Monitoring of Changes of Coastal Conditions as a Result of Increased Industrial Activities: Case Study - Lamong Bay

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Abstract: Many kinds of activities in Lamong Bay area will have a big impact on the environment and surrounding communities. Disposal of large quantities of mud and continuously, the construction and expansion of ports in Lamong Bay was indicated to result in changes of functions around the coast of Lamong Bay. There are several parameters that can be used to determine changes in coastal functions, one of which is the change of land cover classes that occur around the coastal and marine areas. Remote sensing methods with satellite imagery can be a solution for conducting research related to monitoring land cover, because this method is more efficient and effective in large-scale research, and can be done temporally. The satellite image data used in this study are various satellite images from 2002 to 2017. The results of the image processing land cover class validated using the In-Situ data reference from the results of sampling in the field to obtain the linear correlation value (R2).

1 INTRODUCTION

The port management system in Indonesia should be able to provide optimal services to the parties associated with the port. Environmental and sustainability issues are a major issue related to the issue of global warming, climate change and energy consumption (Lam and Voorde, 2012). It's affects the changes in physical conditions around the coastal and marine areas in Teluk Lamong.

Lamong River is one og nine major river in East Java, Condition of water quality for a few important parameters as water pollution indicator is exceeded the boundary conditions which determine the standard (Wahyuningsih, et.al, 2010). Lamong Bay port will become an international category with plans to shift the burden of maritime transportation movements previously in the silver cape port which is currently overcapacity, making the Lamong Bay area the center of the industrial area.

There are several parameters which can be used to determine changes in coastal functions, one of which is the change in land cover classes that occur around the coastal and marine areas. Remote sensing methods with satellite imagery can be a solution to research the problem of land cover mapping in coastal and marine areas, because this method more efficient and effective in large-scale research. Some multi temporal satellite imagery can be used from 2002 to 2017 to examine the problem, has good and multi temporal spatial resolution.

The final result will be expected to provide information about land cover classes, along with changes that affect the recommendations for coastal and marine management in Lamong Bay in order to optimize the results of mapping research using satellite image technology and can be useful for the management of coastal and marine areas in context of regional development sustainable coastal areas.

2 METHODS

2.1 Study Area

The location of this study took Lamong Bay, which is located in a geographical position 7°11'13" LS and 112°41' 24" BT. The study area is presented in the following figure :

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Figure 1: The study area

2.2 Data Acquisition

The data used in this study are Landsat-7 satellite image data path / row: 118/065 in 2002 and Landsat-8 satellite image data path / row: 118/065 in 2017. Data in a period of 15 years was used to determine the major changes of physical condition such as land cover changes that occur in the coastal area.

2.3 Data Processing

2.3.1 Digital Classification

Digital classification that used in this image classification process is a supervised classification with the type of maximum likelihood classification using image processing software. Guided classification is the stage of making comparisons between each pixel image with each category in key interpretation is done numerically by determining the training area. Ground truth is carried out in this classification process aims to take samples of field data that are used as reference data to test the accuracy of image classification using confusion matrix calculations. Remote sensing techniques, including the use of conventional aerial photography, can be used effectively to complement surveys based on ground observation and enumeration, so the potential of a timely and accurate inventory of the current use of the Nation's land resources now exists (Anderson, et.al, 1976).

2.3.2 Sub-setting Study Area

The research area used in Lamong Bay and its surroundings, the image used must be subset based on the specified study area.

2.3.3 Ground Truth

In this research, field survey or groundtruth is something that must be done. It aims to determine the condition of sedimentation in field and condition of the waters in general. Field data is used as a basis for the interpretation of satellite imagery that represents the area so that it can support the process of making land cover maps. The results of the digital classification are determined by the truth or accuracy through a test of classification accuracy which is done by calculating the confusion matrix using image processing software. Things that must be done before performing the classification accuracy test are groundtruth which aims to check in the field about the truth of the image classification results with the appearance of the land cover objects in the field.

3 RESULT AND DISCUSSION

Based on research conducted by Ecoton, type of river from Lamong River which has a high sedimentary estuary, makes this area as a transit and feeding area for migra birds from continental Europe to Australia. Assessment of Land cover changes and transformation for 15 years in the study area is extracted from the Landsat 7 images (30 m) for the period of 2002 and Landsat 8 images (30 m) for the period 2017 using the Maximum Likelihood Classifier (MLC) algorithm of supervised image classification technique. Thus, the result describes the different land cover feature classes based on the Level-II category of USGS-LULC classification table with overall classification accuracies of 79.93% and 81.67% and overall Kappa coeffient statistical values of 0.69 and 0.76 respectively. The information of land cover changes and transformation is an essential source for coastal resources management in the coastal area.

3.1 Assessment of Land Cover Change between 2002 and 2017

Assessment of land cover change area in coastal area of Lamong Bay can be seen in the following table

Table 1: Land Cover Change During 15 Years

Land Cover Feature	Area in Period of 2002 (Ha)	Area in Period of 2017 (Ha)	Area in Change During 15 years
	% of distribution	% of distribution	% of Change During 15 years
Road	15844.77	8079.48	-7765.29
	17.69%	6.94%	-29,02
Vacant Land	9089.71	16937.31	7847.6
	10.15%	14.56%	29.32
Settlement	30877.31	33236.28	2358.97
	34.47%	28.57%	8.81
River	6704.23	6283.48	-420.75
	7.48%	5.40%	-1.57
Pond	17850.62	35280.38	17429.76
	19.93%	30.32%	65.13
Vegetation	9217.27	16528.33	7311.06
	10.29%	14.21%	27.32

Table 1 tell us classification results during 2002 to 2017 to identify the dynamics of change in land cover in coastal area. The proportions of change in land cover feature indicate where development pressure has occurred and they demonstrate an increase in settlement areas to the detriment of dense vegetation. In 2002, many residential buildings. There were some land cover changes area in 2002 to 2017. It occurs due to a change which the increase occurred, namely the residential area of 2358.97 Ha. Land cover change in 2002 to 2017 includes changes vacant land to waters, vacant land to settlements, vegetation to waters, vacant land to ponds, vegetation to ponds, vegetation to road. The most dominant changes are from vacant land to settlements amount 2700.12 Ha.

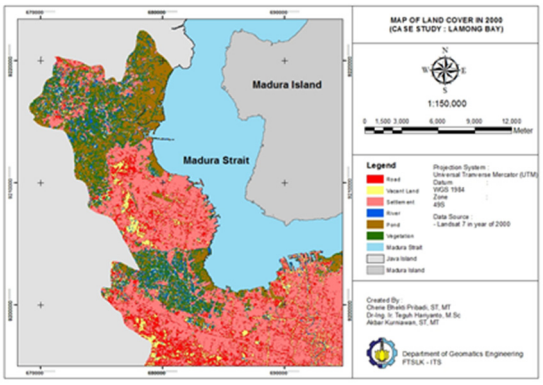

Figure 2: Map of land cover in 2000

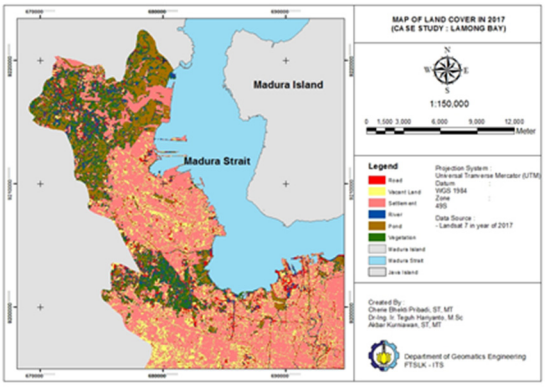

Figure 3: Map of land cover in 2017

3.2 Accuracy Assessment

Accuracy assessment is an integral process of feature extraction from the classified images. It highlights the possible sources of errors in a classified image, thus enhancing the quality of information derived from the data (Lea and Curtis, 2010). The results of the digital classification are determined by accuracy assessment which is done by calculating the confusion matrix using image processing software. From the results of the confusion matrix calculation, the results of the accuracy of all classification results for Landsat 8 satellite images in 2002 were 79.93% and Landsat 8 in 2017 was 81.67%. With the results of the calculation of the accuracy of the classification, the results of the land cover classification with five classes are considered correct because the value is more than 75%. Overall observation of accuracy shows the reliability of land cover features in terms of location area and spatial distribution in the study area.

Table 3: Accuracy assessment of classified Landsat 8 images for 2002 and 2017

Land Cover Feature	Producer's accuracy (%)		User's Accuracy (%)		Commission (%)		Omission (%)	
	2002	2017	2002	2017	2002	2017	2002	2017
Road	76.38	67.92	22.32	77.42	77.68	22.58	23.62	32.08
Vacant Land	95.47	76.74	94.91	69.47	5.09	30.53	4.53	23.26
Settlement	74.44	91.92	90.06	88.78	9.94	11.22	25.56	8.08
River	80.49	89.82	37.92	74.00	62.08	26.00	19.51	10.18
Pond	83.75	76.86	98.71	90.74	1.29	9.26	16.25	23.14
Vegetation	96.12	100	88.57	90.48	11.43	9.52	3.88	0
Overall Accuracy			79.93	81.56				
Overall Kappa Coefficient			0.69	0.76				

4 CONCLUSION

Based on results of this study, there were some land cover changes area in 2002 to 2017. It occurs due to a change in the function which the largest increase occurred, namely the residential area of 2358.97 Ha. Increase in pond area amount 17429.76 Ha, and increase in fields area amount 7847.6 Ha. Land cover change in 2002 to 2017 includes changes vacant land to waters, vacant land to settlements, vegetation to waters, vacant land to ponds, vegetation to ponds, vegetation to road. The most dominant changes are from vacant land to settlements amount 2700.12 Ha.

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