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Coastline and Land Use Changes by Remote Sensing Analysis at Tanjung Bunga West Coastal of Makassar South Sulawesi Indonesia

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Abstract

Identifying of coastline changes and their variability can change naturally or by human activities within the improvement and control of coastal areas. Tanjung Bunga is a landform deposit in the form of a Spit and at this location is planned to be used as the Center Point of Indonesia. In this paper, the coastline modifications that arise at some stage in 20 years which is 2000-2020 analysed the use of satellite statistics inclusive of Landsat picture records to get right of entry to the coastline pattern differention for the years beneath the research. The changes resulting from the erosion, reclamation and sedimentation. The analysis suggests that the maximum commonplace coastline modifications as a result of reclamation or in other words, the coastal area become extra larger with the addition of sand to assist sufficient improvement inside the vicinity. Currently, west coastal of Makassar (Tanjung Bunga) specifically used as tourism place and extra land needed to make higher facilities. Coastline changes can have an effect on the environment as natural habits and settlements near the coast, also economics around the place will be affected too.

Keywords: Coastal, Coastline, Landsat

1.   INTRODUCTION

Indonesia is a maritime country and also an archipelagic country with a total islands of Indonesia (include large and small islands) are 17.000 with the most islands located in Maluku and Papua (Geospatial Information Agency, 2018)[1,2]. According to Geospatial Information Agency (2018), long coastline in Indonesia approximately 108.000 km as the main source of income for this country[1,2]. This research aimed to detect coastline and land use changes by using remote sensing. Landsat 7 and Landsat 8 images of Makassar coastal area for year 2000 to 2020 was analysed to see the differentiation of coastal pattern and area throughout the period. The image was used in Google Earth and Arc-GIS software so the area differences can be calculated.

Previously and present situations, coastline and land use changes research historically provides an overview of present and before present conditions which is important as a consideration in making decisions in the management of coastal areas in the future[3-7].

Therefore, this is anticipated to provide the following contributions to the country wide land cover database inside the destiny which incorporates land cowl and vegetation attributes in beach areas. It contributes understanding to

the human being about the beach erosion and creates awareness to them. The best technology and alternative solutions will also be inform. In addition, a map could be made on this look at which can represent statistics about situations and natural assets, in addition to the ecological and geographical surroundings. In addition, it contributes to a highly efficient healing manner that clearly eliminates this erosional impact on beach morphology.

2. METHODOLOGY

Locations

This research located at Tamalate district on the west coast of Makassar City, South Sulawesi, Indonesia as shown in figure below.

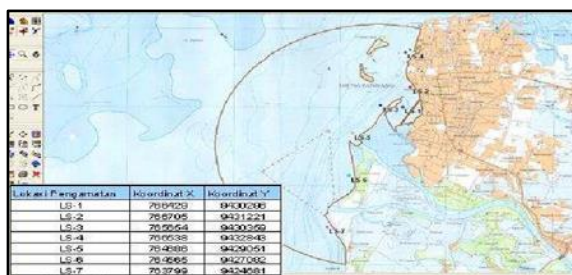**Figure 1.** West Coastal of Makassar Map

Figure 2. Coordinate XY at West Coastal of Makassae Map

Establishing the Coastline Pattern of Study Area

Landsat imagery from the research location is processed using ArcMap 10.5 software to determine the coastline every year. Then combine all the images and differentiate the color of the coastline each year so that observations can be clearer and easier and changes in the coastline can be detected[8-13].

Primary and Secondary Data Collection

Landsat imagery used in this study from 2000 to 2020 every January. In addition, a survey of respondents from the community was conducted.

Data Analysis

To study changes in the coastline of the research location from 2000 to 2020, remote sensing Landsat imagery was used for 6 years. One image for each year, and all images are digitized to produce a coastline in the form of a colored polyline[8-13].

Seasonal influences affect beach conditions, so images are taken only from the same month each year[8-13].

The coordinate grid system used is uniform so that all images can be aligned properly[8-13]. Changes in the coastline are seen in the combined images with parameters, namely the stage of abrasion, sedimentation and abrasion sedimentation[8-13].

Answers from respondents are collected and presented in chart form to show their opinions about changes in the coastline[14,15].

3. RESULT AND DISCUSSION

Changes in land use and coastlines on the coast of Makassar from 2000 to 2020 were detected by remote sensing applications using Landsat 7 imagery for 2000 to 2012 and Landsat 8 for

2013 to 2020. Then, changes in coastal land use from surveys of the respondent community.

Shoreline and Land Use Change in Tanjung Bunga

Makassar's coastal area has increased by around 400 ha in 20 years. Significant changes occurred between 2009 and 2012 when 127.62 ha were reclaimed.
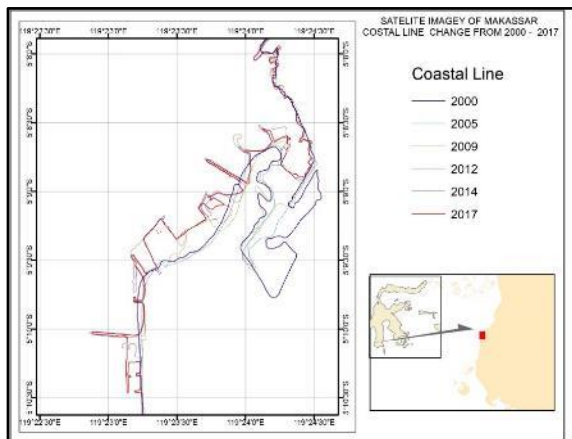

Figure 3. West Coastal of Makassar (Tanjung Bunga) showing the coastline for 2000-2017
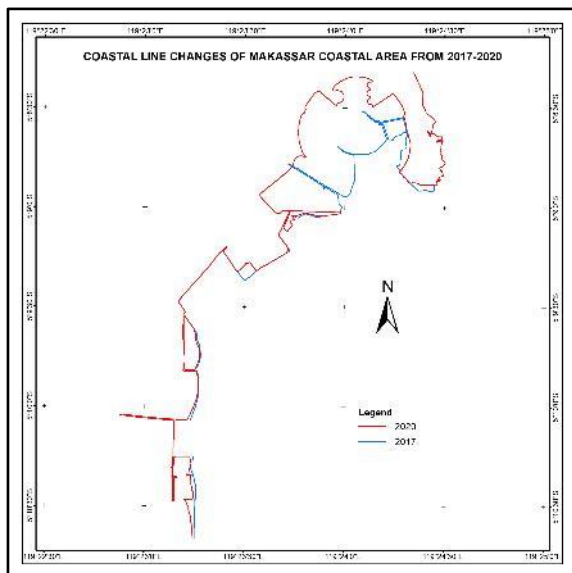

Figure 4. West Coastal of Makassar (Tanjung Bunga) showing the coastline for 2017-2020
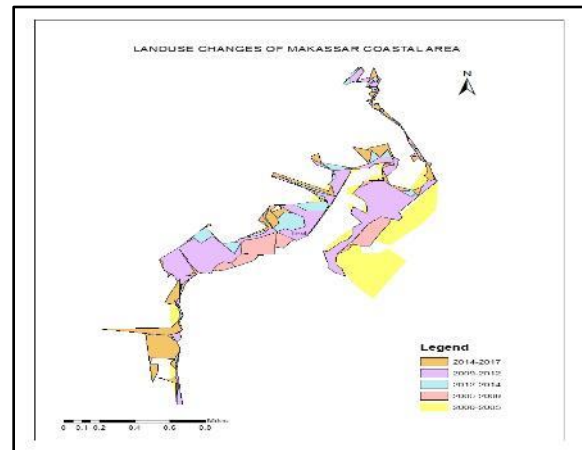

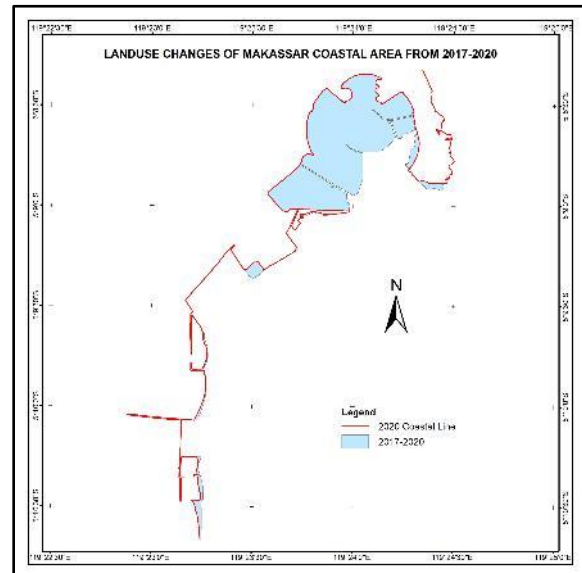**Figure 5.** West Coastal of Makassar (Tanjung Bunga) showing the land use changes for 2000-2017

Figure 6. West Coastal of Makassar (Tanjung Bunga) showing the land use changes for 2017-2020

Figure 7. West Coastal of Makassar area showing land use changes in 2000-2005

YEAR 2005-2009		RECLAMATION	ABRASSION	DEVELOPMENT
		40.44	53.59	2007 – Anjungan Bugis and Anjungan Metro Makassar 2008 - Anjungan Toraja - Mandar
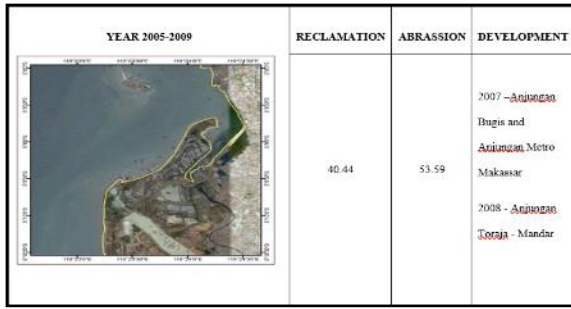
Figure 8. West Coastal of Makassar area showing land use changes in 2005-2009

YEAR 2009-2012		RECLAMATION	ABRASSION	DEVELOPMENT
		127.62	4.93	Construction of Trans Studio (Trans Mall)

Figure 9. West Coastal of Makassar area showing land use changes in 2009-2012

YEAR 2012-2014		RECLAMATION	ABRASSION	DEVELOPMENT
		31.96	16.51	Aminul Mukminin Mosque (Masjid Terapung). Construction of 4 new hotels instead of 8 existed hotels

Figure 10. West Coastal of Makassar area showing land use changes in 2012-2014

YEAR 2014-2017		RECLAMATION	ABRASSION	DEVELOPMENT
		73.09	16.61	Construction of Center Point of Indonesia

Figure 11. West Coastal of Makassar area showing land use changes in 2014-2017

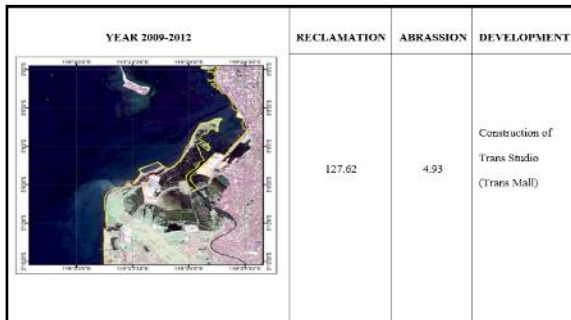| YEAR 2017-2020		RECLAMATION	ABRASSION	DEVELOPMENT
		92.26	-	Construction of Center Point of Indonesia

Figure 12. West Coastal of Makassar area showing land use changes in 2017-2020

In 2000, land use developments began to occur during the construction of the Tanjung Bunga Metro road. There are also places known for growing land surrounded through water.
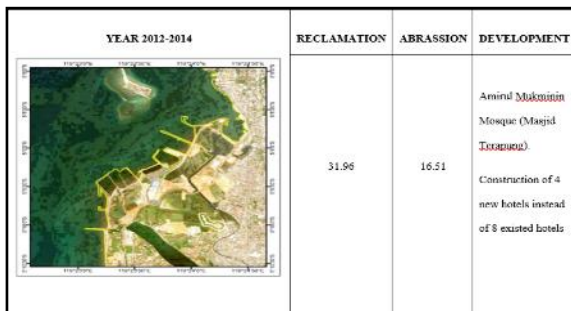

Figure 13. Landsat 7 imagery of Tanjung Bunga in 2015

The construction continued until 2001. In 2004, the construction of the Tanjung Bunga Metro road was completed and the land area expanded. The results show that from 2000 to 2005 the land area increased by around 46.99 ha.
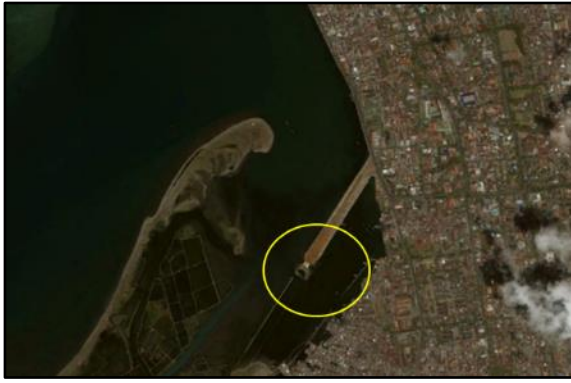
Figure 14. Landsat 7 imagery of Tanjung Bunga in 2000

Figure 15. Landsat 7 imagery of Tanjung Bunga in 2004

Figure 16. Landsat 7 imagery of Tanjung Bunga in 2006

The main physical land use change that occurred was the construction of the Celebes Convention Center (CCC) which is located on Jalan Metro Tanjung Bunga. The Losari Pavilion was also built which is included in the Losari Beach Revitalization. The results show

that land use has changed by around 40.44 hectares.

Figure 17. Landsat 7 imagery of Tanjung Bunga in 2007

The construction of the Makassar Metro Pavilion is one of the causes for the addition of the reclamation area. The development area is limited while the population is increasing, so the seaside area is changed to land. This led to the construction of the expansion of the Celebes Convention Center (CCC).

Figure 18. Landsat 7 imagery of Tanjung Bunga in 2009

Reclamation and land use changes again occurred during the construction of the Makassar-Bugis Platform. Meanwhile, there are more access roads in the area around the Celebes Convention Center (CCC). The area underweant a rapid urbanization process

because of development The Trans Studio Mall in this area.

Figure 19. Landsat 7 imagery of Tanjung Bunga in 2010

The Celebes Convention Center (CCC) reclamation is completed. The reclamation work influenced by existance of a connecting road. The reclamation of the Makassar-Bugis Pavilion is 50% completed while the construction of the Amirul Mukminin Mosque is still in its early stages. Makassar Metro Pavilion is one of the landmarks of Makassar city.

Figure 20. Landsat 8 imagery of Tanjung Bunga in 2013

The construction of three Pavilions (Makassar-Bugis Pavilion, Metro Makassar Pavilion, Losari Pavilion) which are included in the Losari Beach Revitalization has been completed. Reclamation is being carried out actively resulting in an increase in land area. In 2015, around the Celebes Convention Center (CCC) there were more development areas such as malls.

Figure 21. Landsat 8 imagery of Tanjung Bunga in 2015

Figure 22. Landsat 8 imagery of Tanjung Bunga in 2017

The construction is taking place at the Center Point of Indonesia. From 2014 to 2017 the land area increased by around 73.09 hectares.

Figure 23. Landsat 8 imagery of Tanjung Bunga in 2020

Center Point of Indonesia reclamation is completed and become a new landmarks of Makassar city as a waterfront city. From 2017 to 2020 the land area increased by around 92.26 hectares. Generally divided into four parts. Reclamation stage detail from 2018-2020.

Figure 24. Center Point of Indonesia's Reclamation Stage 2018, 2019, 2020

Development has resulted in many changes to the coastline. The massive increase in land area occurred in the construction of many facilities such as hotels, residential areas, business centers, landmarks, and the Center Point of Indonesia which includes artificial islands. In 2000, the coastline was still in its natural state with little development taking place. From the combined images in 2000, 2005, 2009, 2012, 2014, 2017, and 2020 showing physical changes every two years of this coastal.

Questionnaire Survey Analysis

All of background of respondents in this researches including nationality, age, gender, and profession were accumulated. They are individuals that lived around the coast areas and the part of community at there.

The ages of all respondents are between 20 to 60 years old and their nationality are Indonesian. 84% of them are females and 16% of them are males.
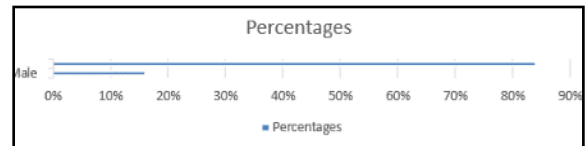

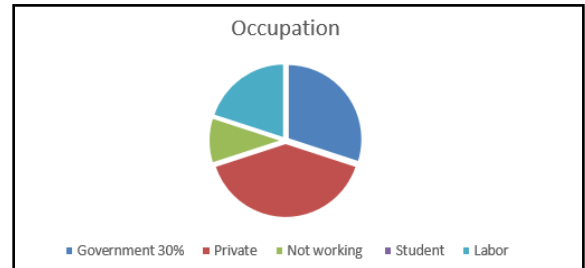**Figure 25.** Gender of respondents

Figure 26. Occupation of respondents

It can be seen in figure 26 that 10% of them are not working in any sectors, 20% of them are labor, 30% them as civil servant and working with their government, and 40% of them working in private sectors or business. Maximum of them operating in personal sectors due to improvement and commercial enterprise sectors that offer them jobs possibility.

The land use adjustments resulting from reclamation consequently needed an extra land area for buildings and offer their career.

Analysis of Social Demographic Reliability of Local Communities

The validity of the question on the respondent as an analysis. The final results of the reliability investigation in sociodemographic terms are shown in Table 1.

Table 1 Sociodemographic background reliability test.

Variable	Cronbach's alpha	N of items
Background	**0.271**	**4**

Reliability analysis statistics for non-public histories show a penalty charge of 0.271 (the appropriate value based on questionnaire). This value cause of the random selection method from the different background.

Table 2 shown the result of the realibilty terms of the local communities which contain about understanding of the effect of land use adjusments that are closer to their living area.

Table 2   Test the reliability of local people's perceptions

Variable	Cronbach's alpha	N of items
Background	**0.635**	**13**

The question is valid because the final result of the realibilty test of the communities about their perception of the impact of land use adjustments is closer to their lives that shown 0.635 values.

Descriptive Analysis

Descriptive evaluation in terms of the influence obtained by the surrounding community due to modifications to land use in the Makassar coastal area is shown in Table 3.

Table 3   Local community perception analysis.

Statements	Percentage				
	1	2	3	4	5
The Makassar coast provides the main income for communities around the coast	60	30	0	10	0
Coastline changes have negative impact for the buildings around it	20	60	10	0	10
Developments in the coastal areas of Makassar create new markets for their local products which can help other traders	40	40	20	0	0
Tourism development has the result making their community more potentials	30	60	10	0	0
Makassar's coastal area is an important area because this area promotes cultural restoration and preservation.	40	40	20	0	0
Coastline changes analysis should be done to provide information to the community around it to protect their own environment	40	50	0	10	0
Sedimentation and abrasion of the coastal disturb the residences	10	30	60	0	0
Tourism in coastal of Makassar must be preserved	40	50	10	0	0
Sedimentation and abrasion as well as current patterns provide beautiful scenery	10	30	40	20	0
The analysis of coastline changes educated for travelers to appreciate coastal area	40	0	10	40	10
Shoreline changes that make their communities dependent on people outside the community.	20	0	70	0	10

Statements	Percentage				
	1	2	3	4	5
Analysis of coastline changes, will help preserve the area.	50	50	0	0	0
Coastline changes analysis is very needed for the future development.	70	20	10	0	0

Indicators ; 1 : Strongly Agree; 2 : Agree; 3 : Disagree or Agree; 4 : Disagree; 5 : Strongly Disagree

Narrative studies are used to study local people's perceptions of the impact of changes in land use on their homes. The announcement "The West Coast region of Makassar City brings principle benefits to the people who live around it" had 10% of the people not unanimous decision, 30% agreed 60% strongly found it to be original with the declaration. This assertion illustrates that the majority of networks on the west coast of Makassar agree that coastal areas are their important source of income.

4. CONCLUSIONS

Through this research, the coastline and land use modifications in west coastal of Makassar become capable of be detected. coastline for the yr of 2000-2020 continuously undergo differentiation each 12 months and accordingly additionally adjustments the land use on the location. The land location increases up to 400 ha through the duration resulted from reclamation. 154.43 ha land became loss because of abrasion method or eliminated to comply with the development undertaking land pattern. The effect of coastline modifications to the land use in the West Coastal place closer to nearby human beings of the look at vicinity become capable of be analyses thru survey evaluation. The coastline and land use adjustments carry more advantage instead of negative effect of their live.

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