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Analysis of Kendari Bay Sedimentation Distribution Pattern By Using High Resolution Image

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ABSTRACT

Specifically, the main problem to be investigated is how wide the spread of sedimentation in Kendari Bay and the extent of delta formation due to changes in land function, with the aim that the government can make decisions in handling sedimentation in Kendari Bay effectively and efficiently. The analytical technique used in this research is spatial analysis by means of Overlay using Series High Resolution Image, each digitized for 3 Series using Geographic Information System (GIS) applications, High Resolution Image has 3 Bands Red, Green and Blue, to be able to find out the distribution pattern of sedimentation, it needs to be adjusted to the distribution from 2014, 2017 and 2021.
Based on the results of the overlay analysis, the sedimentation distribution area of Kendari Bay in 2014, 2017 and 2021 is 159.50 Ha, 258.15 Ha and 280.90 Ha, respectively. The delta pattern is formed at the mouth of the Wanggu river with a delta area of 2014, 2017 and 2021, namely 17.97 Ha, 27.16 Ha and 19.60 Ha respectively.

Keywords: *Pattern, Scatter, Sedimentation, Bay, Kendari*

I. INTRODUCTION

The current global issue is the occurrence of an ecosystem imbalance between natural and human factors, especially in the sea, due to bad human actions that can damage the marine ecosystem, this can threaten the survival of mankind. Things that are often done by humans today are the amount of deforestation, especially on the banks of the watershed which results in erosion, the growth of population settlements on the banks of the river which results in garbage, household waste, this behavior causes the Kendari Bay Sedimentation.

Kendari Bay sedimentation is something that is often discussed by stakeholders, both at the City and Southeast Sulawesi Provincial Government levels and even many community institutions have doubts about the handling of Kendari Bay sedimentation. Handling efforts have also been carried out by the Kendari City government by sucking using a mud suction machine, this also has not given maximum results.

Sedimentation in Kendari Bay continues to increase from year to year, resulting in silting, especially at the Kendari Bay estuary where there has been land forming a delta which will result in the closure of the estuary in the future. This siltation is caused by sedimentation from rivers flowing into the Kendari Bay, especially the Wanggu River, which has a role as the largest sediment carrier. It is known from the research results of the Sampara Watershed Research Institute (BP-DAS) that in the last 13 years there has been silting in Kendari Bay covering an area of 101.8 hectares and the sea depth ranging from 9 meters to 10 meters. The area of this bay shrank from 1,186.2 hectares to 1,084.4 hectares in 2000. (Sudardjat, BK, & Kardhana, 2010). Sedimentation occurs at river estuaries in Kendari Bay.

With the development of technology in the field of remote sensing (Remote Sensing) researchers can find out the distribution pattern of sedimentation in Kendari Bay, to calculate the distribution pattern, it is necessary to use spatial analysis using 3-year temporal High Resolution imagery with the image overlay method, the process of making a sedimentation distribution map by digitizing the distribution pattern. using GIS applications.

Specifically, the main problem to be investigated is how wide the spread of sedimentation in Kendari Bay is and how is the formation of a delta due to changes in land function, with the aim that the government can make decisions in handling sedimentation in Kendari Bay effectively and efficiently.

II. LITERATURE REVIEW

Sedimentation is a process of deposition of material transported by water, wind, ice, or glaciers in a basin. The affected delta and the process of deposition of materials transported by river water (WP, Setiawan, & Karsinah, 2012). Aquatic sediments are mineral materials and organic particulates that are not combined, which settle and are under the aquatic environment. Sediment composition that has a relatively large size and weight will settle to the bottom of the water while those that have a small size will be suspended in a body of water. In aquatic ecosystems, sediments have

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an important role because they are the site of biogeochemical cycles and become the basis of the food chain in aquatic systems. Macrofauna and microfauna and microbes that live in and on the surface of aquatic sediments carry out the process of demineralization of organic materials into basic nutrients for animals at higher trophic levels in the food chain. (Rumhayati, 2019)

Soil or parts of land that are transported by water from an eroded place in a watershed (DAS) and enter a body of water are generally called sediments. Sediment produced by the erosion process and carried away by the flow of water will be deposited in a place where the flow velocity slows down or stops. This depositional event is known as the sedimentation event or process. (Sembiring, Mananoma, Halim, & Wuisan, 2014).

The estuary as a link between the river and the sea also does not escape the occurrence of sedimentation because sediment from downstream and sediment from the sea will meet in the estuary area. If this condition continues and is left unchecked, gradually the estuary area will be covered with sediment and hinder the flow of the river so that the water level in the upstream of the river will increase. The silting at the mouth of the river also has an impact on the activities of fishing vessel shipping lanes which are hampered when the river is receding. (Roswaty, Muskananfola, & Purnomo, 2014). The estuary is the downstream part of the river that is directly connected to the sea, which functions as an outlet for river water. This river water carries sediment transport that will accumulate in the estuary. The accumulated sediment will cause siltation in the estuary area (Atmodjo, 2011).

The estuary of the river functions as a liaison between the river and the sea, in this area there is a meeting between river currents and ocean currents. The meeting of these currents will later cause a process of sedimentation at the mouth of the river. The sediments that are deposited will later undergo a transport process caused by the influence of currents in the waters. (Satria, Saputro, & Marwoto, 2017)

Remote sensing is the science and art of obtaining information about an object, area, or phenomenon through the analysis of data obtained with a device without direct contact with the object, area, or phenomenon under study. Remote sensing in English is called Remote Sensing, French is called Teledetection, German is Fernerkundung, Portuguese calls it Sensorianmento Remota, Russian is called Distantionaya, and Spanish is called Perception Remota, (Somantri, 2009)

Remote sensing has been defined in various ways but basically it is the art or science of telling something about an object without touching it. Remote sensing is the acquisition of physical data of an object without touch or contact. Images are obtained with sensors other than (or in addition to) conventional cameras used to record scenes, such as by electronic scanning, using radiation beyond the normal visual range of film and microwave, radar, thermal, infrared, ultraviolet, as well as multispectral, special techniques applied to process and interpret remotely sensed imagery for the purpose of producing conventional maps, thematic maps, resource surveys, etc., in agriculture, archaeology, forestry, geography, geology, and others. Remote sensing is the observation of a target by a device separated by a certain distance. The term "remote sensing" in a broad sense simply means "reconnaissance from a distance". Remote sensing, although not precisely defined, includes all methods of obtaining images or other forms of electromagnetic recordings of the earth's surface from a distance, and the maintenance and processing of image data. Remote sensing in the broadest sense is concerned with detecting and recording electromagnetic radiation from a target area in the field of view of the sensor instrument. This radiation may originate directly from separate components of the target area; perhaps solar energy reflected from them; or perhaps reflected energy transmitted to the target area from the sensor itself (Campbell & Wynne, 2011).

A map is a picture of the earth's surface on a flat plane with a certain scale and projection system. Maps can be presented in a variety of different ways, ranging from printed conventional maps to digital maps displayed on a computer screen. Mapping is a real solution to providing sufficient quantities of accurate and reliable spatial information about a particular area. In addition, these activities can be a means of updating existing spatial information. (Budisusanto, Khomsin, Purwanti, Nurry, & Widiastuty, 2014)

Definition of Geographic Information System (GIS or GIS) is a computer-based system of hardware, software and procedures) that can be used to store, manipulate geographic information. Geographic information system (GIS) works on the basis of managing geographically referenced data. GIS is not just an application (software) or just a tool for making maps, but a GIS is a system that is needed as a framework for understanding and managing the world we live in. GIS works in managing geographic information and with GIS allows connections between objects or activities based on proximity analysis (proximity analysis). GIS also allows the integration of spatial information systems with other systems in a system. (Darmawan, 2011)

Overlay is an important procedure in GIS (Geographical Information System) analysis. Overlay is the ability to place one map graphic on top of another map graphic and display the results on a computer screen or on a plot. In short, an overlay overlays a digital map on another digital map and its attributes and produces a composite map of the two that has the attribute information of both maps. Overlay is the process of combining data from different layers. Overlay is simply referred to as a visual operation that requires more than one layer to be physically combined. The understanding that a map overlay (minimum 2 maps) should result in a new map is absolute. In technical language there must be a polygon formed from 2 overlaid maps. The principle of overlay is to compare characters from the same location in each layer, and to produce the required information. The specific results are determined by the manufacturer who can load calculations, or other requirements that can be applied to the area or location. In short, the overlay process aims to show the area/region of conformity between two or more data. (Wibowo, 2020)

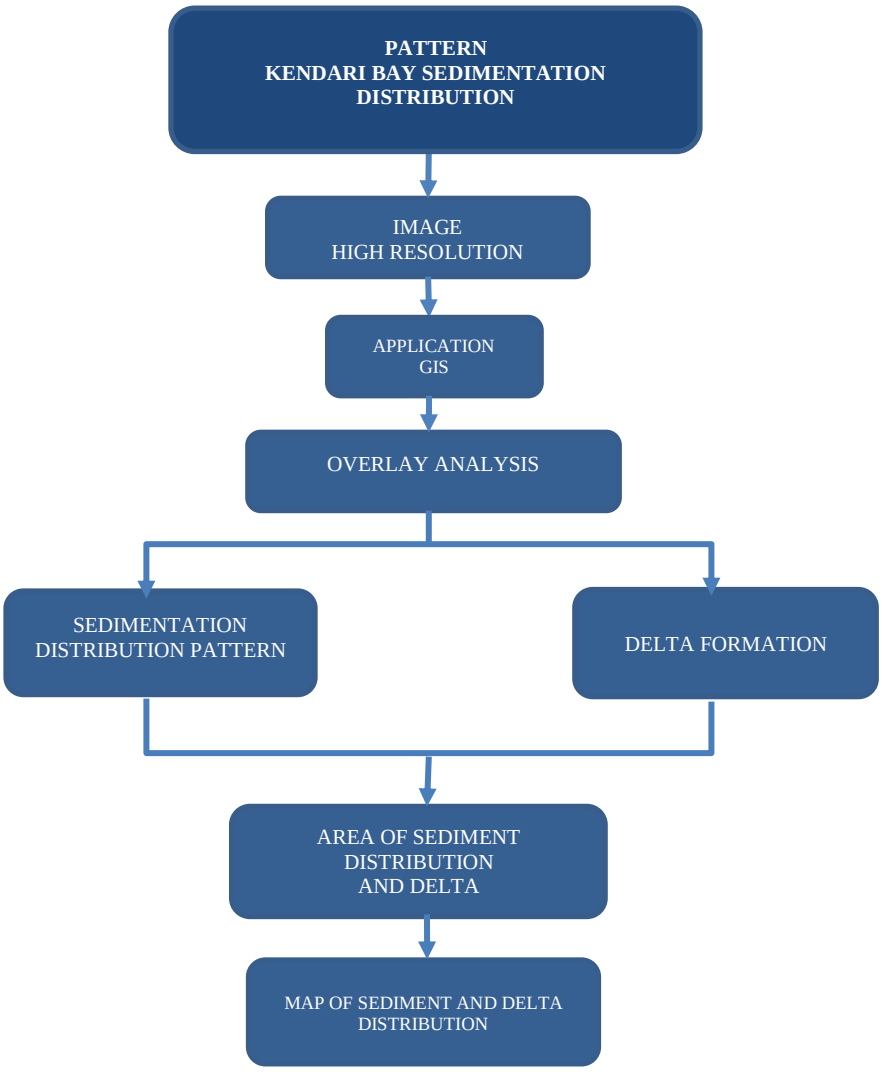
III. RESEARCH METHODS

Location This research was conducted in Kendari Bay, especially at the mouth of the river, more specifically the Wanggu River estuary, the research was carried out in April 2021. The data used in this study were Kendari City Spatial Planning, Kendari City Administration Map and High-Resolution Image Data 3 years series, and field observations. The equipment used is a computer with a Geographic Information System Application (Qgis Application), GPS (Geographic Position System).

The analytical technique used in this research is spatial analysis by means of Overlay using Series High Resolution Image, each digitized for 3 Series using Geographic Information System (GIS) applications, High Resolution Image has 3 Bands Red, Green and Blue, to be able to know the pattern of sedimentation distribution, it is necessary to adjust it to the distribution from 2104, 2017 and 2021.

The weighted overlay method is a spatial analysis using the overlay technique of several maps related to the factors that influence the vulnerability assessment. One of the functions of this weighted overlay is to solve multi-criteria problems such as optimal site selection or suitability modeling. (Adininggar, Suprayogi, & Wijaya, 2016). The map overlaid on the High-Resolution image will produce the area of sedimentation and delta caused by changes in land use.

Delta is a mass of sediment, both subaerial and submerged, which is deposited in a body of water (sea or lake) mainly by river activity. In the Oceanography dictionary, it is explained that deltas are sediment deposits originating from land that are formed at river mouths bordering the sea or lake. (Sanjoto, 2012).



Picture 1 : Research Flowchart

IV. RESULTS AND DISCUSSION

4.1. Sedimentation Distribution

Sediment resulting from the erosion process and carried away by the flow of water will be deposited in a place where the flow velocity slows down or stops. This depositional event is known as the sedimentation process. This process is very complex, starting from the fall of rain which produces kinetic energy as the beginning of the erosion process then the soil becomes fine particles, then rolls along with the flow, some are left on the ground while others enter the river carried by the flow into sediment transport. (Roswaty, Muskananfola et al. 2014)

The erosion rate of the Kendari Basin is 108.01 tons/ha/year, with the Wanggu sub-watershed as the highest sediment contributor at 66,064.92 tons/year. The grain size of the sediment is dominantly sandy, comes from a variety of rocks, is poorly sorted, strongly negative skewness and is strongly influenced by river activity (Jassin 2020)

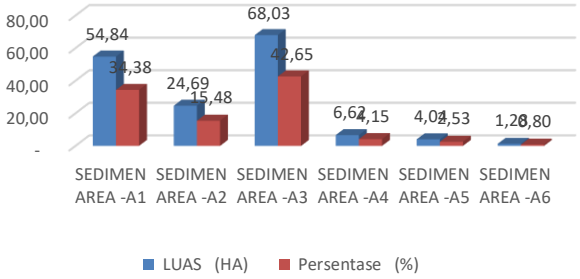
Based on the spatial analysis of sedimentation in Kendari Bay from high resolution images for the recording year in October 2014, the sedimentation area is 159.50 Ha with a Perimeter of 25.399.53 M1.

Table 1. Kendari Bay Sedimetation Area in 2014

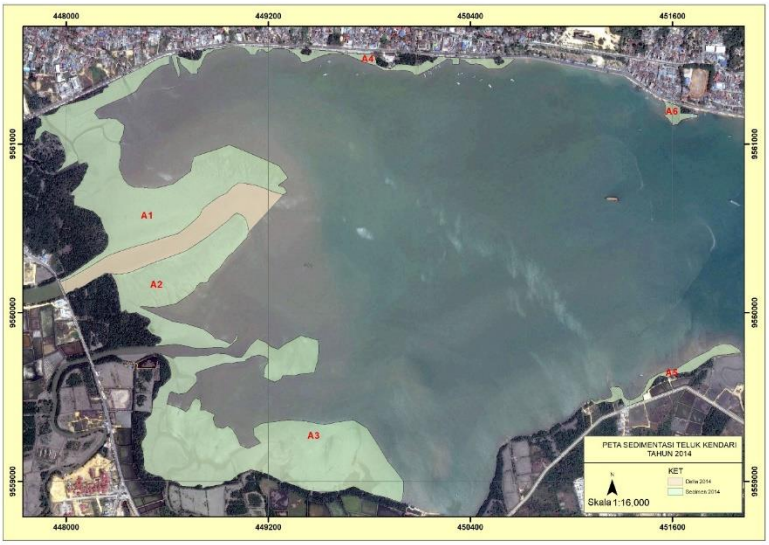
No.	Description	Perimeter (M1)	Hectares (HA)	Percentage (%)
1	Sedimen Araea -A1	6,739.44	54.84	34.38
2	Sedimen Araea -A2	3,722.81	24.69	15.48
3	Sedimen Araea -A3	7,068.47	68.03	42.65
4	Sedimen Araea -A4	4,954.57	6.62	4.15
5	Sedimen Araea -A5	2,308.74	4.04	2.53
6	Sedimen Araea -A6	605.50	1.28	0.80
	Jumlah Total	25,399.53	159.50	100.00

Source : Data Analisys Result 2021

Picture.2 Sediment Area Chart 2014



Picture. 3 Map of Kendari Bay Sedimentation Distribution 2014



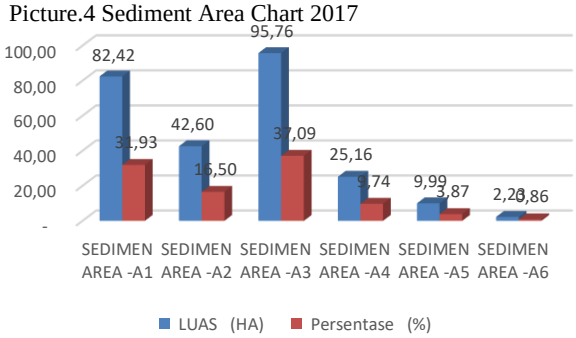
Furthermore, in the recording year in November 2017, the sedimentation area was 259.15 Ha with a Perimeter of 1,113,116.82 M1. The largest sedimentation was in Sediment Area A3 with an area of 95.76 Ha or 37.09%, then in Sediment Area A1 with an area of 82.42 Ha or 31.93% and the lowest was Sediment Area A6 with an area of 2.23 Ha or 0.86%

Table 2. Kendari Bay Sedimetation Area in 2017

No.	Description	Perimeter (M1)	Hectares (HA)	Percentage (%)
1	Sedimen Area -A1	292,023.66	82.42	31.93
2	Sedimen Area -A2	163,950.25	42.60	16.50
3	Sedimen Area -A3	332,068.13	95.76	37.09
4	Sedimen Area -A4	186,694.45	25.16	9.74
5	Sedimen Area -A5	94,389.39	9.99	3.87
6	Sedimen Area -A6	43,990.95	2.23	0.86
	Jumlah Total	1,113,116.82	258.15	100.00

Source : Data Analisys Result 2021

Picture.4 Sediment Area Chart 2017



Picture. 5 Map of Kendari Bay Sedimentation Distribution 2017

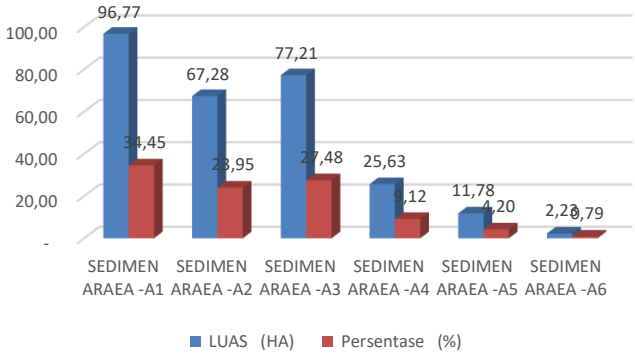
Furthermore, in the recording year in February 2021, the sedimentation area was 259.15 Ha with a Perimeter of 1,113,116.82 M1.

Table 3. Kendari Bay Sedimetation Area in 2021

No.	Description	Perimeter (M1)	Hectares (HA)	Percentage (%)
1	Sedimen Area -A1	353,496.57	96.77	34.45
2	Sedimen Area -A2	235,743.93	67.28	23.95
3	Sedimen Area -A3	346,957.34	77.21	27.48
4	Sedimen Area -A4	187,161.09	25.63	9.12
5	Sedimen Area -A5	104,201.81	11.78	4.20
6	Sedimen Area -A6	43,990.95	2.23	0.79
	Jumlah Total	1,271,551.69	280.90	100.00

Source : Data Analisys Result 2021

Picture.6 Sediment Area Chart 2021



The largest sedimentation was in Sediment Area A1 with an area of 96.77 Ha or 34.45%, then in Sediment Area A3 with an area of 77.21 Ha or 27.48 % and the lowest was Sediment Area A6 with an area of 2.23 Ha or 0.79%

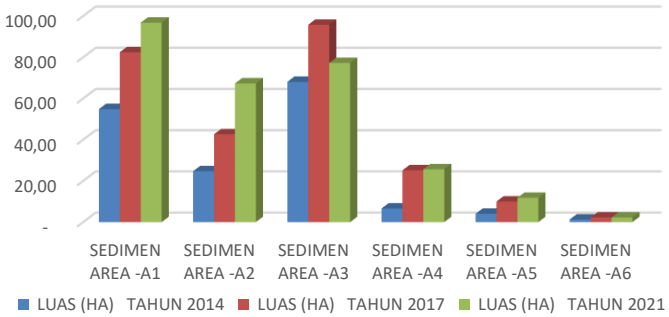
Picture. 7 Map of Kendari Bay Sedimentation Distribution 2021

Table 4. Kendari Bay Sedimetation Area

No.	Description	(Ha) 2014	(Ha) 2017	(Ha) 2021
1	Sedimen Area -A1	54.84	82.42	96.77
2	Sedimen Area -A2	24.69	42.60	67.28
3	Sedimen Area -A3	68.03	95.76	77.21
4	Sedimen Area -A4	6.62	25.16	25.63
5	Sedimen Area -A5	4.04	9.99	11.78
6	Sedimen Area -A6	1.28	2.23	2.23
	Jumlah Total	159.50	258.15	280.90

Source : Data Analisys Result 2021

Picture.8 Sediment Area Chart



The results of the analysis using the overlay method get the area from the 2014 2017 and 2021 image recording periods, there is a change in sedimentation from year to year there is an increase and there is also a decrease in the area of sedimentation in certain areas. Areas that experience changes in sedimentation increase are Sediment Areas A1, A2, A4, A5. Sediment Area A1 in 2014 was 54.84 Ha, in 2017 it increased to 82.42 Ha and in 2021 it rose to 96.77 Ha. Furthermore, Sediment Area A2, in 2014 with an area of 24.69 Ha, increased to 42.60 Ha in 2017 and in 2021 the area increased to 67.28 Ha. Furthermore, Area A4 sediments also increased in 2014 covering an area of 6.62 ha, to 25.16 ha in 2017 and in 2021 to 25.63 ha. Likewise, Sediment Area A5 also increased in 2014 to an area of 4.04 ha, in 2017 it was 9.99 ha and in 2021 it increased to 11.78 ha.

The area that experienced a decrease in sedimentation was in Sediment Area A3, the decrease occurred in 2021 covering an area of 18.55 ha this was due to a change in land function, namely the construction of a road to the Al Alam mosque on the south side, sediment was blocked by the road, but in 2014 to 2017 there was an increase from 68.03 Ha in 2014 to 95.76 in 2017. For Sediment Area A6 in 2017 to 2021 there was no change in sediment.

4.2. Pembentukan Delta DAS Wanggu

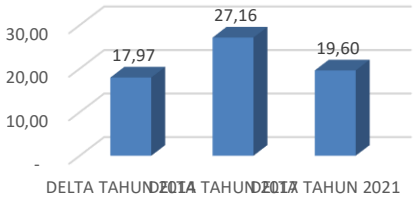
Delta is a mass of sediment, both subaerial and submerged, which is deposited in a body of water (sea or lake) mainly by river activity. In the Oceanography dictionary, it is explained that deltas are sediment deposits originating from land that are formed at river mouths bordering the sea or lake (Sanjoto 2012).

Table. 5 Wanggu Watershed Delta Area

NO.	DELTA	PERIMETER (M1)	AREA (HA)
1	Delta Tahun 2014	125,872.24	17.97
2	Delta Tahun 2017	158,570.35	27.16
3	Delta Tahun 2021	198,351.73	19.60

Source : Data Analisys Result 2021

Picture. 9 Wanggu Watershed Delta Area Chart



The results of the analysis show that there is a change in the area of the delta in the Wanggu watershed, in 2014 the delta area was 17.97 Ha with a perimeter of 125,872.24 m1, in 2017 there was an increase of 27.16 Ha with a perimeter of 158,570.35 m1, but in 2021 it experienced an increase. settlement area of 19.16 ha with a perimeter of 198.351.73.

The shape of the Wanggu estuary delta deposit, controlled by several processes and can be classified through the geometry of the formation process, whether the Wanggu estuary delta is of the type (1) fluvial-dominated, (2) tide-dominated, or (3) wave-dominated. Based on its geometric shape, the Wanggu river estuary delta seems to be dominated by fluvial processes with a dominant tidal influence. According to Yasin (2016) the grain size of sedimentation forming the delta of the Wnaggu River estuary, has a dominant grain size of fine-grained towards the river mouth and increasingly coarse-grained upstream. The grain size distribution shows the influence of small longshore currents and dominant river activity. According to Maria (2015) based on the deltaic depositional environment which has low tidal conditions, low currents along the coast, as well as fine material as suspended load, the shape of the delta will tend to be even more dominant, forming a wide delta. The change in the area of the delta in 2021 which will be reduced, is probably due to the construction of a retention pond in the Wanggu watershed. So that the supply of sediment to the mouth of the bay is reduced.

V. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusion

Based on the results of the overlay analysis, the sedimentation distribution area of Kendari Bay in 2014, 2017 and 2021 is 159.50 Ha, 258.15 Ha and 280.90 Ha, respectively. The delta pattern is formed at the mouth of the Wanggu river with a delta area of 2014, 2017 and 2021, namely 17.97 Ha, 27.16 Ha and 19.60 Ha, respectively.

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5.2 Suggestion

For further research, it is hoped that it will focus more on examining the causes of sedimentation, the elements contained therein and how to overcome them

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