Granulometric Extraction Value to Determine Waves, Currents, and Tides Characteristic of Tangsi Beach (Pink Beach) East Lombok Regency, Indonesia

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Abstract. The coastal area is the most dynamic place on earth. Deposition of coastal material is one of the natural agents to determine the occurrence of the coastal dynamic. Characteristics of the coastal material reflect the characteristics of waves, currents, and tides. This research was conducted at Tangsi Beach or Pink Beach, East Lombok Regency, Lombok Island. Lombok Island is one of the islands in the province of West Nusa Tenggara, considered as the world's third best island in 2018 for tourism. The main objective of this study was to extract granulometric values as estimators of the characteristics of waves, currents, and tides of Tangsi Beach, East Lombok Regency. Sorting and roundness as part of granulometry information were used as the main parameters of the granulometric approach. The method to granulometry assessment by the Gradistat program that was taken from the results of the coastal material screening. The results show that the characteristics of Tangsi Beach material are classified as Rounded poorly sorted. The classification results illustrate that wave and current conditions tend to be less stable with a distance of high highest water level (HHWL) and low lowest water level (LLWL) tend to be medium.

1. Introduction
Climate change has made a significant influence on various human activities on the earth's surface, shown by global warming or sea level rise [1-3]. Indonesia is one of the countries with the greatest risk of global climate change [4]. This is due to Indonesia is an archipelago with the threat of rising sea levels [3] and at the same time is located in the equatorial region which has an impact on dynamic weather conditions.

Indonesian as an archipelagic country, resulted in a wide coastal area. In fact, coastal areas facing a direct impact on climate change. This is characterized by storm events and/or high waves in various regions of the earth's surface. In addition to hurricanes and high waves, changes in ocean waves and currents are also an impact of climate change.

Characteristics of ocean waves and currents in a coastal area are one of the important aspects of oceanographic studies. Currents are the main agents for supplying suspended sediments in the nearshore zone and deposit them around which are then naturally configured by waves [5, 6]. Thus, the material characteristics deposited in the coastal area can basically determine how the wave, current, and tidal processes occur, namely through grain size analysis (granulometric). Widely, the material analysis mentioned as one of important study to analyze the landform evolution [7]. The deposited material characteristic was also utilized by [1, 7]. Nevertheless, in their analysis the deposited material only mentioned in general context which not describe in grain size analysis physically, can be called remote analysis.

The purpose of this study was to identify wave and current characteristics using a grain size analysis approach for coastal material or granulometry in Tangsi Beach, East Lombok Regency, West Nusa Tenggara, Indonesia. Tangsi beach was chosen because of its unique sediment material with a
red color combination of coral reefs and give the impression of a pink color on the beach material. In addition, Tangsi Beach was chosen because of the lack of research related to physical characteristics and in general, research only leads to socio-economic studies. On the other hand, the socio-economic potential will not develop optimally if the physical potential is not well understood.

1.1. Study Areas
Lombok Island is the world's third-best island based on a poll of one of the world's traveling websites for 2018 precisely as edited at www.travelandleisure.com. Currently, Lombok Island is also one of the islands that are a development priority in Indonesia. It is mentioned in 2016-2019 Priority Tourism Destination Development Plan. In its development, Lombok Island is planned to become the best halal tourism destination in the world [8]. The other branding mention of Lombok Island as a sister island of Bali. Another branding related to halal tourism is that the island of Lombok is called the 1000 Mosques Island.

East Lombok is one of the regencies in West Nusa Tenggara, Indonesia. The eastern boundary is Sumbawa Regency. Oceanographic conditions in East Lombok region are more likely calmer than West Lombok [9]. These conditions can basically support tourism activities in East Lombok, one of which is Tangsi Beach. Tangsi Beach is a beach located in Jerowaru District, East Lombok Regency, West Nusa Tenggara Province. Geographically it is at position 8°49'33,4" EL and 116°31'21,5" SL (Figure 1).

![Figure 1. The location of Tangsi Beach marked with the red box](image)

Tangsi Beach is one of the unique beaches in Lombok Island. Tangsi Beach has reddish white sand due to the presence of pipe coral debris (*Tubipora Sp.*) As presented in Figure 2 [10] and is a pink-colored beach in Indonesia.
2. Methods

The method used in this study is the direct retrieval of beach material samples which then carried out laboratory analysis to obtain granulometry data. Laboratory analysis was done by weighing a sample of 100 grams. Samples that have been weighed, then sieved using a sieve measuring 8 mm, 4 mm, 2 mm, 1 mm, 0.5 mm, and 0.25 mm. The sieve results then used to determine the grain type (Figure 3) and the mean value, standard deviation (sorting), skewness, and kurtosis. The determination of these values is based on the following formulation (Table 1) [11]:

Table 1. Formulation to determine the grain types, the mean value, standard deviation (sorting), skewness, and kurtosis

| Mean | Standard Deviation (Sorting) | Skewness | Kurtosis |
|------|-----------------------------|----------|----------|
| \( \bar{x} = \frac{\sum fm}{100} \) | \( \sigma_a = \sqrt{\frac{\sum f (m - \bar{x})^2}{100}} \) | \( Sk_a = \frac{\sum f (m - \bar{x})^3}{100\sigma_a^3} \) | \( K_a = \frac{\sum f (m - \bar{x})^4}{100\sigma_a^4} \) |

Note: \( f \) is a frequency in percent; \( m \) is the midpoint of each class interval in the metric (\( m_m \) or \( m_f \)).

Determination of wave, current and tide characteristics (HHWL, high highest water level, and LLWL, low lowest water level) was seen based on the standard deviation (sortation) obtained from granulometric and roundness that calculated based on visual interpretations of sediment and digital microcamera matched with Wentworth's scale. Sortation and roundness classification were described in Table 2 [12]. The simple idea of this determination is that the better standard deviation or sorting of...
a beach material and also the more rounded material, the more stable wave power and current both direction and energy which tends to be low, in case of the source of the material is not the terrestrial material which transported by fluvial activity. The sorting and roundness relationship as presented in Figure 4.

**Table 2. Sortation and Roundness Classification**

| No. | Material | Sortation and Roundness | Waves, Currents, and Tides Characteristic |
|-----|----------|-------------------------|-------------------------------------------|
| 1   |          | *Rounded poorly sorted* | Wave conditions and less stable currents are weak in strength, a medium distance of HHWL and LLWL |
| 2   |          | *Rounded well sorted*   | Stable wave and current conditions with energy that tends to be weak, long distances of HHWL and LLWL |
| 3   |          | *Angular well sorted*   | Stable wave and current conditions with energy that tends to be strong, short distances of HHWL and LLWL |
| 4   |          | *Angular poorly sorted* | Unstable wave and current conditions, the distance between HHWL and LLWL is very short |

Source: [12] and modification

**3. Result and Discussion**

The first results were taken from the visual interpretation of the beach material at Tangsi Beach as shown in Figure 2. Based on observations, the beach material in Tangsi Beach is classified as rounded poorly sorted or round with unfavorable sorting. Thus, based on existing material classifications it can be said that the wave and current conditions in Tangsi Beach can be said to be less stable with weak strength, and the distance of HHWL and LLWL to the tides tends to be medium. This is also accompanied by granulometric calculations as shown in Table 3.
The relationship of coastal material conditions with waves, currents, and tides is evidenced by research conducted by [13] as shown in Figure 5. Long HHWL and LLWL conditions wave and current dissertations that tend to be weak, allowing coastal material to be sorted well while experiencing protection effectively so that the material is more rounded.

**Table 3. Tangsi Beach Sample Granulometry Calculation Results**

|                | FOLK & WARD METHOD |                |                |
|----------------|---------------------|----------------|----------------|
|                | Geometric mm        | Logarithmic f  | Description    |
| MEAN (x)       | 482.1               | 1.053          | Medium Sand    |
| SORTING (s):   | 1.547               | 0.629          | Moderately Well Sorted |
| SKEWNESS (Sk): | -0.270              | 0.270          | Fine Skewed    |
| KURTOSIS (K):  | 0.757               | 0.757          | Platykurtic    |

**Figure 5.** The relationship graphic between the distance of deposition and roundness

Based on research conducted by [13], the distance and roundness relationship reached 88% seen from the results of the coefficient of determination (R²) obtained based on the correlation test. The farther distance of the material will be deposited at a low speed, the condition of the material grains will be even more circular [14].

Wave and current conditions as the results of the assessment shew a weak tendency with the unstable condition. This is evidenced by the results of matching the wind speed carried out on July 14, 2018, precisely on the east season measurement of 11 km/hr or 3.05 m/s (Figure 6). Wind and waves...
have a strong relationship as in the Beaufort Scale [15]. With this result, the measured wave height reaches 0.2 - 0.5 m which tend to have a slight breeze. Furthermore, from wind and wave availability, kinetic energy is directly transmitted to current conditions [16-20].

The distance between HHWL and LLWL which is classified into the medium is evident from the results of time series observations which indicate that the type of tides tends to be mixed to double daily (Figure 7). Thus, the term of medium classification means that even though the peak distance of HHWL and LLWL in tidal events tends to be far away, but there are smaller peak and low tide in the top of the peak so that the material will not be sorted and rounded perfectly. The peak and low tide in the middle of HHWL and LLWL are interpreted as a distance breaker at the peak of HHWL and LLWL.

Figure 6. Wind conditions in the area of Tangsi Beach with a speed of 11 km/hr (source: [21])

Figure 7. Tidal conditions in the area of Tangsi Beach based on observations at Tanjung Luar Station, East Lombok Regency (source: [22])

The matching process that had been done based on sorting classification and roundness towards the wave, current and tidal characteristics gives results that correspond to real-time data published by the responsible agency or website. Thus, it can be said that the classification of the
sorting values and roundness for wave, current and tidal assessment formulated in this study can be justified as the conditions that occur in the field.

4. Conclusion
Based on the results, the classification of materials in Tangsi Beach is in the rounded poorly sorted category which means it has the characteristics of waves and currents that tend to be less stable with weak strength. Furthermore, the current conditions are classified into the medium category. In this category, Tangsi Beach is suitable for tourism activity, not only seen by its unique of the pink sand but also the wave and current characteristics shown by grain analysis. The artificial tourism attraction better not to close to the beach, because even if the wave and current shew a weak tendency, but it shown to have the unstable condition and the tidal classified into medium classification which indicates that the type of tides tends to be mixed to double daily. The more artificial tourism attraction faces the unstable wave and current and also the tidal energy the more its face the degradation of the durability.

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