

Analysis of Coastal Characteristics in Canggu Area Badung Regency

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ABSTRACT

Coastal in Canggu area is one of the coastal areas in Badung Regency which has a large tourism potential and has a variety of beach functions. Given the importance of the function and role of beaches in the Canggu area, their existence needs to be maintained. Managing of coastal damage can be done effectively if knowledge of damaging or building characteristics in the area is known. This research aims to analyze the characteristics of coastal in Canggu area which later by knowing these characteristics can be determined appropriate coastal damage management strategies of the coastal in Canggu area, so that the existence of the coastal in the Canggu Area can be maintained. This research is a descriptive research to find out the characteristics of the coastal in the Canggu area, Badung Regency by taking three coastal as research locations. Based on the results of the analysis of the coastal in the Canggu area is a sandy beach with the type of ocean coastal and where the erosion process is more dominant than the sedimentation process with geological structures originating from alluvium deposits. The morphology of the coastal in Canggu area is dominated by medium and low relief hills with latosol soil type. The dominant wind direction blowing from the West is 38.33% with the most dominant wind speed in the range of 15-20 knots, with significant wave heights that occur due to wind generation is range from 1,782 to 2,202 m and have a semidiurnal tide type.

KEYWORDS; coastal, morphological characteristics, hydro oceanography.

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I. INTRODUCTION

Bali is one of the provinces in Indonesia that has been known to the world for its beautiful coastal scenery. The coastal area in Bali has been used for tourism, social activities and also in some coastal areas in Bali there is a temple area that is used for religious activities by local people. The coastal of Bali in general are coral beaches with white sandy beaches. These beaches are widely used as tourist beaches. To support the development of tourism, many facilities and infrastructures have been built such as hotels, restaurants, shops, beach recreation facilities and airports. Most of the supporting facilities are built on the beach. With the increasing activity of coastal development in the end caused problems in the coastal areas. One of the problems of the beach is erosion or abrasion. The condition of the coast of Bali shows that 20% of the 436.5 km long coastline in Bali suffered damage due to coastal abrasion which needs immediate treatment. Beach damage in Bali from year to year is increasingly alarming [1].

Badung Regency is one of the regencies in Bali Province that has a beach with high assets as an international coastal area. Badung Regency has a coastline of 64 km in length, but an average of 13.75 m has changed the coastline in Badung Regency, with an average erosion rate of 1.96 m / year. Coastal in Canggu Area is one of the coastal areas in Badung Regency. The Coastal in Canggu area has an average erosion rate of 2.05 m/ year with an average change in coastline of 14.36 m [2]. The Coastal in Canggu area has all the potential to make it a new favorite for tourists. There are several beaches in the Canggu area which are now being visited by many tourists including the Brawa Beach, BatuMejan Beach and BatuBolong Beach.

Given the importance of the function and role of coastal area in the Canggu area, their existence needs to be maintained. To protect the coastal area from coastal erosion has been attempted by the local government by building a coastal protection work in the form of revetments from river stone pairs. The revetment that was built at this time has not been effective and has failed as shown in Figure 1. In general, this failure is caused by the failure of the revetment structure due to toe scouring that occurred.

Handling of coastal damage can be done effectively if knowledge about changes in coastline, hydro-oceanographic characteristics such as waves, tides and currents that cause destructive or building changes in the area are known. This research aims to analyze the characteristics of the beach in the Canggu area which later by knowing these characteristics can be determined appropriate coastal damage management strategies in the Canggu Area, so that the existence of the coastal in the Canggu Area can be maintained.



Figure 1 Coastal Protection Work damage at BatuMejan Beach

II. RESEARCH METHODS

Research Location

This research takes location in the coastal area of Canggu which in this study is represented by taking three beaches as research locations namely BatuBolong Beach, BatuMejan Beach and Brawa Beach which are included in the Canggu region, Badung Regency as shown in Figure 2. These three beaches chosen because it is assumed to have the same characteristics.



Figure 2 Research Location

Source: Google Earth (2019)

Research Data

The research data used are primary data and secondary data. Primary data obtained from direct observations in the field to see the characteristics of the beach visually which will later be adjusted to the existing theory. Then secondary data was obtained from relevant agencies and from literature studies on research sites.

Data Analysis Technique

This research is a descriptive study to find out the characteristics of the coastal in the Canggu area, Badung Regency by taking three beaches as research locations. Then from the research data it will be adjusted to the existing theory to find out the characteristics of the coastal. It is expected that by knowing the characteristics of the beach both morphological characteristics and hydro oceanographic characteristics, it can determine the strategy of managing coastal damage that occurs so that the Canggu beach area can be maintained.

III. RESULT AND DISCUSSION

Overview of the Research Locations

Badung Regency is geographically located between 8°14'20" -8°50'48" LS and 115°05'00" -115°26'16" BT with an area of 418.52 km² or around 7.43 percent of mainland of the island of Bali. This geographical area is divided into six sub districts with the widest area is Petang sub-district followed by South Kuta, Mengwi, Abiansemal, North Kuta and Kuta sub-districts. Canggu Village is still included in the North Kuta District. The coastal in this area is classified as very crowded because it is located in a tourist destination with many bars, villas, restaurants, and stalls owned by residents who at any time can spoil the visitors. Visually the beach in the Canggu area is a beach with brown sand. Coastal characteristics refers to Dolan et al [3] divides the type of beach into 4 main elements, namely: 1) Geology (composing lithology), 2) Morphology (relief), 3) Coastline characteristics, and 4) Dominant factors affecting coastal process.

Coastal Type in Canggu Area

The types of coastal in the Canggu area based on the classification of the types of exposure (shelf) and waters are the type of ocean coastal. Ocean coastal is a coastal where the erosion process is more dominant than the sedimentation process, has the following characteristics:

- River mouths are in a bay, deltas are not well developed and the water is clear.
- The depth of the coast towards the sea changes suddenly (steep)

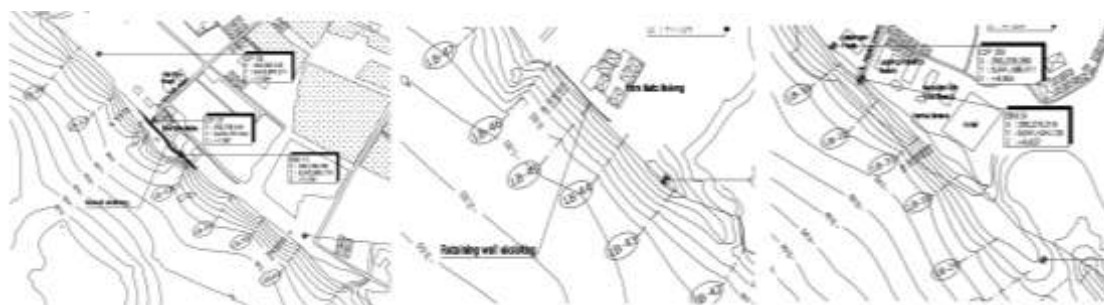


Figure 3 Bathymetry of BatuMejan Beach, BatuBolong Beach and Brawa Beach

Source: River Basin Bureau Bali Penida (2018)

From the bathymetry map obtained from the River Basin Bureau Bali Penida [4] it can be seen that the deeper bathymetry of the coastline in the Canggu region has a deeper and steeper beach depth. And from visual observations the delta area is also clear and not turbid under normal circumstances.

Meanwhile, based on its constituent material, the coast of the Canggu area includes beaches composed of loose material in the form of sand (sandy beach), that is if the beach is composed of sand deposits. Based on the morphology of the beach Canggu area is a non-cliffed coast, which is a beach with a coastal slope. This sloped beach is usually a sand beach.



Figure 4 Condition of BatuMejan Beach, BatuBolong Beach and Brawa Beach

Source: www.google.com (2019)

Coastal Geological Characteristics

Based on the Badung Regency Spatial Planning map [5], the coastal area of Canggu is dominated by geological structures originating from alluvium deposits. Dolan, et al [3] divided 5 (five) coastal classification variables based on rock type and mineral hardness contained in the rock.

Based on the compilation lithology which is dominated by Alluvium Deposits as Figure 5, the coastal areas in Canggü area have low resistance to the process of erosion by waves, currents and tides. Therefore, in the management and planning of coastal areas must be very careful and encouraged to pay attention to the Analysis of Environmental Impacts



Figure 5 Geological Map of the Canggü Area

Source: Badung Regency Spatial Planning (2013)

Coastal Morphology

Coastal morphology is an area that is always changing because there are many processes that occur in it both from land and sea, the two processes converge on the coast [6]. Coastal morphology is influenced by the wave factor, the slope of the area, the type of soil and the beach oceanographic hydro factor.

a. Coastal morphology

Coastal morphology in the Canggü area is dominated by medium and low relief hills with latosol soil types such as Figure 6. Soepardi [7] states that Latosols are formed under climatic conditions with rainfall and high temperatures in the tropics and semi-tropics, crushed forces work faster and the big effect is more extreme than in moderate areas. In many parts of the tropics, the alternating wet and dry seasons greatly intensify chemical activities, especially from organic matter. Latosol soil has a rather thick to thick soil solum, starting from around 130 cm to more than 5 meters. The soil is red, brown, to yellowish. Soil texture in general is clay Soil structure in general is crumb with a loose consistency, has a pH of 4.5 to 6.5, ie from acidic to slightly acidic and has infiltration rather quickly to rather slowly.

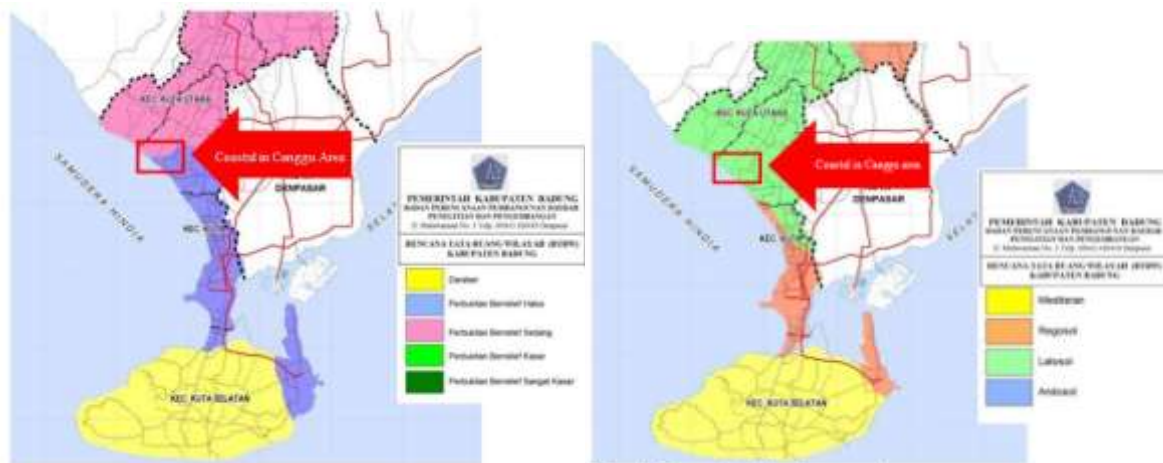


Figure 6 Morphological Maps and Soil Types in the Canggü Area

Source: Badung Regency Spatial Planning (2013)

b. Slope

Based on the slope table proposed by Zuidam [8], the beach in the Canggu area has a slope which is dominated by 5-10% slope. Based on this slope classification, the coastal in the Canggu Region is a very ramps until ramps slope.

Table 1 Slope Classification

Slope (%)	Classification
0-2	Flat-nearly flat
3-7	Very ramps
8-13	Ramps
14-20	Rather steep
21-55	Steep
56-140	Very steep
>140	High-steep

Source: Zuidam (1985) in Purnomo (2012)

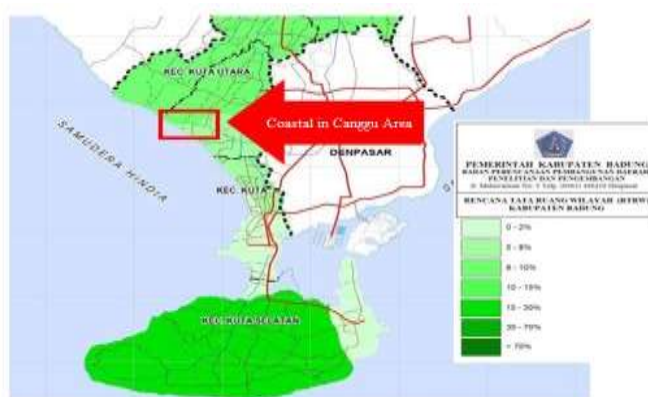


Figure 7 Slope Map of Canggu Area

Source: Badung Regency Spatial Planning (2013)

HydroOceanography

Hydro Oceanography is a scientific scope of the sea that specifically studies the properties of sea water movements which include wind, fetch, waves and tides. Hydro Oceanography is a scientific sphere of the sea which specifically studies the properties of sea water movements which include wind, fetch, waves and tides.

a. Wind

Wind is moving air caused by the rotation of the earth and also due to differences in air pressure around it. The wind moves from a place of high pressure to low pressure air. Wind data is needed for forecasting height and wave periods. The wind data obtained are then presented in tabular form (summary) or diagram called wind rose.

Table 2 Data of Monthly Average Wind Speed in 2007-2016

Years.		Months											
		JAN	FEB	MAR	APR	MEI	JUN	JUL	AGT	SEP	OKT	NOP	DES
2007	ARAH	W	W	W	SE	E	E	SE	SE	SE	SE	W	W
	KEC.	13	11	15	10	12	13	13	13	12	11	11	15
2008	ARAH	W	W	W	E	E	E	SE	SE	SE	SE	W	W
	KEC.	14	17	10	12	13	11	13	12	12	10	10	12
2009	ARAH	W	W	E	E	E	E	SE	SE	SE	SE	W	W
	KEC.	14	17	10	10	11	10	12	12	10	11	11	11
2010	ARAH	W	W	E	W	E	E	E	SE	E	E	W	W
	KEC.	15	10	10	10	10	12	12	12	11	11	10	14
2011	ARAH	W	W	W	E	E	E	SE	SE	SE	SE	SE	W
	KEC.	17	16	14	12	12	14	17	16	16	14	13	16
2012	ARAH	W	W	W	SE	E	E	SE	SE	SE	SE	SE	W
	KEC.	24	16	21	16	18	17	18	18	15	16	15	18
2013	ARAH	W	W	W	E	E	E	E	E	E	SE	W	W
	KEC.	25	21	17	14	14	16	20	15	16	17	17	16
2014	ARAH	W	W	E	W	E	E	E	E	E	W	SE	W
	KEC.	23	22	15	14	16	19	18	20	17	17	16	17
2015	ARAH	W	W	W	E	E	E	E	E	E	W	SE	W
	KEC.	23	19	17	16	17	19	19	19	18	17	16	18
2016	ARAH	E	W	W	E	E	E	E	E	E	W	SE	W
	KEC.	18	17	15	16	16	17	18	18	17	16	16	21

Source: Ngurah Rai Station Meteorology and Climatology Center (2017)

Table 3 Percentage of Wind Speed in Specific Intervals in 2007-2016

Wind Speed (Knot)	Wind Direction							
	U/N	TL/NE	T/E	TG/SE	S/S	BD/SW	B/W	BL/NW
0<V?5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5<V?10	0.00	0.00	4.17	2.50	0.00	0.00	4.17	0.00
10<V?15	0.00	0.00	14.17	12.50	0.00	0.00	12.50	0.00
15<V?20	0.00	0.00	19.17	9.17	0.00	0.00	15.00	0.00
>20	0.00	0.00	0.00	0.00	0.00	0.00	6.67	0.00
Total	0.00	0.00	37.50	24.17	0.00	0.00	38.33	0.00

Source: Analysis Results, (2017)

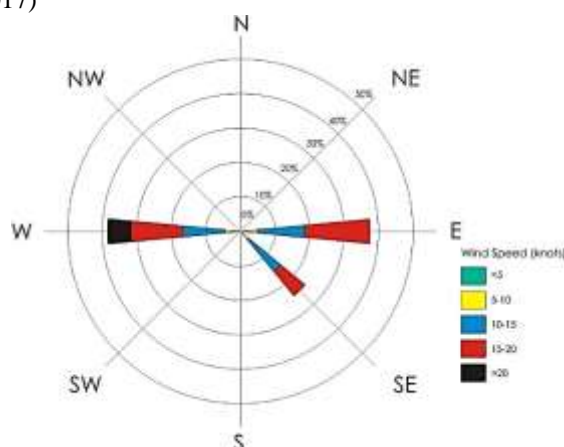


Figure 8 Wind rose of the Coastal in the Canggu Area

Source: Analysis Results, (2017)

From the analysis of wind speed from BMKG NgurahRai [9], it is found that the dominant wind direction blowing from the West is 38.33% with the most dominant wind speed in the range of 15-20 knots. From the analysis of wind data, it can be seen that the dominant wind blows from the west which means that the direction of the perpendicular to the coast, so that if sediment transport occurs it will occur onshore-offshore sediment transport. This can be used as a basis for determining.

b. Waves

Waves are a form of energy that can form a beach, because currents and sediment transport in the perpendicular direction and along the coast, and cause the forces acting on coastal structures. Tides are also an important factor because they can generate strong currents, especially in narrow areas, for example in bays, estuaries and river mouths.

In addition, the elevation of the tide and low tide levels is also very important for planning coastal structures [10]. Wave height is one of the factors that influence the amount of wave energy. Thus, the higher a wave, the more energy it produces. Based on the analyzed wind data, wind blows and fetch time, wave forecasting can be done to find out significant wave heights (Hs) and significant wave periods (Ts). By using a maximum wind speed of 19 knots (12.76 m / sec) then converted based on the height of the measurement to 16.27 m / sec can then be calculated height and significant wave period at that location as in Table 4.

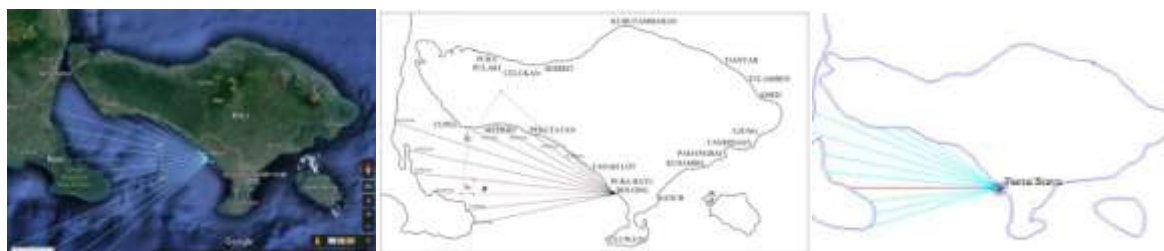


Figure 9 Fetch of BatuMejan Beach, BatuBolong Beach and Brawa Beach

Table 4 Significant Wave Height

Location	Effective Fetch (km)	Significant Wave Height (Hs) (m)
BatuMejan Beach	70,170	2,202
BatuBolong Beach	63,130	2,088
Brawa Beach	45,975	1,782

Source: Analysis Results(2019)

Based on the calculation results obtained that a significant wave height that occurs due to the generation of wind speeds obtained significant wave height ranging from 1,782 to 2,202 m.

c. Tides

Tides are sea level fluctuations due to the attraction of objects in the sky, especially the sun and moon against the mass of sea water on earth. The highest (low) and low tide water levels are very important for planning coastal structures. For example, the elevation of the crest of a breakwater, jetty, etc. is determined by the elevation of the tide level, while the depth of the shipping lane / port is determined by the low tide [11].

Tidal Classification is carried out as follows:

- Double daily tides (semi diurnal tide)
In one day there are two high tides and two low tides with almost the same height and tides occur regularly. The average tidal period is 12 hours 24 minutes.
- Single daily tides (diurnal tide)
In one day there is one high tide and one low tide. The tidal period is 24 hours 50 minutes.
- Tidal mixture tends to double daily (mixed tide prevailing semidiurnal)
In one day there were two high tides and two times low tide, but the height and period were different.
- Tidal mixture tends to a single daily (mixed tide prevailing diurnal)
In this type in one day there is one high tide and one low tide, but sometimes for a while there are two high tides and two low tides with a height and a very different period.

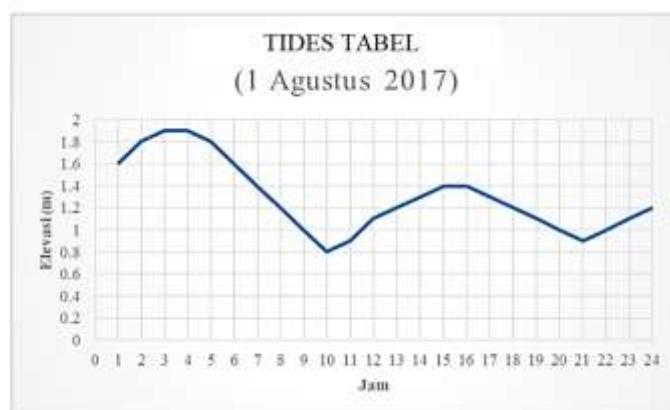


Figure 10 Tidal Charts for One Day

Source: DISHIDROS (2017)

Tidal data is used in the process of analyzing the High Water Level (HWL), Mean Sea Level (MSL), and Low Water Level (LWL). The data used are data from DISHIDROS [12], the following is a sample of tides around the job site on August 1, 2017.

From these data it is known that there are 2 (two) tides, and 2 (two) tides so that the coastal in Canggu area is classified as a coastal with a type of daily tidal (semidiurnal tide).

IV. CONCLUSION

Based on the results of the study, there are several conclusions that can be drawn including the following. The coastal in the Canggu area is a sandy beach with the type of ocean beach and where the erosion process is more dominant than the sedimentation process.

1. Based on the Badung Regency Badung Regency Spatial Planning map, the coastal area of the Canggu area is dominated by geological structures from alluvium deposits that have low resistance to erosion by waves, currents and tides. Therefore, in the management and planning of coastal areas must be very careful and it is recommended to pay attention to Environmental Impact Analysis.

2. The morphology of the Canggu area is dominated by hills of medium and low relief with latosol soil types. Latosols are formed under climatic conditions with high rainfall and temperatures in the tropics and semi-tropics, crushed forces work more quickly and which have a more extreme influence than in temperate regions.
3. The direction of the dominant wind blows from the West by 38.33% with the most dominant wind speed in the range of 15-20 knots, with a significant wave height that occurs due to the generation of wind speeds ranging from 1,782 to 2,202 m.
4. Based on tidal data obtained from DISHIDROS, it can be seen that there are 2 (two) tides, and 2 (two) tides so that the coastal in Canggu area is classified as a coastal with a type of daily tidal (semidiurnal tide).

REFERENCE

- [1]. The Government of the Province of Bali, "Bali Province's Regional Environmental Status", 2015.
- [2]. Aryastana, P., Ardantha, I.M., &Agustini, N.K.A., "Analysis of Coastal Change and Erosion Rate in Denpasar City and Badung Regency with Spot Satellite Imagery", *Journal of Foundations*, Volume 6 No 2, 100, 2017.
- [3]. Dolan R., B. O. Hayden, and M. K. Vincent, "Classification of coastal landforms of the Americas", *Encyclopedia of Beach and Coastal Environments*. p. 72-88., 1975.
- [4]. Bali Penida River Basin, "Map of Canggu Area Bathymetry", 2018.
- [5]. Regional Development Planning Agency Research and Development, "Regional Spatial Planning (RTRW)", Badung Regency Government, 2013.
- [6]. Dahuri, R et al, "Integrated Resource Management of the Coastal and Ocean Areas", Jakarta: PT.PradnyaParamita, 2001.
- [7]. Soepardi, G., "Nature and Characteristics of Soils", Faculty of Agriculture Bogor Agricultural University, 1983.
- [8]. PurnomoDony, "Slope classification", <http://Pinterdw.blogspot.com/2012/03/classification-slopesmartzone-blogger-slope>, Accessed on 7 August 2019.
- [9]. NgurahRai Station Meteorology and Climatology Center, "Monthly Average Wind Speed Data", 2017.
- [10]. BambangTriatmodjo, "Beach Engineering", Beta Offset, Yogyakarta, 1999.
- [11]. Lolong, M., Masinambow, J., "Determination of the Characteristics and Performance of Hydro Oceanography", 127-134., 2011.
- [12]. DISHIDROS of the Navy, "Tidal Charts for 1 Day", 2017.

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