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Analysis of The Impact of Land Use on The Degradation Of Coastal Areas at Ambon Bay-Mollucas Province Indonesia

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Abstract. Ambon Bay coastal region has a considerable fast and dynamic of geomorphology developments. This study was aimed to analyze the impact of land use on the degradationof the coastal area in Ambon City. The changes of land use were analyzed using overlaying Landsat imaging and scoring methods. The results show that land uses had changed rapidly in the period of 42 years, which mainly for residential, office, industrial, and trade development purposes. The most affected areas were in the district of Sirimau and Baguala Bay, and that 77.8% of Ambon Bay coastal is categorized as highly affected coastal damage.

Peer-review under responsibility of scientific committee of the ICTCRED 2014

Keywords: *impact, land use, degradation, coastal, bay of Ambon.*

1. Introduction.

Today, the coastal area constantly develops due to the growth of the human population living around the vicinity and in the coastal area[1]. Rapid increasing population growth to various problems in the development of the areas. The coastal area also has a high conflict value between the efforts of utilization aspects and the environmental sustainability [2]. The interaction between the community and the land lead to the changes in the use of land [3-4]. The changes of land utilizations have a potential negative impact for the sustainability of natural resources. The un-planned coastal areas development may trigger the emergence of biophysical and socio-economic problems.

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The high intensity of utilization between stakeholders as well as the tendency of regional authority to excessively intervene the resource area results in serious impact on vulnerability to coastal damage either in local and regional perspective [5-6].

The problems of decreasing quality of coastal environmental as a result of unplanned and uncontrolled use of coastal area occurs in the coastal areas at Ambon Bay. Ambon bay with an area of143.5km^2 and a coastline stretch of 59,953 km, it has a fast and dynamic considerable development of coastal geomorphology. The increasing of population,the fast growing development and the uncontrolled land use, the increase of sectoral resource utilization, and excessive exploitation which exceeds the carrying capacity of the environment has an impact on the degradation of the coastal Bay of Ambon [7-9]. Ambon Bay coastal environmental degradation including pollution, shoreline set backs, sedimentation and silting up of the bay are due to a decrease in the capacity of coastal resources[10-11].

The effort to control the impact of development in the coastal areas of Ambon Bay have not yet fully resolved. Ambon City Government has set the Spatial Plan (Spatial) coastal city of Ambon in 2011-2031 as a reference of the use of resource in the coastal city of Ambon. Although, spatial planning has been implemented but the process of the degradation is on going. The cause of the degradation of the coastal areas at Ambon Bay needs to be assessed to find out the problem solving and alternative of prevention. In detail, the purpose of this study are: (a) analyze changes the use of land in the periods of 1972, 1987, 2001 and 2014,(b) analyze the factors that affects the change of land use, and (c) analyze the impact of land use on degraded coastal areas at Ambon City. The results of the research are expected to provide an alternative solution of pattern arrangement and security of coastal areas at Ambon Bay as a contribution in managing and structuring coastal areas at Ambon City.

2. Materials and Methods.

This study was conducted along the coast of the Bay of Ambon in the 3^o-4^o position south latitude and east longitude 128^o-129^o. The activities of this research was carried out from October 2013-April 2014. The sample that has been used in the form of non-probability is based onthe consideration of the location of coastal areas through observation and physical appearance that has been degraded. The samples that used were nine samples covering three sub districts in Ambon City, the District of Nusaniwe, District Sirimau and Baguala Bay District. District Nusaniwe includes coastal Amahusu, Eri, and Latuhalat. District Sirimau includes coastal area of Mardika, Batu Merah, Tantui, and Galala. While the District Baguala includes the coastal Lateri and Passo.

The changing of land use in Ambon Bay were analyzed based on the identification of multi temporal Landsat satellite images, and using the overlay method. Landsat images that have been used are Landsat-1 MSS image of 1972 Landsat-5 MSS 1987, Landsat-7 ETM 2001 and Landsat-8, 2014. The Interpretation of using land form Landsat land is done on-screen for the using of land and then did the field checks to prove the results of interpretation image. The processing of image data is done through several stages. The first stage is a composite image and geometry correction; it includes the preparation of data retrieval control points between the images of the map of the earth, determining the point of control is done by the system of UTM (Universal Mercator Transvere). The second stage is cropping. The third stage is image enhancement and the combination of channel selection. Sharpening the channel using composite channel 5, 4 and 2 (RGB 542) and then using a band 4 as gray scale. The next stage is the spectral classification. The software has been used are the ER-Mapper software 7.0 and Ar-GIS version 9.Secondary data is collected in the form of bathymetry map scale 1: 50.000, Ambon Island geological map scale of 1: 100.000, river hydrology, geomorphology and geologic conditions of the Bay of Ambon.

The degradation of coastal areas at Ambon Bay were analyzed using the scoring method. The analysis includes aspects of damage to coastal degradation, sedimentation and silting aspects of estuarine and coastal environmental aspects. The score of damage in coastal areas of Ambon Bay beach from damage aspects includes 5 (five) parameters namely: the changing in coastline, the scour at the foot of the building, the area that affected by erosion/coastal erosion and the influence on the surrounding area, abrasion on the rocks, and abrasion of building coastal protection.The Sedimentation and environmental aspects include three (3) parameters which are aspects of the settlement, vegetation and building problems. Each parameter has value or score accordance with the level of damage. Each parameter has a category damage score such as: minor damage, moderate damage, severe damage, the damage is really severe and extremely were damage category. The score of damage is associated with the use of land and area of economic to specified the importance. The score of the damage and the rate of interest and then summed to obtain the order of priority counter measures Ambon Bay coastal degradation.

3. Result and Discussion.

3.1. Land Use Changes in Ambon City.

Based on the results of multi temporal Landsat imagery interpretation (Figure 1- 4), it appears that the development of coastal land use Ambon Bay has under gone some changes or shifts in the allocation during the period of forty-two years. Land use varies from Ambon City is still forested until settlement activities are characterized as urban. In the years 1972 to 1987 (Figure 1 and Figure 2), the use of land in Ambon Bay is dominated by forest and sub area that reaches 49% or about 17,685.60 hectares. The use of land for resident in 1972 amounted to 856.260 hectares and in 1987 amounted to 1812.104 hectares.

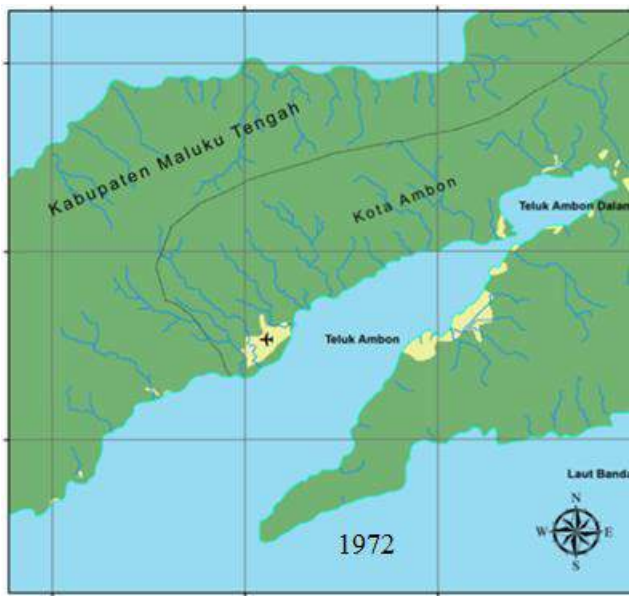

Figure 1. Land Use of Ambon Bay Year 1972.

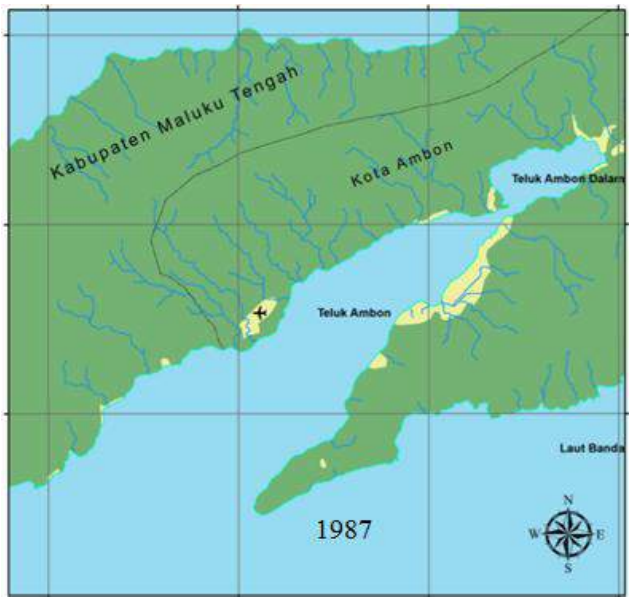

Figure 2. Land Use of Ambon Bay Year 1987.

Ambon City land use based on satellite imagery interpretation of 2001 (Figure 3) shows there has been a considerable increase in land use tremendously over fourteen years, where the coastal forest areas in Ambon bay experience a shift in land use to residential land which is equal to 4,141.049 hectares.

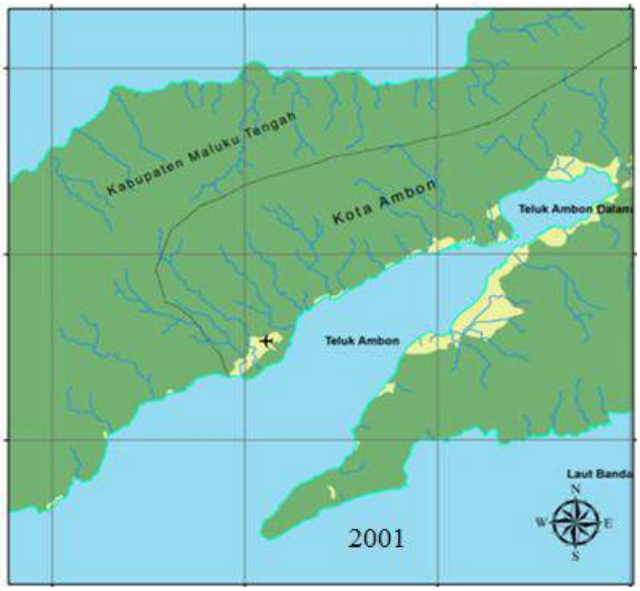

Figure 3. Land Use of Ambon Bay Year 2001.

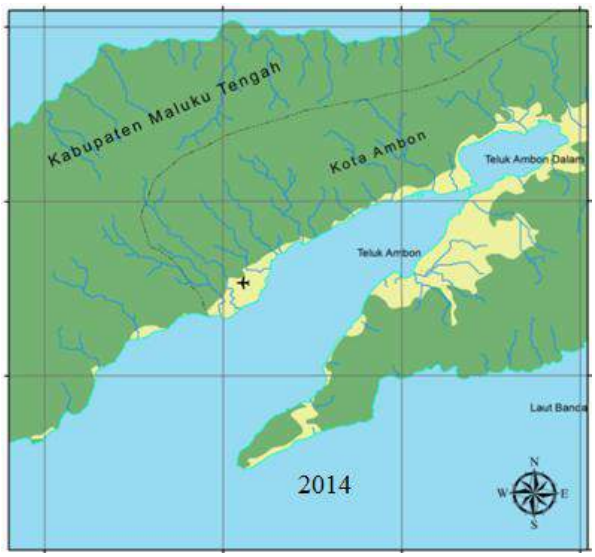

Figure 4. Land Use of Ambon Bay Year 2014.

The land use in Ambon City based on interpretation of satellite imagery in 2009 were carried out by the Local Government of Ambon City showed 53.87 percent of the land is green space, which is a 30.14 percent and 18.49 percent of the forest area is the plantation area. Woke region amounted to 42.44 percent, which the area has been utilized for the settlement amounts to 41.07 percent or 4348 hectares [12-13]. Image interpretation of lands at results in 2014 (Figure 4) showed that the area woke utilized as residential areas has increased to 4505.012 hectares.

The number of residents in the Ambon city is quite high; reaching 331.254 people with the largest population density is concentrated on the Sirimau District which amounted to 1,613 people / km^2[13]. High population growth requires large and clearing for settlement. The topography of the Ambon city hilly and steep slope, with an altitude of 700 – 1000 meters above sea level while the flat land in the city of Ambon only about 5%. Limitations of flat land cause nearly all clearing new land for residential and other development activities are concentrated in the hilly areas. Shifts in land use to residential are also often caused by the presence of refugees as a result of social conflict that plagued the city of Ambon in 1999.

3.2. Ambon Bay Coastal Area Degradation from Damage Beach Aspects.

The degradation of the coastal areas of Ambon Bay beach damage is depicted in Figure 5. Based on the results of the degradation of the coastal Bay of Ambon weighting corresponding Figure 5, it appears that from the aspect of coastal damage in nine (9) location of the study, the greatest damage occurred in three (3) locations namely Amahusu village, Eri and Latuhalat. According to the criteria abrasion protective building of the three coastal villages are covered under the category of damage with weight 78.While the weight of the criteria scour at the foot of the building, Eri and Amahusu villages are categorized by weight of 100, followed by weight 55 Mardika coast of criteria impact the affected area erosion/abrasion of the surrounding area is seen that the coastal Latuhalat, Amahusu, Eri, Mardika and Batu Merah covered as moderate damage is categorized by weight of 55-60.

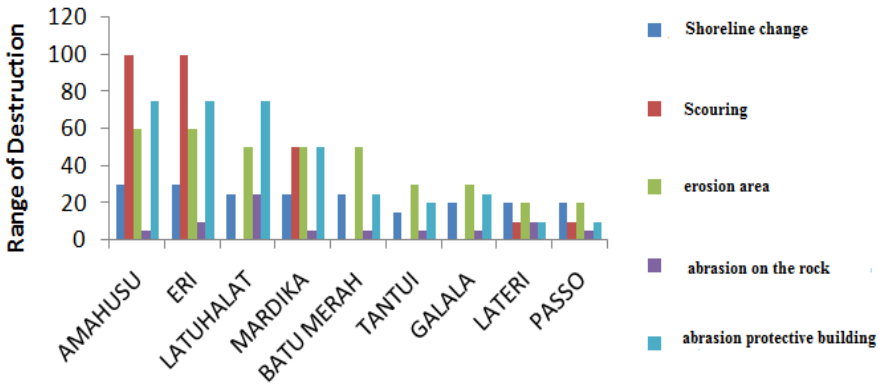

Figure 5.Ambon Bay Coastal Area Degradation from Coastal Damage Aspects.

Based on the shoreline change criteria, the nine locations included as light category. However, overall aspects of coastal damage locations are included in the mild category to moderate damage. This fact proves that in addition to the influence of hydro-oceanography form of waves, currents and tides turns, human intervention in the form of exploitation of coastal resources in the form of the material making Ambon Bays and, rocks and forest conversion Mangrove helped accelerate the rate of degradation of the coastal Ambon Bay [8-9,14-15].

3.3. Ambon Bay Coastal Area Degradation of Sedimentation and Environmental Aspects.

Based on sedimentation and environmental aspects at the Figure 6 shown that the damage from beach vegetation is three (3) location of study namely Galala, Lateri and Passo with categorized of 70-100. Estuary silting and sedimentation the great damage seen in 5 (five) study sites namely Batu Merah, Tantui, Galala, Lateri and Passo. The sites in the category are of moderate to severe damage to the weight of 30 – 60. This occurs as a result of land clearing up to the settlement, and coastal reclamation too.

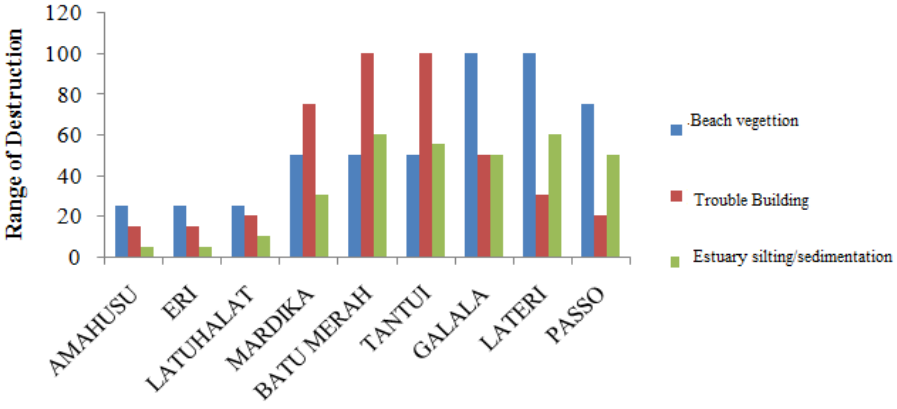

Figure 6.Damage Ambon Bay Coastal Area of Sedimentation and Environmental Aspects.

While the problem of building criteria coastal, Batu Merah, Tantui and Mardika occupies the highest weight. This is possible because of the location of the study nine villages, namely Batu Merah, Tantui and Mardika a coastal village with a very dense residential and irregular, even construction has exceeded beach Sempedan.

3.4. Determination of Priority Management at Ambon Bay Coastal Degradation.

Determination of the order of priority of the degradation of the coastal Bay of Ambon is conducted by summing the weights of coastal damage with the level of importance of coastal management. The results of determining order of priority counter measures Ambon Bay coastal degradation as shown in Figure 7 as follows :

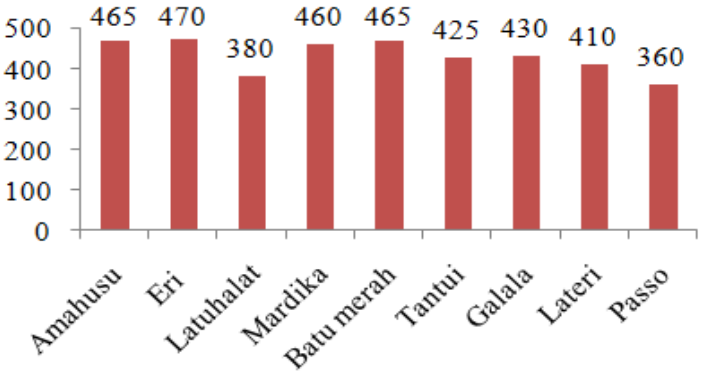

Figure 7. Mitigation priority of coastal degradation of Ambon Bay.

Based at Figure 4, corresponding counter-measures prioritization of coastal degradation is seen that of the nine study sites, seven (7) locations or as much as 77.8% in the category of the category B is preferred to be addressed coastal damage. Mean while, about 22.2% of coastal areas Latuhalat and Passo village includes as category C, the category of precedence priority coastal damage reduction.

4. Conclusion

The results showed that the changes in land use for 1972 amounted to 856,260 hectares, 1987 hectares of 1,812.104; 4,141.049 hectares by 2001 and in 2014 increased to 4505.012 hectares. The most intensive changes in land uses were for residential, office, industrial, and trade purposes. Most areas experiencing changes in land uses wee in Sirimau district and Teluk Baguala district. The results also showed that 77.8% of Ambon Bay coastal locations are categorized as highly preferred, while 22.2% are categorized as precedence for over come damage to coastal.

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References

1. Wu, X., Z. Shen, R. Liu, and X. Ding (2008).Land Use/Cover Dynamics in Response to Changes in Environmental and Socio-Political Forces in the Upper Reaches of the Yangtze River, China. Sensors, 8. pp. 8104-8122.

2. Purwoko Agus (2009). Function Analysis and Land Changein Coastal Area Using Satellite Imagery Based Geographic Information System(A Case Study in the Area Wild life Coral Ivory and Langkat Northeast). Journal of Planning & Regional Development, Voumel.4, No.3, April 2009 (In Indonesia).

3. A.R. As-syakur (2011). Land Use Change in Bali Province Ecotrophic Journal, Vol 6, No 1: 2011 (In Indonesia).

4. Sumbangan Baja (2012). Land Use Planning in Regional Development, Spatial Approachand its Application. Andi Offset Publisher, Jakarta (In Indonesia).

5. Wahyudi,Teguh Haryanto,Suntoyo (2009). Assesment of the Coastal Vulnerability to Coastal Erosion in the Tegal regency, Central Java Indonesia. Proceedings of theNational Seminar onTheory and Application of Marine Technology ITS 2009.pp.A149-A156 (In Indonesia).

6. Hamidreza Masoumi, Ahmad Motamed, Hamidreza Peyrovan, Jamal Tarrah (2011). An Investigation of Alongshore Sediment Transport Trends using Experimental Relation, Morphological Landcapes and Coastline Changes in the Persian Gulf. Journal of American Science 7(6) (2011) 925 - 930

7. Belvi Vatria, (2010). Impact of Human Activity Can Cause degradation of Coastal Ecosystem. Belian Journal Vol. 9 No. Januari 2010: pp. 47-54 (in Indonesia)

8. Berhitu P and Kakisina,T.J (2009).Geographic Information Systems(GIS) and Spatial Analysis Studies to Interpretation Physical Coastal Damageat the Beach of Ambon and Central Maluku. Proceedings of the National Seminar on Theory and Application of Marine Technology ITS2009. pp. B53-B62 (In Indonesia).

9. Kakisina T.J (2008). Identification of Coastal Area Damage at Ambon Bay. Journal of Engineering Sciences and Technology Science Vol. 5 Number 2 October 2008, pp.65-70 (In Indonesia).

10. Sahetapy, D (2010).The existence of Coral Reefs in the Coastal Waters of Ambon Bay. Journal of Water Resource Management Volume 6 Number 2 October 2010,pp.18-27 (In Indonesia).

11. Triatmodjo,B (2012). Planning of Coastal Structures. Beta offset, Jakarta (In Indonesia).

12. Bappeda Kota Ambon (2009). Master Plan Ambon Water Front City (In Indonesia). .

13. Statistics Agency of Ambon City (2011) Ambon City in Numbers (In Indonesia).

14. Lembaga Ilmu Pengetahuan Indonesia (2008). Monitoring the Bay of Ambon. Pollution Control Programe and the Destruction of the Environment. Indonesian Institute of Sciences Ambon, pp.1-70 (In Indonesia)

15. Suyadi (2009).The Condition of Mangroove Forest in Ambon Bay, Prospect and Chalenges. Journal of BiologyVol. 9 No.5, Agustus 2009, Pp.481-490 (In Indonesia).