in one day, and the average working time is about 8 hours (8-16 hours).

Table 2. Prediction of visitor activity time

Activities	*Time needed (Wp)*	*Time provided (Wt)*
Beach recreation	*3*	*6*
Beach Sport	*2*	*4*
Swimming	*2*	*4*
Sunbathing	*2*	*4*

Results and Discussion

Activity area (Lt) and activity duration (Wp)

Based on the questionnaire as in Table 3, it shows that of the respondents who filled out the questionnaire, the highest percentage activity is taking a photo with 27% of the respondents and the least was 4% of the respondents doing tourism and picnics.

Table 3. Tourist Activities at Melasti Beach

Activities	*Percentage*
Stroll	*12%*
Playing	*8%*
Sit and relaxing	*16%*
Sightseeing	*12%*
Taking a photo	*27%*
Swimming	*8%*
Sunbathing	*4%*
Eating	*10%*
Picnic	*4%*

Tourism activities that have the highest percentage are taking a photo, it must be considered in designing building or landmark that can attract and increase tourist visits. Meanwhile, for tourism activities with a low percentage, namely sunbathing and picnics with 4% of total respondents. This means that tourists do not feel comfortable doing sunbathing activities or picnics at Melasti Beach or there are no facilities that support these activities. Managers can provide a picnic area equipped with the availability of equipment needed for picnics.

The size of the area, the time required for activity and the total time provided for one day greatly affect the comfort of tourists to do activities. In the equation for calculating tourism carrying capacity according to Yulianda (2007), time and area are the parameters that are entered into the calculation to obtain the carrying capacity value. These values are different for each area because these values depend on the situation and conditions in each area. Based on the results of the questionnaire to Melasti Beach visitors regarding visiting times, it can be seen in table 4. The highest time duration is 4 hours and the lowest is 0.5 hours (30 minutes). The activity with the highest average time duration is strolling with an average time of 3 hours. While the activity with the lowest average time duration is eating, which is 1.5 hours.

Table 4. Duration of time for tourism activities

Activities	*Highest duration (hour)*	*Lowest duration (hour)*	*Average time (hour)*
Stroll	*4*	*2*	*3*
Playing	*3*	*1.5*	*2.7*
Sit and relaxing	*4*	*0.5*	*2.4*

Sightseeing	*3*	*2*	*2.2*
Taking a photo	*4*	*0.5*	*2*
Swimming	*3*	*1.5*	*2.6*
Sunbathing	*3*	*2.5*	*2.75*
Eating	*2*	*1*	*1.5*
Picnic	*4*	*1.5*	*2.75*

Tourist activities namely sightseeing, have the highest average time of 3 hours, so it can be concluded that tourists feel comfortable walking around Melasti Beach. There is a fairly wide and well-organized pedestrian path as well as an access road and a large parking area. In addition, there is signage that helps direct pedestrians to the existing facilities at Melasti Beach. These things can increase the comfort of tourist's stroll activity. Eating has the lowest average duration of 1.5 hours. This is due to the main motivation of tourists coming to stroll and sightseeing Melasti Beach so that consuming food and beverage is only an additional/supporting activity.

From the results of the calculation of the average duration of time (Wp) for each activity, then these values will be combined and averaged to produce the area's Wp value in 1 day. The final Wp value obtained based on these calculations is 2 hours. The operational hour of Melasti Beach provided for tourists based on data is 12 hours, from 8 am to 8 pm.

Related to the calculation of the area provided, the zoning area is divided based on certain tourist activities. The zoning area is divided into 9 parts by naming the area using numbers 1 to 9 based on the type of activity in the area (see Figure 2).

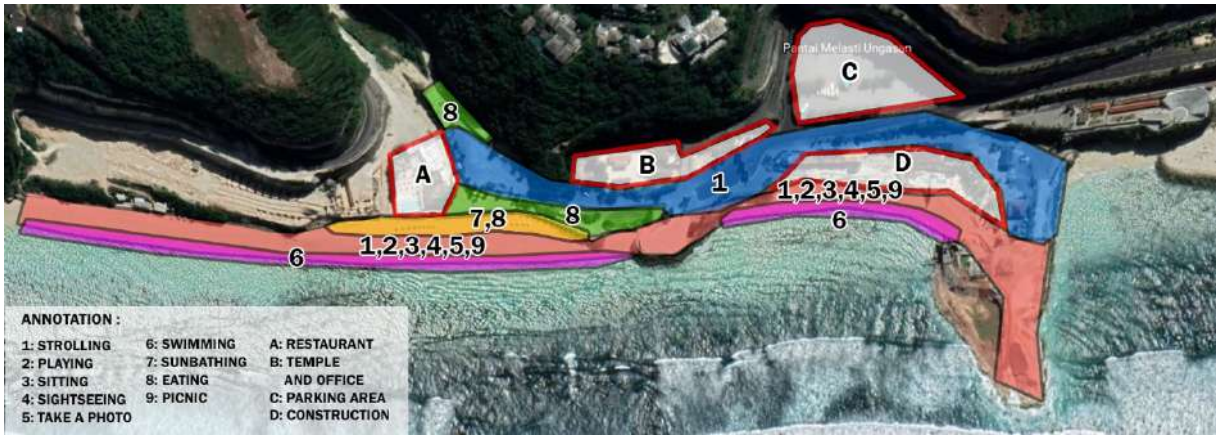

Figure 2. Zoning based on tourist activity

Table 5. Area provided per activity category

No.	Activity	Area Provided (m2)
1.	*Stroll*	22.918
2.	*Playing*	11.726
3.	*Sit and relaxing*	11.726
4.	*Sightseeing*	11.726
5.	*Taking a photo*	11.726
6.	*Swimming*	8.112
7.	*Sunbathing*	2.851
8.	*Eating*	2.486
9.	*Picnic*	11.726

The total area that is provided for tourism activity on Melasti Beach is 94.632 m2. This area does not include entrance road access, parking, management offices, temple and ongoing construction, etc. From this area, it is divided based on tourist activities categories that can be used by tourists

on Melasti Beach (see Table 5). The total area needed by tourists to carry out tourism activities can be seen in Table 6. The highest area needed by tourists is 724 m2 and the lowest area is 98 m2. The highest average area is 332 m2 and the lowest is 183.6 m2.

Table 6. Total area needed by tourist activity

No.	Activity	Highest activity area (m2)	Lowest activity area (m2)	Average(m2)
1.	Stroll	357	98	232
2.	Playing	330	104	183.6
3.	Sit and relaxing	398	104	186.3
4.	Sightseeing	724	98	220.3
5.	Taking a photo	473	104	244.3
6.	Swimming	357	104	247.25
7.	Sunbathing	231	231	231
8.	Eating	383	225	332
9.	Picnic	330	105	217.5

Tourist activities, namely eating, have the highest average area of 332 m2 because eating activities are carried out while doing other activities such as sightseeing, strolling and picnic. In addition, there are food stalls that are quite complete so that tourists can buy food and drinks while resting for a while. Occasionally, tourists eat on the beach or sometimes eating while doing other activities. The activity with the lowest average area is playing which is 183.6 m2. Tourists playing in various areas where they feel comfortable and tend not to move too far, so the average value of the area is not too large.

From the results of the calculation of the average value (Lt) of each activity, then these values will be combined and averaged to produce the Lt value of the area in 1 day. The final Lt value obtained based on these calculations is 232.7 m2.

Analysis of Melasti Beach carrying capacity value (DDK)

Based on the results of the questionnaire data analysis, the value of the area (Lt) and duration of activity (Wp) of each tourist activity was obtained. Furthermore, the Lt and Wp values will be analyzed using the DDK formula to produce DDK values per day in Table 7 below.

Table 7. Carrying capacity value (DDK) per activity category

No.	Activity	Coeffi-cient	Area Provided (m2)	Activity area (m2)	Time provided (hour)	Activity duration (hour)	Carrying Capacity (DDK) (people/day)
		(K)	(Lp)	(Lt)	(Wt)	(Wp)	K x (Lp/Lt) x (Wt/Wp)
1.	Stroll	1	22.918	232,0	12	3.0	395
2.	Playing	1	11.726	183,6	12	2.7	284
3.	Sitting	1	11.726	186,3	12	2.4	315
4.	Sightseeing	1	11.726	220,3	12	2.2	290
5.	Taking a photo	1	11.726	244,3	12	2.0	288
6.	Swimming	1	8.112	247,3	12	2.6	151
7.	Sunbathing	1	3.243	231,0	12	2.8	60
8.	Eating	1	5.337	332,0	12	1.5	129

9.	*Picnic*	*1*	*11.726*	*217,5*	*12*	*2.8*	*231*

The tourism activity with the highest carrying capacity value is sitting activity, which is 395 people/day, with details of the area required is 232 m2 with a duration of 3 hours. This causes the number of DDK values to be high, the average duration of activity is high because sitting activities are usually done while chatting and doing other activities. On the other hand, the tourism activity with the lowest DDK value is sunbathing, which is 60 people/day, with details of the required area of 231 m2 with a duration of 2.8 hours. The factor that causes the low DDK value is because sunbathing is only done at certain times and is usually done in certain places, usually areas with beach chairs and umbrellas.

The carrying capacity value data can provide an overview of the area capacity of each tourism activity that must be prepared or developed by the Melasti Beach manager. Such as strolling and sightseeing activities, the capacity of visitors can be increased by adding pedestrian paths in strategic areas. So that the number of visitors who carry out strolling and sightseeing activities can increase.

The results of this study when compared with the research of Wunani et al. (2014) who modified the Lt and Wp values at Botutonuo Beach, Gorontalo and the research of Vibriyanto et al. (2015) in Lombang Beach, Madura showed almost the same Wp value, which was 3 hours/day. This means visitors at Lombang Beach have almost the same time needs as visitors at Melasti Beach in carrying out tourist activities. The Lt value according to Vibriyanto et al. (2015) in Lombang Beach, Pasuruan Regency is 250 m2. These results indicate that visitors to Lombang Beach require a wider area to carry out tourism activities when compared to visitors to Melasti Beach.

Based on this, it can be said that each beach has different conditions, be it environmental conditions or tourists characteristic. This is happen because in carrying out a tourist activity, the needs of each tourist for space and time are very varied and relative and can be used as information about the condition of carrying capacity in a tourism area (Akliyah and Umar, 2013). These differences will affect the carrying capacity value at each beach. Thus, it is important to determine the Lt and Wp values based on the conditions and characteristics at each beach.

Based on the carrying capacity value data for each activity, it is then used as a reference in calculating the carrying capacity value for the area as a whole so that the results are obtained in the form of the total carrying capacity value per day, month and year at Melasti Beach. The results of the overall Melasti Beach carrying capacity analysis can be seen in Table 8 below.

Table 8. Melasti Beach overall carrying capacity value (DDK)

No.	***Criteria***	***Coeffi-cient***	***Area Provided (m2)***	***Activity area (m2)***	***Time provided (hour)***	***Activity duration (hour)***	***Carrying Capacity (DDK) (people)***
		(K)	*(Lp)*	*(Lt)*	*(Wt)*	*(Wp)*	*K x (Lp/Lt) x (Wt/Wp)*
1.	*Carrying capac-ity per day*	*1*	*94.632*	*232,7*	*12*	*2,4*	*2.008*
2.	*Carrying capac-ity per month*	*1*	*94.632*	*232,7*	*12*	*2,4*	*60.227*
3.	*Carrying capac-ity per year*	*1*	*94.632*	*232,7*	*12*	*2,4*	*722.724*

The calculation of carrying capacity (DDK) based on primary data focuses on the comfortable of tourists while doing tourism activities. Based on the results of primary data calculations using Lt and Wp values, the average Lt value of all activities was 232.7 m2 and the average Wp value was 2.4 hours. Then the Lt and Wp values produce DDK values for tourism activities at Melasti Beach according to Table 8, which is 2.008 people/day. These results show that in one day, the Melasti

Beach can accommodate 2.008 tourists to fulfill DDK values. If it is assumed that DDK per day is the same, then the results obtained are DDK values per month is 60.227 people and per year is 722.724 people. This value will be used as a reference in determining whether the number of visitors to Melasti Beach is over carrying capacity (OCC) or under carrying capacity (UCC).
If analyzed based on monthly visits during 2020 at Melasti Beach, it can be seen that several months got high season tourist visits such as January and December (see Table 9). This is because these months are the peak of holidays each year and other months are not the peak of visits (low season). In addition, in 2020 the whole world, including Bali, was affected by the Covid-19 pandemic which has a huge impact on the tourism sector. It can be seen that from April to June Melasti Beach was temporarily closed to suppress the spread of the virus, so that nobody was allowed to enter Melasti Beach.

Table 9. Comparison between number of tourist visits in 2020 with the carrying capacity value

Month	***Total visitor per month (people)***	***Carrying capacity per month (people)***	***Percentage***	***Notes***
(a)	*(b)*	*(c)*	*(d=b/c x 100%)*	
January	*71.236*	*60.227*	*118.3%*	*OCC*
February	*54.745*	*60.227*	*90.9%*	*UCC*
March	*31.017*	*60.227*	*51.5%*	*UCC*
April	*0*	*60.227*	*0.0%*	-
May	*0*	*60.227*	*0.0%*	-
June	*0*	*60.227*	*0.0%*	-
July	*47.713*	*60.227*	*79.2%*	*UCC*
August	*42.300*	*60.227*	*70.2%*	*UCC*
September	*34.435*	*60.227*	*57.2%*	*UCC*
October	*35.409*	*60.227*	*58.8%*	*UCC*
November	*46.049*	*60.227*	*76.5%*	*UCC*
December	*83.600*	*60.227*	*138.8%*	*OCC*
2020 year	***446.504***	***722.724***	***82.4%***	***UCC***

Notes: UCC= Under carrying capacity; OCC=over carrying capacity

The number of tourist visits per month to Melasti Beach in 2020 when compared to DDK using a primary data approach with the assumption that the value of DDK per day has the same value for all days for one year, then tourist visits are still categorized as not exceeding the value of DDK (under carrying) capacity) with an average percentage for 2020 of 82.4%. However, this value cannot be a good comparison because the number of visits is not optimal due to the Covid-19 pandemic that has occurred throughout the world.
The next analysis is to use the Lt and Wp values based on the approach used by Yulianda (2007). The values of Lt and Wp are the assumptions of the required area in each beach tourism activity and the prediction of the time required by tourists (see Table 10). The results of the analysis will then be compared with the analysis that has been done with primary data.

Based on the results of calculations using the approach according to Yulianda (2007), the DDK value for tourism activities at Melasti Beach is by following per under Table 10, which is 3.785 people/day. These results show that in one day, the Melasti Beach area can accommodate 3.785 tourists to fulfill DDK. If it is assumed that DDK per day is the same, then the results obtained are DDK per month is 113.558 people and DDK per year is 1.362.701 people.
Melasti Beach as one of the beaches in Bali with a fairly large area, cannot immediately accommodate the DDK value using the approach by Yulianda (2007) which has been developed previously.

This means that alternatives methods are needed to accommodate the carrying capacity. The approach using primary data with an emphasis on tourist comfort is used as an alternative in accommodating tourist visits without having to interfere with existing tourism management.
These conditions indicate that there are differences in carrying capacity based on natural conditions and visitor characteristics on each beach. The difference is influenced by the total area of an area, the area needs for tourism activities, the total time provided by the area for tourism activities and the time required by tourists to do activities. Thus, the values of Lt and Wp cannot be directly equated to determine the value of DDK on different beaches, and primary data based on a survey is needed to determine the conditions in the area.

Table 10. Melasti Beach overall carrying capacity value (DDK) based on the approach by Yulianda (2007)

No.	***Criteria***	***Coefficient***	***Area Provided (m2)***	***Activity area (m2)***	***Time provided (hour)***	***Activity duration (hour)***	***Carrying Capacity (DDK) (people)***
		(K)	*(Lp)*	*(Lt)*	*(Wt)*	*(Wp)*	*K x (Lp/Lt) x (Wt/Wp)*
1.	*Carrying capacity per day*	*1*	*94.632*	*50*	*6*	*3*	*3.785*
2.	*Carrying capacity per month*	*1*	*94.632*	*50*	*6*	*3*	*113.558*
3.	*Carrying capacity per year*	*1*	*94.632*	*50*	*6*	*3*	*1.362.701*

Conclusion

Based on the results of the study, the value of the area (Lt) and duration time of visit (Wp) obtained from primary data in the questionnaire form with tourists as subjects in tourism activities can be used in calculating the carrying capacity of tourism areas in Bali Province, especially Melasti Beach. Based on the study, it can be concluded that the time required for tourists to carry out each tourist activity (Wp) is 2.4 hours/day and the required area (Lt) is 232.7 m2. The carrying capacity (DDK) value at Melasti Beach based on primary data calculations is 2.008 people per day or 722.724 people per year. This value is more suitable to describe the carrying capacity of Melasti beach tourism than the standard value used by Yulianda (2007), where there are other factors such as the natural environment and characteristics of the tourists. The results of this study indicate that Melasti Beach has an area carrying capacity value that is still under carrying capacity for 2020. This study still requires additional data such as more questionnaire respondents and interviews with domestic and international tourists. So that it can be determined in more detail in comparison with the carrying capacity of the areas. In addition, this research primary data needs to be surveyed again under normal circumstances after the Covid-19 pandemic ends to obtain optimal data and better analysis of tourists activity.

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