Distribution of sediment grain size in Kajhu coastal area, Aceh Besar District, Indonesia

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Abstract. Kajhu coast located in Baitussalam sub-district, Aceh Besar district. This location was once hit by a tsunami. Currently, the Kajhu coastal area continues to change, among which changes occur in new sediment deposits which are quite rapid around the estuary followed by an increase in the rate of erosion on the other side of the estuary. This phenomenon resolves rehabilitation plants to become extinct. This research conducted to analyze the distribution of sediment grains in the Kajhu coastal region. The distribution of sample grain size determined by the dry sieving procedure. Sediments sorted into grain size fractions of 4.75 mm, 1.70 mm, 850 μm, 200 μm, 100 μm. Then the sediment weight calculated based on Shepard's triangle. The results showed the Kajhu Coast research area had three sedimentary fractions namely gravel, sand, and mud with the gravel highest percentage at station 2 (33.72%), the sand highest percentage at station 4 (97.27%) and the mud highest percentage found at station 6 (24.61%).

1. Introduction

Kajhu coast was one of the largest areas impacted by the tsunami in 2004. Besides causing fatalities, the tsunami has also made significant changes in the coastline area. This phenomenon was also reported to occur in others area, for instance, the western coast of Simeulue, Indonesia[1,2], north-west coast of Peninsular Malaysia [3] and the coast of Sendai, Japan [4, 5].

To date, changes in the Kajhu coastal area because of abrasion and sedimentation continue. This has an impact on damage to the mangrove rehabilitation area and increased seawater intrusion into the residential areas. According to Dong et al., sediment characteristics were one factor that influences the rate of abrasion and sedimentation in coastal areas [6]. Currently, sediment statistical approaches have become a popular method used to assess topographic changes that occur in an area [7-9]. In addition, chemical analysis of sediments provides significant tools for water-quality management and partitioning dynamics of heavy metals [10, 11].

Grain size characteristics were one of the fundamental factors affecting the sediment transport rate in the coastal area [12], Purnawan et al. [13], state that studies related to the distribution of sediment grain required in order to analyze the provenance of sediments, transport history, and other hydrodynamic processes. Besides that, the grain size of sediments can also be used to describe the deposition rate and distribution of energy in an area [14]. To date, studies underlying sediment...
characteristics based on grain size in the coastal region of Kajhu still have not revealed. Therefore, this study conducted to find out the distribution of sediment grain size in Kajhu coastal area.

2. Materials and Methods
The data collection was carried out at Kajhu coastal area, subdistrict of Baitussalam, district of Aceh Besar. The sampling station was divided into six locations, which was considered to represent the coastal area, estuary area, and river area (Figure 1). Sediment sampling was taken using bottom grab sampler. The collected samples were put into labeled containers and transported to the laboratory for further analysis. Current velocity at each station measured using floating dredge.

![Figure 1. Sampling Location](image)

Analysis of sediment samples was carried out in the Marine Biology Laboratory, Faculty of Marine and Fisheries, Universitas Syiah Kuala. The grain size distribution of the sediments determined by standard dry sieving procedure. The sediment sorted into grain size fractions of 4.75 mm, 1.70 mm, 850 µm, 200 µm, 100 µm. The sediment samples left at each filter size were weighed and determined using:

\[
\text{weight percentage of sediment fraction } i = \frac{\text{Weight of sediment fraction } i}{\text{Total weight of sediment}} \times 100
\]

Sediment classification was determined based on the Wentworth Scale, while the type of sediment at each station was determined based on Shepard triangle.

3. Results and Discussion
Grain size can provide basic information on different processes of erosion, movement, and deposition of sediment particles [15]. In addition, the distribution of grain size was also been linked with the
energy level of the sediment transport agent [13, 16]. Results of the study show that Kajhu coastal area consisted of three sediment fractions namely gravel, sand, and mud (Figure 2 and Figure 3). The gravel highest percentage has found at station 1, the sand highest percentage has found at station 5, while the mud highest percentage has found at station 6 was 33.72%, 97.27%, and 24.61% respectively (Figure 3). Based on the type of sediment, the sand was the dominant type of sediment that found spread in most of the stations observed (Figure 2 and Figure 3). Similar results have also reported in several other coastal areas in Aceh, for instance, Alue Nagariver [17], Pulau Kayuestuary of Southwest Aceh District [18], and Lamrehestuary, Aceh Besar District [19].

![Figure 2](image-url)  
Figure 2. Comparison of the sediment composition in each sampling stations

Results of the study showed that the sediment type of gravelly sand only found in one station, station 1. This phenomenon was thought to be influenced by the stronger current around this station compared to other stations. The measurement results show that the current velocity near the coast was higher than the other 2 locations, which were 0.28 m/s, 0.23 m/s and 0.18 m/s, respectively. According to Irham et al. [20], currents and tides play an important role in selecting the size of the type of sediment that has an impact on the grain size variation in certain areas. Sediments that have a coarse fraction tend to be difficult carried away by strong currents, whereas fine sediments will be suspended and settle at stilled waters condition.
The highest percentage of sediment fraction of mud was found at station 6. Besides that, this station also contains a higher percentage of fine sand than other stations. The high percentage of mud and fine sand in this location was thought to be influenced by the reduction of the current velocity at this station. Irham et al. [20] stated that the estuary area was a common region of fine-sized sediment deposition, due to a reduction in current velocity both from the river and the sea. According to Purnawan et al. [13], sediment characteristics that lead up from the river to estuaries tend to have a finer grain size, whereas sediment originating from the coast tend to more coarse.

4. Conclusion

Results of the study show that Kajhu coastal area comprised three sediment fractions namely gravel, sand, and mud. The gravel highest percentage has found at station 1, the sand highest percentage has found at station 5, while the mud highest percentage has found at station 6 was 33.72 %, 97.27%, and 24.61 % respectively. Based on the accumulation of sediment distribution, sand was a sediment fraction with the highest percentage coverage in the most stations observed. This condition has a potential impact on an inadequate sediment binding process that can change the coastal landform condition.

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