Distribution of basic sediments (bedload transport) on changes in coastal coastline Donggala, Central Sulawesi Province, Indonesia

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Abstract. This study entitled "Distribution of Bedload Transport Against Coastline Changes in Donggala Coast", the formulation of the problem (1) how much of the estimated bedload transport in Donggala Bodies; (2) where were the location of erosion and sedimentation strong point based on the estimation of bed load transport; (3) the extent to which the prediction of shoreline change rate of transport of sediments in coastal areas Donggala. This study aims to: (1) the calculation of estimated bed load transport in Donggala waters; (2) determining the location of the point of erosion and sedimentation strong basis of estimated bedload transport; (3) the prediction of shoreline change rate of transport of sediments in coastal areas Donggala. The survey method used in this research to collect primary data include: (1) decision point waypoint coordinates of each location of measurement; (2) measurement of height, period and direction of the waves; (3) a large measurement of sediment transport; (4) The angle measurement coastline, angle of attack and wave direction, and secondary data include: (1) information from the public; (2) the physical condition data field. The results showed that: (1) general estimate sediment transport base in each location data collection is varied. This is due to the different points of the coastline as well as the angle of attack of the shoreline waters broke Donggala; (2) strong abrasion at the study site occurs at the point Ts4 (622.75 m$^3$/yr) and TS11 (755.25 m$^3$/yr) located in the Village Tosale and point Tw7 and Tw17 (649.25 m$^3$/yr) located in the Village of Towale. As for the strong sedimentation occurs at the point Ts3 (450.50 m$^3$/yr) located in the Village Tosale and Tg3 point (357.75 m$^3$/yr) located in the Village Tolonggano; (3) of the predicted outcome coastline changes based on the input data estimate sediment transport, beaches and waves parameters is seen that the changes in the location prophyl coastline tends toward research into or undergo a process of abrasion.

1. Introduction

Increased disaster due to atmospheric weather systems (ie tropical storms) is a major risk in coastal areas. With global weather changes, storm surges have shown an increasing trend in intensity and frequency [1]. Changes in Donggala beaches are naturally unavoidable from disaster vulnerabilities; However, vulnerability assessment, hazard mitigation, and adaptation planning can reduce the impact and facilitate community recovery [2-4]. Particularly, the vulnerability that combines potential loss with regional response capacity is key to disaster defense [5], which illustrates how coastal areas vary
in risk coverage, risk levels, and handling capacities, has played an important role in overall disaster management [6]. Thus Donggala coastal areas, as well as a very fertile area for these waters as part of Makassar Strait. Therefore, to be able to show the extract of coastline position with high accuracy preferably with IKONOS Geo stereo image [7].

Overview of Oceanography shows that the coastal region of Donggala with batimeties great depth, suitable to support coastal tourism facilities. Until now, the beach “Cape Coral” as one of the domestic and foreign tourist and harbor “Donggala” as one of the fishing ports and container ports located along the coast of Donggala.

Over the years, it is generally regarded as the degree of vulnerability or coastal change as the degree of vulnerability of society, systems, or units to risk, including their capacity to adapt to hazardous conditions [8, 9]. Most existing research focuses on exposure, sensitivity / vulnerability, and capacity / resilience [10-12]. However, a comprehensive assessment that emphasizes the holistic features of coastal vulnerability has become a hot topic [13]. Many studies fail to capture the comprehensive influence of sediment distribution factors on the coast [14, 15], ie river basin aggregation, sensitivity / vulnerability, capacity / resilience, and coastal adaptability [16, 17]. The problems that occurred in the coastal area of Donggala for which this is a sediment transport system which resulted in erosion and sedimentation processes, impacting changes in the beach profile. The complexity of the problems in the management of coastal and marine areas indicate a need for the formulation of strategic steps to handle because it was realized that the resources contained in the region capable of providing a significant economic value for public revenue and regional development.

This study will focus on determining the basic sediment transport rate (bed load), and predicts changes in coastlines. The location selected in the waters Donggala southern part of the process of erosion and sedimentation is quite high in every year and has threatened a variety of facilities and infrastructures, namely the geographical position 0° 38' 34" - 0° 49' 33" latitude and 119° 32' 30" - 119° 46' 36" East Banawa sub district area 99.04 km2 with a population 16,467 people (males) and 15,775 people (womens); South Banawa subdistrict area 430.67 km2 population 12,338 people (men) and 11,506 people (womens); and spacious subdistrict Middle Banawa 74.64 km2 with a population of 5,259 people (males) and 4,884 people (womens). In terms of weather and climate, Donggala has a tropical monsoon climate types with an average annual temperature between 26.70°C to 28.70°C; Average annual air pressure between 1008.50 to 1011.60 mb; the average annual air humidity between 70.00 to 82.00% and total annual rainfall of 31.3 mm to 123.0 mm, the average wind speed of 3 to 5 knots and the average wind direction is north and northwest.

2. Methods
The research methodology is based on several steps, namely: determining the location of the research conducted by purposive sampling, primary and secondary data collection, data analysis and report preparation. The research location is along the territorial waters (coastal) Donggala southern distributed in 3 Districts with the 6 village/village, as shown in Table 1.

2.1 Determining the Location
Purposive sampling carried out by the consideration that the beach location of the study consisted of loose material such as sand, gravel, clay or a mixture of all three are capable of change when there are external forces, such as erosion, abrasion, and accretion [18]. In general, the sediment transport processes occur because: (a) stirred material cohesive from the sea floor to the suspended, or the escape of non-cohesive material on the seabed; (b) horizontal displacement of the material; (c) settling back particles / sediment material.
Table 1. District and village/village Location Research

| No. | Name of the District | Village                     | Geographical location          |
|-----|----------------------|-----------------------------|--------------------------------|
| 1.  | Banawa               | Loli Saluran and Loli-Tasiburi | 0° 38’ 34” – 0° 49’ 33” LS and 119° 39’ 43” – 119° 42’ 25” BT; |
| 2.  | Central Banawa       | Salubomba and Towale         | 0° 41’ 11” – 0° 50’ 07” LS and 119° 39’ 43” – 119° 46’ 17” BT; |
| 3.  | South Banawa         | Tosale and Tolonggabo        | 0° 45’ 53” – 1° 00’ 57” LS and 119° 32’ 30” – 119° 46’ 36” BT; |

2.2 Data Collection
There are two forms of data: primary data obtained from the field, while the secondary data obtained at meteorological stations Palu Mutiara airport.

2.3 Analysis
Three dimensions of change/vulnerability have been well articulated in the literature [19]. The first dimension is exposure, which focuses on frequency, duration, and magnitude of natural hazards. The second dimension is the degree to which the system is affected, usually named as sensitivity to harm. Adaptability, the third dimension, is the ability to adapt to external pressures, moderate damage potential, exploit opportunities, or overcome the consequences [20]. Another framework proposed by [21] includes sustainable development in the assessment of changes on the coast, covering social, economic, and environmental aspects.

Change (evolution) coastline can occur on a scale of seconds to millions of years [22]. According to, [23, 24] its shape can be divided into: beach, shore, shore line, back shore, offshore, and barrier[11]. Profile shape as in Figure (1) beach is very influenced by the wave of attacks, the nature of the sediment, wave and current conditions, as well as coastal bathymetry. The beach is made up of a basic material such as silt and clay (Ø = 0.063 mm) with a very small slope is 1:5,000 and caused variations in the slope of the beach; sand (Ø = 0.063 to 2.0 mm) with a relative density of about 2.65 to form a slope beach about 1:20; and stone (Ø = 2.1 to 2.56 mm) has a gradient ranging from 1: 4 [17, 11, 25].

The journey of a wave towards the shore, several changes the wave height, such as: the process of silting wave (wave shoaling), the process of refraction, the process of diffraction, or the reflection before the wave broke (wave breaking) [26]. The processes of the above need to know to predict how large component that causes long shore wave energy and wave height determination plan. This information is useful to determine the best location of a port or harbor entrance. The process of transformation of waves that occur above will be explained below:

Events a wave toward the shallow waters will undergo a process of change in height, length, speed and direction of the waves due to bending deformation depth contours, resulting in shallow water waves slower stir. The process of change in this direction is called refraction. This means that when the diffraction of waves, then the energy will surge towards the area protected by the island, the rock/reef jutting into the ocean or coastal structures. This energy transfer will cause waves in the protected area. If the slope of the waters can be ignored, it can be stated as follows. The weight assigned to each weighting method can then be calculated using equation (1, 2), as follows:

\[
L = \frac{c g T^2}{2\pi} \tanh \frac{2h}{L}, \quad c = \frac{g T^2}{2\pi} \tanh \frac{2h}{L}, \quad L_o = \frac{c g T^2}{2\pi}, \quad C_o = \frac{g T}{2\pi}
\]  

From the above equations can be written in equation form, as follows:

\[
\frac{L}{L_o} = \frac{C}{C_o} = \tanh \frac{2h}{L} \text{ and } \frac{h}{L} = \frac{h}{L} \tanh \frac{2h}{L}
\]
where: \( L = \) wavelength at a depth \( h \) by water depth and wavelength in deep water, the wavelength can be calculated from the period of the wave [27].

2.4 Wave Breaking
If the incident wave silting continues, it will gradually tilt the wave will grow, and in the end the wave will break at certain depths. Breaking waves are classified into three categories: spilling, plunging and surging as shown in Table 2 [28, 29].

Breaking wave boundary conditions for all water depths is to meet the following equation [20]:

\[
\frac{H}{L_{\text{max}}} = \frac{1}{7} \tanh \left( \frac{2\pi h}{L} \right)
\]  

Meanwhile, for the water in \( \frac{H}{L_{\text{max}}} = \frac{1}{7} \) and for shallow water \( \frac{H}{L_{\text{max}}} = \frac{1}{2} \frac{2\pi h}{L} \).

2.5 Bouncing wave field Tilt, beach, Revetment, and Breakwater
The reflection wave (Wave Reflection) occurring process as well as the reflection of light that occurs in the mirror as shown in Figure 3 below: The reflection coefficient-\( C_R \) is a high ratio of the reflected wave (\( H_R \)) with the coming wave height (\( H_i \)). So that the reflected wave peak amplitude is equal to the amplitude in the shadow of the wall reflection coefficient multiplied.

\[ H_R = C_R \times H_i \]  

The reflected energy from the beach or an artificial structure depends on the slope, roughness, and the permeability of the beach or the structure, as well as fraud wave (wave steepness) and the angle of attack shows the relationship of these parameters as follows [28]:

\[ \xi = \frac{1}{\cot \phi \sqrt{\frac{H_i}{L_o}}} \]  

where:
- \( \phi \) = slope of the beach or the building to the horizontal
- \( H_i \) = high wave coming
- \( L_o \) = wavelength in deep water

2.6 Refraction wave (wave refraction)
General equation of wave refraction:

\[ C = \frac{gL}{2\pi} \tan \frac{2\pi h}{L} \quad \text{or} \quad C = \sqrt{gh} \]  

for shallow water, for shallow water, the waves can be transformed from the wind data. Therefore, the wave crests are moving towards the shallow area, experiencing deflection or orthogonal, hereinafter called "refraction". At sea in the distance between the orthogonal fixed, but in shallow waters this distance will be widened or narrowed depending on depth contours. Figure 5 the distance between the orthogonal when the waves approaching the shore. By ignoring the wave energy dissipation, we can state of conservation of the energy flux that is bounded by two orthogonal as follows:

\[ b_o \times P_o = b \times P \]  

where:
bo and b = distance between orthogonal in the deep sea and shallow waters
P, and P = wave power (average energy flux per unit width in one period of the wave) in the
deep sea and shallow waters.

\[ P = nE \frac{c}{C} \]

\[ E = \text{energy wave} \left( = 8 \frac{c}{2} \right) ; n = \frac{C}{c} = 0.5 \left( 1 + \frac{2kh}{\sinh 2kh} \right), b_0 = 0.5 \]

thus the equation (9) above can be written in the form:

\[ b_0 n E \frac{c}{c} = b_0 n E \frac{c}{c} = \text{constant} \]

\[ \frac{H}{h_0} = \frac{\frac{1}{2}c}{2 \frac{k}{b} + \frac{k}{b}} = \frac{H}{h_0} \frac{\frac{1}{2}c}{2 \frac{k}{b}} \]

where:

\[ \frac{H}{h_0} = \text{is shoaling coefficient (K_s) whose value depends on the} \ \frac{d}{L} \ \text{or} \ \frac{d}{L_o} \ \text{and} \ \sqrt{\frac{b}{b_0}} \ \text{is the} \ \text{refraction coefficient (K_r). ;} \ H_o \ \text{is the equivalent of wave height in the water.} \]

From equation (8) shows that the wave height is larger if the distance is orthogonal to shrink. Therefore, a long wave with a period which will first undergo refraction in the water, thus forming a higher wavelength when it reaches the shore [30, 31]. Wave refraction obtained from wind will be off again by a cape (headland) is then received by a bay nearby [32].

2.7 Diffraction Wave (Wave Defraction)
Wave diffraction is analogous to the diffraction which also happens to light, sound or electromagnetic waves. It showed that the mathematical completion to the diffraction of light can also be used to estimate the pattern of wave peaks and high variations in water diffraeted wave.

Diffraction occurs when there are differences in wave energy, as waves across a barrier. will have a larger energy (early wave energy) than previously calm waters behind the barrier (no energy or no waves).

2.8 Changes By Presence Structure Coastline Beach
Shoreline change will occur because of the presence of structures that interfere with the stability of natural sediment transport by scouring. At the foot of coastal structures where sediment transport occurs in the direction perpendicular to the shoreline (onshore-offshore transport/cross-shore transport) [31].

2.9 Changes in Coastline Models
This current is largely confined within the zone waves (surf zone) and was highly influential in the process of sediment transport because it lasts a long time.

According[12],that the coastal fringe flow velocity can be calculated using the following equation:

\[ V_b = \frac{5 \pi v}{16 \gamma} \left( \frac{gh_b}{16} \right)^{1/3} \left( \tan \beta \sin \alpha \right) \]

where: \( V_b \) is the flow velocity at the coastal fringe area of a breaking wave, \( C_f \) is the friction coefficient basic beach

\[ C_f = \left[ 1.7 + 2 \log \left( \frac{18}{2k} \right)^{-2} \right] \gamma \]

is the ratio between the wave height and depth at the time of rupture breaking wave, \( H_B \) is the depth at the time of breaking waves, \( \alpha_B \) is the angle of attack on the line of
destruction, tan α is the flatness of the beach, k is characteristic of sedimentary grains = 10^{-3} to the sandy beaches and g is the acceleration due to gravity [19; 28].

The model changes apply shoreline sediment continuity equation, the beach is divided into a number of cells (segments) [33]. In every cell in terms of sediment transport incoming and outgoing, is the net amount of the mass flow rate in the cell is equal to the rate of change in the cell mass per unit time. Mass flow rate of sediment in the cell are:

\[ M_k = \rho_s (Q_{in} - Q_{out}) \]  

(10)

If there is a river that spew sediment, then the sediment will be diffused along the coast around the river [27]. Conversely, when there are no rivers along the coast are reviewed, then the changes arising from the erosion of the coastline somewhere accompanied by sedimentation elsewhere. Changes in the shoreline can be approximated by using conservation of sediment continuity equation, namely:

\[ \frac{\partial}{\partial t} \left( \frac{1}{1-\lambda} \left( \frac{\partial q_x}{\partial x} + \frac{\partial q_y}{\partial y} \right) \right) = 0 \]  

(11)

If the constant wave circumstances, then the first term and the second term equation can be ignored, resulting in the above equation becomes:

\[ \frac{h_k}{B} \frac{\partial y_o}{\partial t} = \frac{1}{(1-\lambda)B} \frac{\partial Q_x}{\partial x} \]  

(12)

Where: hk is the depth waters down steeply, B is the width of Sandrift, yo is shoreline change, and the amount of sediment transport Qx coastal fringe. Interpretation of the above equation is:

\[ \frac{\partial y_o}{\partial t} < 0, \quad \text{if} \quad \frac{\partial y_o}{\partial t} > 0 \quad \text{erosion}; \quad \frac{\partial y_o}{\partial t} > 0, \quad \text{if} \quad \frac{\partial y_o}{\partial t} < 0 \quad \text{accretion (sedimentation)} \]

If coastal erosion will occur at the location of the transport of sediments to increase, then the accretion beach is going to happen in the area where the transport of sediment decreased.

3. Result and discussion

The data on the research and discussion on wave parameters and the potential transport of sediments (bedload transport) to the rate of change of coastline in the territorial waters of Donggala (Table 2, Table 3, Table 4, and Table 5).

3.1 Data Meteorological Station

| Year | Temperature °C | Air pressure (mb) | Humidity (%) |
|------|----------------|------------------|--------------|
| 2016 | 27.71          | 1010.39          | 76.67        |
| 2015 | 27.58          | 1010.28          | 74.92        |
| 2014 | 26.56          | 1010.40          | 79.00        |
| 2013 | 27.31          | 1010.32          | 77.67        |
| 2012 | 27.29          | 1012.05          | 74.25        |
Table 3. Average Solar Radiation Parameter, Precipitation, Wind Speed, Wind Direction at the Meteorological Station 2016

| Month | Length of Daylight (%) | Rain falls (mm) | Winds velocity (knots) | The most of wind direction |
|-------|------------------------|-----------------|------------------------|---------------------------|
| 2016  | 63.53                  | 71.62           | 3.67                   | North                     |
| 2015  | 65.17                  | 46.90           | 4.42                   | North                     |
| 2014  | 54.25                  | 79.09           | 3.55                   | North                     |
| 2013  | 62.42                  | 79.45           | 4.18                   | North                     |
| 2012  | 67.42                  | 50.05           | 4.40                   | North                     |

3.2 Results of Data Processing Wave

Table 4. Results of Wave Data Management

| No | Location (Kel.) | H0(m) | n | Input Data | Result |
|----|-----------------|-------|---|------------|--------|
|    |                 | T(s)  |   | T(s)       |        |
|    |                 |       |   | A(°)       |        |
|    |                 | L(m)  |   | HB(m)      |        |
|    |                 | db(m) |   |            |        |
| 1  | Loli-Saluran    | 1     | 100| 237        | 15     | 8.76 | 1.67 | 1.50 |
| 2  | Loli-Tasiburi   | 1.5   | 100| 275        | 20     | 8.80 | 1.812| 2.09 |
| 3  | Salubomba       | 2.0   | 100| 353        | 35     | 10.7 | 2.12 | 3.2  |
| 4  | Tsaloe          | 1.5   | 100| 317        | 30     | 9.01 | 1.99 | 2.57 |
| 5  | Tsaloe          | 2.0   | 100| 275        | 13     | 8.80 | 1.84 | 2.57 |
| 6  | Tolonggano      | 1.5   | 100| 321        | 15     | 8.92 | 1.93 | 1.51 |

where:

H0: The wave height (m); HB: High waves break (m); Q: wave period (s); L: Wavelength (m); db: The depth of the breaking waves (m); α (°): The angle of incidence of the waves (°)

3.3 Results Average Predicted Sediment Transport Rate of edges Beaches

Table 5. Prediction Results Sediment transport rate of seashore Loli-Saluran village

| No | Location          | α (°) | Tan β | D (mm) | Hb (m) | Hb/L0 (m) | Q (m³/day) |
|----|-------------------|-------|-------|--------|--------|-----------|------------|
| 1  | Loli-Saluran Village | 15.62 | 0.02  | 2.0    | 1.67   | 0.19      | 14.52      |
| 2  | Loli-Tasiburi Village | 13.06 | 0.02  | 2.0    | 1.67   | 0.19      | 16.88      |
| 3  | Salubomba Village   | 14.57 | 0.02  | 2.0    | 1.67   | 0.19      | 18.10      |
| 4  | Tsaloe Village      | 17.47 | 0.02  | 2.0    | 1.67   | 0.19      | 20.99      |
| 5  | Tsaloe Village      | 18.94 | 0.02  | 2.0    | 1.67   | 0.19      | 21.46      |
| 6  | Tolonggano Village  | 15.63 | 0.02  | 2.0    | 1.67   | 0.19      | 18.95      |

3.4 Changes Average Predicted Results Coastline

a. Predicted Changes Coastline (Mₐ=-51m³/years) Village Location of Loli-Saluran (Qₐ=-49.15; Q₀=68.60; ρₐ=2.65).
b. Predicted Changes Coastline (Mₐ=-59.63 m³/years) Village Location of Loli-Tasiburi (Qₐ=68.75; Q₀=46.25; ρₐ=2.65)
c. Predicted Changes Coastline (Mₐ=-111.75 m³/years) Village Location of Salubomba (Qₐ=50.00; Q₀=90.00; ρₐ=2.65)
d. Predicted Changes Coastline (Mₐ=-165.43 m³/years) Village Location of Towale (Q₀=59.72; Q₀=147.50; ρₐ=2.65)
e. Predicted Changes Coastline (Mₐ=-47.70 m³/years) Village Location of Tosale
3.5 Analysis of Broken Wave Height and Depth

A variety of physical processes on the beach, especially those found along the Donggala coast, which is strongly influenced by one of the oceanographic parameters, like the waves of the sea. Strong sea wave action on the coast can lead to erosion and acceleration of the process time of wave energy attenuation. Wave energy generated by the effects of friction forces with winds moving on the surface of the water [25]. The faster the wind blows, the larger the affected area (location). Therefore, sea waves that are formed will be greater. causing greater wave energy. The natural phenomenon that occurs in the location is the wavelength that will gradually diminish. While the high wave height will increase when the waves into shallow water. The wavelength of the wave will increase. and eventually the wave will break at a certain depth.

From the data processing to know the wave height and depth of breaking waves. visible and variation of breaking wave depth in each segment of data retrieval. For the first location (Loli Sub- Saluran) with an average mileage angle of 15.62° with wave height coming 2 m, the depth is obtained by breaking wave 1.67 m and sediment yield average 14,523 m³/day. Meanwhile, for the second location (Loli-Tosiburi village) with an average event angle of 13.16° with wave height coming 2 m. obtained by break wave 1.67 m and sediment yield average 16,88 m³/day. So this is the third location (Salubomba village) with an average event angle of 14.57° with an upcoming 2.0 m wave height. height and depth value obtained by breaking wave 2.12 m and 3.2 m and sediment yield 18.09 m³/day. Meanwhile, for the fourth location (Towelale village) with an incident angle of 17.47° and wave waves which came in at 2.0 m. the value of the breaking wave height and depth of 1.69 m and the average sediment yield of 20.99 m³/day. Location fifth (Tosale village) with an angle of incidence 18.94° where the waves break the wave height 2.0 m. high wave value breaks and depth 1.67 m and sediment yield 21.46 m²/day. Finally, for the sixth location (Tolonggano village) with an angle of incidence 15.63° with wave waves reaching a height of 2.0 m. found the wave height and depth of 1.67 m and the average sediment yield 18.94 m³/day.

3.6 Prediction Analysis Changes in Coastline

The beach profile can destroy the waves. Beaches that experience erosion, acceleration (sedimentation) or remain stable depending on the supply of sediments that enter and exit or leave the coast. Behavior in the sediment transport system at the Loli-Channel village location has a natural behavior perpendicular to the beach. This is because the angle of occurrence 90o breaks the waveform that looks too big and the presence of beaches and natural bulge in the form of beach buildings that also leads to the sea. Therefore, the potential for sediment transport (Ma), the largest is at the location of Ls14 (-609.50 m³/year) and follows Ls11 (-569.75 m³/year). In the field (Ls3) found container port area, around Ls6 and Ls10 is mangrove forest, and at location of Ls11 to Ls15 is known to have increase, because at this moment location of wave incident start to form from angle toward coastline.

Next, the location of Loli-Tasiburi Village, namely: Lt1 to Lt9 and chart. 11 transport estimates produce abrasion or erosion (ma) ranging from (185.5 m³/year) to (251.75 m³/year). while the estimated incremental process or sedimentation range (-198.75 m³/year) to (238.5 m³/year), indicates that there is a weak coastal profile change. Meanwhile, at the starting point location Lt10, and Lt16 until Lt20 happened erosion process or coastal erosion.

Village Salubomba in locations Sb1, Sb4, Sb5, Sb8, Sb9 to abrasion point Sb11. Meanwhile, around the point Sb6 to Sb7 sedimentation process occurs slightly prominent, indicating that the location of Salubomba village occurs 2 kinds of natural processes. that is, the transport of sediments along the coast (long coastal transport) and perpendicular to the shore (long shore-offshore transport). The field found in the abrasion process is greater than the acceleration process.
Towale village for Tw1 point to Tw17 happened very dominant change process, that is abrasion process far bigger than acceleration process. There are estimates of sediment transport data from -13.25 to -649.25 m³/year. In connection with that, Tw1 point, Tw12, Tw13, and Tw18 potentially altering the process occurs due to sedimentation acceleration and flow of sediment flow material by Towale. Based on field abrasion process found more dominant than acceleration or sedimentation process. This is due to the collapse of coastal cliffs and coastal buildings at the point of data collection [26, 30].

The village of Tosale shows that the potential for sediment transport (Ma), the largest is at the site at point Ts1 (-795 m³/year) and Ts11 (-755.25 m³/year). Therefore, in both locations there is a difference in shoreline profile profile despite the direction of transporting the second sediment. Le from the south. From the field, it can be seen that at the location of the acceleration data collection process or sedimentation, the direction of the wave is strong and constantly changing as it depends on the angle of events from season to season.

Village Tolonggana Tg1 point. Tg2. Tg3, Tg9, Tg12, Tg13 and Tg20 to Tg24 the supply of incoming sediments is much greater than the location of other points. ranging from 172.25 m³/year to 397.50 m³/year. In the field a sedimentation process is caused by a wave that breaks perpendicular to the shore. When the waves come forming an angle to the coastline with a small angle, a large wave of high waves, then the coast will be the process and behavior in the sediment transport system along the coast [24].

4. Conclusion
From the data analysis and prediction based on input data and parameter estimation of sediment transport and wave coast, we can conclude that: (1) In general approximation (estimate) of sediment transport base at any location data collection is varied. This is due to the difference in angle of coastline as well as the angle of attack broke from the shoreline waters of Donggala. (2) Strong abrasion at the study site occurs at the point Ts4 (622.75 m³/year) and Ts11 (755.25 m³/year) located in the Village Tosale and Tw7 and Tw17 point (649.25 m³/year) located in the Village Towale. As for the strong sedimentation occurs at the point Ts3 (450.50 m³/year) located in the Village Tosale and Tg3 point (357.75 m³/year) located in the Village Tolonggano. (3) From the results predicted coastline changes based on the input data estimate sediment transport, parameter beach and wave, it appears that the change in location profile coastline inclined towards research into or undergo a process of abrasion.

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