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PHYSICAL TYPOLOGY OF COASTAL AREA IN THE TELUK AMBON DALAM

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Abstract

The physical typology of the coastal area in this study is built from a combination of landforms, slopes, and materials. The research method used is a field survey to validate land units on secondary maps and GIS analysis to process typology maps of coastal areas based on a process-response system matrix. The results of this study indicate that the TAD coastal area has only one coastal typology, namely the type of land deposition with a gentle slope characteristic, the constituent material in the form of loose material and the terrain which is dominated by alluvial plains. As a result, in general, the coastal area of Teluk Ambon Dalam is easy to develop and manage.

Keywords: Typology, Coastal, Teluk Ambon Dalam

A. Introduction

The coastal area is one of the unique areas because there is a combination of two different processes, namely land and sea, each of which forms a certain ecosystem. In Indonesia, especially the area of the coast is very large with a long coastline that reaches 99,093 km (Puryono, 2016).

According to Post and Lundin (1996) in Anonimous (2010), coastal areas become important precisely because of their special characteristics. These characters include changes in dynamic coastal properties which are a response to the physical, chemical, biological, and geological characteristics of the surrounding environment (Marfai, 2013).

According to Rahardjo (2003), the study of coastal typology is very important both on a macro and micro scale. Its purpose is to help provide recommendations to related parties in decision-making. Currently, the coastal area is experiencing rapid development so that many overlapping policies have resulted in conflicts in several regions. Of course, the role of typological studies is also contained in this issue. However, studies of coastal typology in Indonesia are still rarely conducted (Hartono, et al., 1999).

The morphology of Ambon City, which is in the form of a bay and directly adjacent to the sea, emphasizes many developments in the coastal area. This massive development has an impact on reducing the quality of the coastal and marine environment (Tiene, 2001). The processes that occur on land and sea continuously will have an impact on the characteristics of the coastal area such as the material and genetics of a landscape to give certain forms and characteristics in the coastal area. These shapes and characteristics can then be grouped into a coastal type category (Khakhim, 2009).

A. Methodology

1. Research Design

This research is included in qualitative research using the integrated rapid survey method (Gunawan, et al., 2007). Broadly speaking, this research is divided into three stages of research, namely the pre, work, and post-field stages. In the pre-field stage, the activities carried out are literature studies, preparation of research materials and tools, collection of secondary data, geomorphological interpretation to obtain landform units in the research area, compilation and drawing of tentative land unit maps, and determination of research locations. Determining the sampling location is done by looking at the distribution of the overlapping map of the same land unit and then proportionally selected the sample points to be surveyed.

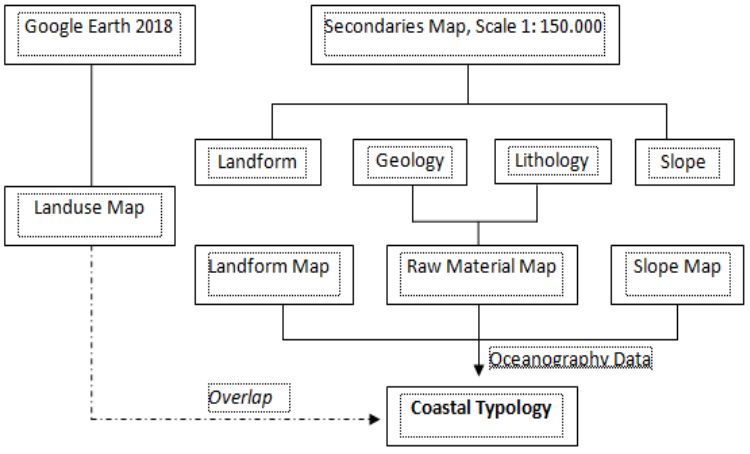


Fig. 1, Flowchart for This Study

The flow of the map depiction of the results of the GIS analysis in this study is shown in Fig. 1. Furthermore, at the fieldwork stage, the activities carried out included terrain orientation, observation, and measurement of geomorphological, oceanographic, and soil parameters through

field checklists. and the final stage which is the formulation and synthesis of research results. For convenience, the research location is presented in the form of a map as shown in Figure 2.

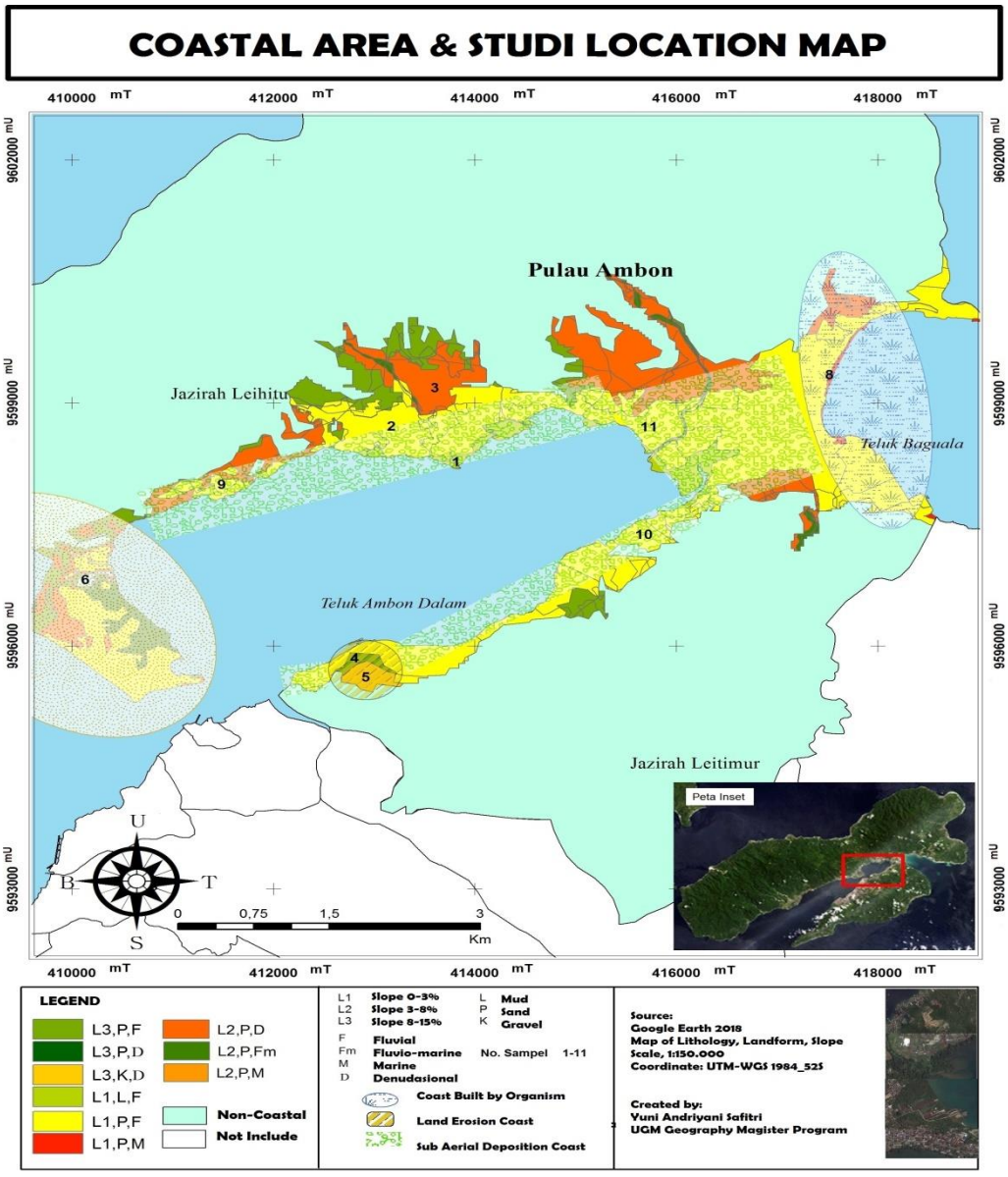


Fig. 2, Location of Study in Ambon City, Indonesia

2. Instruments

The instrument for this research are GPS, used to determine the location of the research sample as well as a tool for coordinate correction in the field. ArcGIS 10.2, for processing spatial data sourced from Google Earth imagery (output; land use maps) and secondary maps in SHP format (output: Map of Slope, Landform, and Fraction of Materials). Field checklists are used to collect oceanographic data.

3. Technique of Data Analysis

The determination of coastal typology in this study is based on a combination of the process-response system (morphology) and the substance/energy flow system in the coastal area (Cascade). The Cascade method focuses more on oceanographic data analysis while the morphological method is used to trace coastal groupings based on slope, genesis, constituent materials as shown in the following matrix table 1:

Table 1. Matrix of Typology Determination of Coastal Areas

Coastal Type / Indocators Typology	Land Erosion Coast	Sub Aerial Deposition Coast	Volcanic Coast	Structurally shaped Coast	Marine Deposition Coast	Wave Erosion Coast	Coast built by organism
Relief							
1. Flat		✓					✓
2. Sloping					✓		
3. Rather Steep	✓		✓	✓			
4. Steep	✓		✓	✓		✓	
5. Very Steep	✓		✓	✓		✓	
Raw Material							
1. Stone	✓		✓	✓		✓	
2. Mud		✓			✓		
3. Sand		✓			✓		
4. Organism							✓
Genesys Process							
1. Structurally				✓			
2. Volcanic			✓				
3. Solusional	✓						
4. Marine Tide					✓		
Wave						✓	
5. Fluvio-marine		✓					
6. Aeoliomarine					✓		
7. Biomarine							✓

Source: Khakhim (2009)

C. Findings and Discussion

1. Findings

After cross-tabulating the variables of landforms, slopes, and compilers of material, it was found that the coastal area of Ambon Dalam Bay was dominated by fluvial activity. Marine activity is not dominant due to the morphology of the deep Ambon bay which is a narrow niche so that air circulation is slow. The process is a result of high sedimentation in this area. The data from the analysis of each variable are presented in table 2.

The area of the variable landforms found in the largest coastal area is the alluvial plain. This terrain generally has a flat to gentle slope. This alluvial plain is the result of accumulated sediment deposition on the coast and river boundaries due to erosion on the upper lands. This land cover is generally residential and agricultural with a few mixed gardens which are randomly distributed and form small groups. Figure (3a) is an example of an alluvial plain form of a coastal area used by local communities as agricultural land.

In the study area, the fluvio-marine plains were built by the origin of the river process and the process of wave currents in Ambon Dalam Bay which is counterclockwise, so that the beach is located in the western part of TAD will occur accumulation of sediment material. The land use in this coastal area is generally for residential areas, educational facilities, and other economic activities.

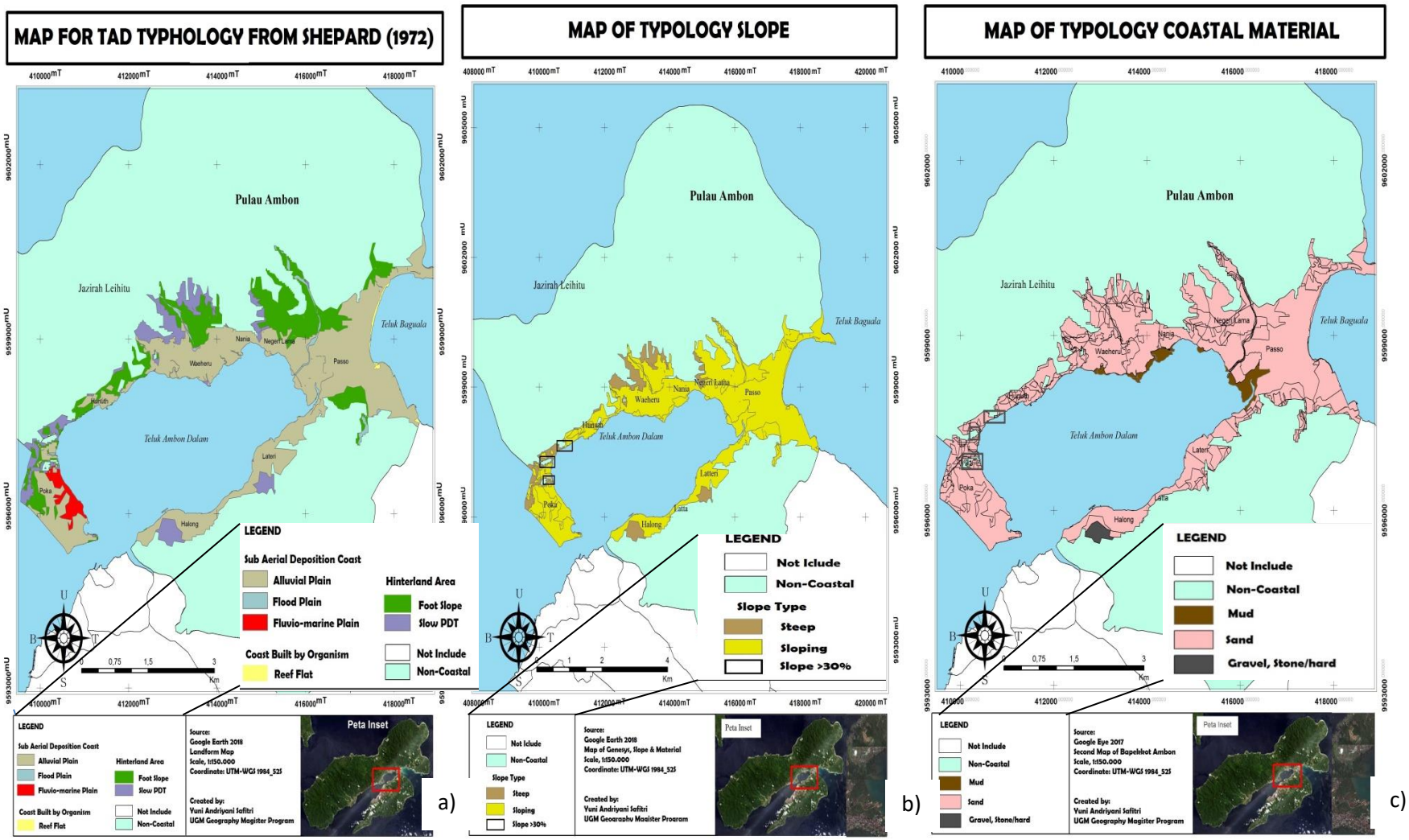
Table 2. Physical Typology of Coastal in Inner Ambon Bay

Genesys	Landform	Slope	Raw Material	Type
Fluvial	Mud Flat	0-3%	Alluvium (Clay)	*Sub Aerial Depositon Coast*
	Alluvial Plain	0-3, 3-8%	Aluvium (mix and and gravels)	
	Flood Plain	0-3%	Alluvium (Sand)	
	BackSwamp	0-3%	Alluvium (mix sand and clay)	
	Point Bars	0-3%	Alluvium (Sand)	
	River Base	0-3%	Alluvium (Sand Mix Gravel)	
	Fluvio-Marin Plain	3-8%	Alluvium (Sand)	
	Lake	3-8%	Alluvium (Clay)	
Denudasional	Foot Slope	8-15%	Sand Stone	*Land Erosion* (*Hinterland*)
	Rest Hill	15-30%	Loose materials	

Source: Analysis Result (2018)

Floodplain landforms (fig. 3b), are found along the Waeheru and Waetonahitu rivers. Areas with flat topography often experience inundation during the rainy season and river water overflows. Existing conditions in the field, this form of land is partially covered by vegetation and partly converted into settlements. The river bed (figure 3c), especially in Waeheru Village, is used by the local community as a sand and stone mining area. This sedimentary material is continuously transported by the river during high-intensity flow conditions in the rainy season.

Fig. 3, Eksisting Landform of Fluvial in Waeheru Village.
Source : Field Photos by Y.A.S (2018)



Fig, 5. Variable of Physical Typology for Map Overlaying
Source: GIS Analysis

Figure 4 (a) has been discussed in advance regarding what landforms are found in the coastal area of the study. Figure 4 (b), the slope map above categorizes coastal areas into two categories, namely flat (0-3% slopes), gentle (3-8% slopes), and slightly steep (8-15% slopes). The basis for determining this typology refers to Sunarto (2000) in Khakhim (2009), that the boundary of the coastal area towards the land is marked by the first topographic change with a slope angle <25%. In the processed data, there are slope angle classes of 15-30%, but if viewed from the aspect of landform, it is not classified as a coastal region forming genesis. As a result, the slope class is generalized into the hinterland area.

Generally, the coast with flat slopes is directly adjacent to the sea and dominates the Ambon Dalam Bay area. However, referring to the map of the largest area of the coastal area with a slope class of 0-3%, it is located in Passo State. It can be explained from a geological point of view that this location is squeezed in the north and south by denuded or further weathered hilly areas. The results of this rock weathering are eroded and carried away by river flow and surface runoff and then deposited in river estuaries or plain areas at the legs of the slopes.

The distribution of coastal areas as a whole is very narrow if the administrative area is used as a comparison. The cause was explained by Ongkosongo (in LIPI, 1991), as a result of the removal of the island which formed nine terraces or steps. These steps in the field are generally included in the 3-8% slope class which is located on the foot slope. The results of the GIS analysis found that the proportion of gently sloping coastal types (<20%) occupied 93% of the study area of 502,136m2. the remaining slightly steep slopes are known to be found at several locations such as Halong, Batu Koneng, and Hunuth. Generally, this slope in terms of lithology is included in reef limestone units.

Figure 4 (c) The constituent materials in the coastal area are made based on the interpretation of the lithology map and the soil type map at a scale of 1: 150,000. The classification of constituent materials is based on a grouping by Sunarto (2003). The constituent material in the coastal area is very diverse so that all groups of constituent materials exist in the area.

The material along the coast of TAD is mud/clay with an area of about 391,831 m2 (3.22%). The constituent lithology is the alluvium group. In the research area, alluvial soil types are visible and generally associated with kambisol, rensina, and gleisol soil types (Lasaiba, 2012). The formation of mud material on the shore is a form of draining sediment that is transported from the upstream of the river and the result of erosion in the hillside / upper lands. Another thing that helps the accumulation of mud material on the beach is the weak flow velocity in the deep bay waters <5 cm/sec.

Apart from the mud/clay material on the beach, the predominance of the constituent material in the coastal area is loose material (sand). This material dominates as seen from the extent of the alluvial plains in the study area. The formation process that occurs is the same as the formation of mud material which is powered by rivers. However, because there is no direct contact with the water, the material does not experience more drainage and accumulation of moisture.

For solid/hard coastal materials, generally found in hilly areas. Appearances in the field such as large rocks and white to brownish-yellow. The distribution of this material is found in Halong Village and parts of Poka Village. Selanno (2009), has researched sediment variation specifically in the Ambon Dalam Bay coastal zone based on grain size (mm). From the results of field

observations and also GIS analysis on secondary maps and literature review, it can be concluded that the constituent material at the research location is gradual. This means that the more towards the sea area, the sediment grains are getting smaller/soft (not coherent), while towards the hinterland the sediment grains are getting bigger/harder (solid).

2. Discussion

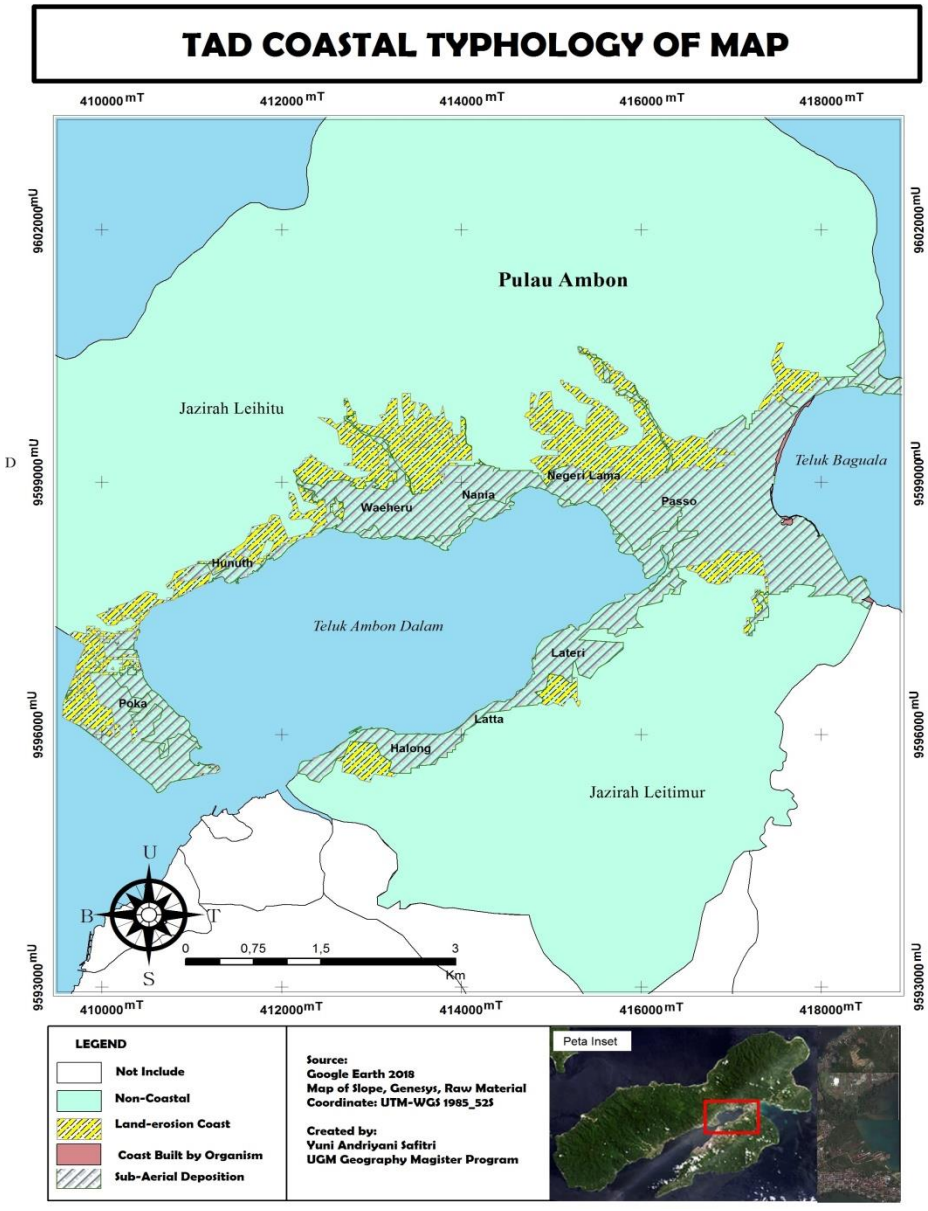


Fig.5, Typologi Map of Teluk Ambon Dalam
Source: GIS Analysis, (2018)

The final result of this research is a physical typology map of the Teluk Ambon Dalam coastal area which is an overlay of genesis type maps, slope maps, and constituent material maps. It was

found that in the study location, the coastal type is homogeneous with the characteristic land-based coastal type (Fig. 5). The characteristics according to Santosa (2015), include (1) the process of deposition of mud material is very intensive, (2) calm waves, (3) high risk of sedimentation, floods, robs and tsunamis, (4) high risk of sea pollution and social conflict, (5) very potential for mangrove ecosystems, wetlands, and aquaculture ponds, and (6) accessibility and infrastructure are difficult to develop due to drainage constraints and high ground/ wrinkled flower movements.

Silt in the study area is an accumulation of material carried by the river during the rainy season. This material is sourced from erosion in hilly areas which have undergone further weathering. The type of soil found on this upper land is generally a red and yellow podzolic soil type that has high wrinkled flowers. during the dry season, this type of soil appears to have cracks on its surface and during the rainy season, it is very easily carried away by surface runoff so that it is prone to soil movement and landslides.

According to Pattipeilohy, (2014), another impact of the formation of mud deposits in the coastal area as a result of erosion of the upper land is the silting of the seabed in Ambon Dalam Bay. This silting has the effect of reducing the quality of marine waters. According to Saiya (2015), the rate of silting the bottom of the waters of Ambon Dalam Bay is 13.9 mm / year. Besides, the influence of the sea cannot be separated from this silt activity. Teluk Ambon Dalam, which is closed water, has a slow water circulation, resulting in high mud material in the mangrove area and a decrease in seagrass conditions. Silting is also exacerbated by reclamation activities that are intensively carried out by the government in the context of providing infrastructure for urban areas.

As for the use of existing land at the research location in the form of agriculture, mixed gardens, settlements, fisheries, industrial areas, and service areas, ports and others. Access in this area is classified as very easy because it is supported by 90% paved road conditions and interconnected roads (BPS Kota Ambon, 2017). Apart from what has been mentioned above, the riverbed landforms as identified in table 2, generally there are mining activities for Quarry C (industrial) materials in the form of sand and stone for building purposes. This activity often creates conflicts of interest between communities who are miners and between communities and the government as regulators. Latupono (2016), researched in Ambon Bay in particular related to the mining of C excavated materials. According to him, sand mining in hilly areas directly changes the landscape and creates channel erosion due to the sharpening of the hillside which has an impact on increasing the intensity of erosion.

Typological analysis is very important to do, besides being able to quickly identify the characteristics of the physical area in general, another thing that can be identified is the type of disaster threat that appears. Based on the results of a review of some historical literature on disasters that occurred in the research location, two types of disasters have been recorded, namely earthquakes and tsunamis, and floods. Summarized from Latief, et.al (2016), there were 13 Tsunamis in the Ambon Dalam Bay area with a height ranging between 2-5 meters. The first incident was recorded in 1648 and the last tsunami occurred in 1983. The 1950 incident was constructed and modeling was carried out to determine the cause of the tsunami. It was found that the tsunami that occurred in the Teluk Ambon Dalam area was (1) a tsunami propagated from Banda Island and (2) a local tsunami as a result of underwater sediment landslides deposited on the coastal slopes.

Apart from earthquakes and tsunamis, the biggest threat to this coastal area of land sedimentation type is flooding. Flooding in the research location was identified as a result of poor drainage, conversion of forests to settlements, upper land which has undergone further weathering to easily erode, decreases in river systems and functions, and short-term flood management. When the rainy season arrives, areas that are flat and close to the coast will generally be inundated although the length of inundation in each area is not the same. Therefore, in

developing or managing coastal areas, it is necessary to identify the physical characteristics of the area as well as the threat of disasters that are always lurking. Ecosystem restoration efforts in the research area are needed to minimize the socio-economic impacts that arise so that the principle of sustainability of an ecosystem management system and coastal areas can be realized.

D. Conclusion

Based on the results of the overlaying map between the physical characteristics indicators of the coastal areas composing the typology, it was found that the coastal areas of Teluk Ambon Dalam were included in the category of land-based sedimentation coasts. This type of coast is generally more difficult to develop, although, in its application, it still pays attention to the regional development directions contained in the regional RTRW and RPJM Documents. This research is limited, so that the typological variables discussed are only from the physical aspect, even though the scope can be expanded towards the built-in coastal type (anthropogenic).

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