J. Basic. Appl. Sci. Res., 1(7)579-582, 2011

ISSN 2090-424X
Journal of Basic and Applied Scientific Research
www.textroad.com

Identification of Coastal Line Change in Surabaya East Coast Using Remote Sensing Image Data

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ABSTRACT

This research is carried out by using remote sensing method with multi-temporal landsat image in the years of 2000, 2003, 2009 for mapping of coastal line change with color composition (RGB 543). From then on, it is conducted coastal line extraction process and tidal correction, where MSL (Mean Sea Level) value is used as a common reference standard. The final result of this research is known that in 9 years period (from Landsat image year 2000 up to Landsat image year 2009), it is occurred a maximum displacement of coastal line as far as 704.842 meter with displacement rate about 78.315 meter per year. The overlay result of Landsat image year 2000 and year 2003 is an area increasing as far as 109.484 Ha, whereas in overlay of Landsat image year 2000 and year 2009, the area increasing is about 334.453 Ha with increasing rate about 37.161 Ha yearly.

KEY WORDS: Remote sensing, coastal line change, color composite.

INTRODUCTION

Surabaya east coast is marine area with highly potential sedimentation occurred every year. In this case, it is caused by many rivers taking sediment from the stream, and many kinds of human activity, such as land utilization. So it is influence marine area environment especially coastal line (Khomsin, 2006). Identification of the coastal line change precisely and effectively for wide area in the same time used remote sensing satellite data (Landsat Image) with many band combinations (Alesheikh et al., 2007; Danoedoro, 1996). By using multiplied research and multispectral analysis methods, it is very useful for monitoring the widely coastal area in the means of time efficiency, cost, and man/person needed (Hermanto, 1986; Harianto, 2010),

East coast, as a marine area which is laid on east of Surabaya city-East Java Provence has a potency that can be developed. This case can be shown at the land use change rapidly, such as housing, industry area, fishpond is agriculture, public facility, tourism area, and the other utilization (Tito et al., 1998; Wijaya, 2009). The presence of Suramadu Bridge has conected Jawa Island and Madura Island cause more changes at the environment surroundings. An impact of land utilization is coastal line change. And in other side, it is influenced by many rivers flowing and empting to Surabaya east coast, such as Wonokromo river and Kali Buntung river carrying sediment material or suspended sediment, such as mud/clay, soft sand, rough sand mostly caused by land erosion brought by river water flowing. Geographicly,the coastal type in Surabaya east coast is a coast with dominanly sediment process. At this location, it is often ocurred the changes with land increasing caused by coastal line changing happen every time.

Base on the condition happen in Surabaya east coast, it is needed a research of coastal line changing at the entire Surabaya east coastal line to give spatial information with better accuracy. The Method of remote sensing technology can measure and observe the phenomenon on coastal line changing yearly (Purwadhi,2008). The advantage of this method comparing with other method is that it explain the object, region, and indication of earth surface with shape and object position on the earth relatively complete, consist of wide and permanen area, can be formed in 3 dimentional map so it can clear relief condition and it can be made fastly although the area is difficult to reach, and the data is up to date characteristic.So the remote sensing data with multitemporal data can be applied for detecting coastal line change.

The aim of the research are to detect coastal line change of Surabaya east coast with multitemporal image the year 2000, 2003 and 2009 by overlay result method, and to know how much does the coastal line increase or decrease.

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Methodology

1.1. Research area

The research area is in the east coast of Surabaya city-East Java Provence with boundary of area study 7°15'2''.34 S,112°47'44''.47 E and 7°21'4''.19 S ,112°52'27''.2 E. The coastal area of east Surabaya is the estuary for many rivers such as Wonokromo river and Buntung river

2.2.The Data

The data used for this research are the image data of Landsat satellite 2000, 2003 and 2009 and tidal data during 10 years using by WXTide 3.2 software, Indonesien Topographic Map 2000 edition

2.3. The data processing

The topographic map registered to grid and UTM Projection for synchronizing point coordinat and digitized by Autocad to see patern, morphologi of coastal line to determine coastal line early or datum.

The tidal data is used to correct coastal line position at the image recording,it is stated as coastal line reference to correct position of coastal line at the processed image. To determine of datum (MSL), it is used WXTide 3.2. sofware as long as 10 year as first reference. Every image is conducted similarization of water surface elevation reference toward Mean Sea Level (MSL) using MSL as its reference, so the image should follow the reference as the same standard. This process can be done by reducing or adding the coastal line position as correction.

The cutting of image is conducted for restricting research area and minimizing memory storage so image processing can be done rapidly.(Purwadi,2001) Image correction conducted for image ratification is aimed that the coordinate image appropriate with geographic image for registering image position with other or transforming coordinate system of multispectral or multitemporal image. However for registering image to map or transforming image coordinate system to map, it is used certain projection system.

The separation of land and sea area is aimed for image processing (specially by image classification) more accurately and easily. This method use RGB Composite with band combination 543 RGB. The next process is overly by each satellite image (2000,2003,2009) for correcting coastal line changing every year, and coastal area increasing or decreasing.

2. Result and Analysis.

3.1. Tidal Data Correction

The Tidal data is used to determine tidal level in the image data recording. By using software WXTide 3.2. it can be obtain tidal level on image data 2000 1,07 m so the margin of tidal level with MSL is about 0,43 meter, it can be stated that the displacement of coastal line is + 0.43 m, by satellite data 2003 +0,17 m and by satellite data 2009 +0,35 m.(see Table 4.1.) The tidal data for 10 years with WXTide 3.2. Software obtains MSL on 1.5 meter level. This result is used to common reference toward tidal in every image recording.

Tabel 4.1. Tabel of Tidal Correction of recorded Landsat image

Recording Date	Recording Time	Tidal Level	MSL	Diff.
08-17-2000	03:26:44	1,07 meter	1,5 meter	0,43
22-05-2003	05:30:01	1,67 meter		0,17
29-10-2009	01:39:00	1, 84 meter		0,35

3.2. Geometric correction

The image used in this research is image with 1G level that for each image is one more geometric correction by rectification process. The rectification use landsat image 2000 and 2009 with the ortho landsat image reference corrected. The point sum used is about 10 point as long as the coast. It is aimed for accuracy between upland and coast. The average RMS error for geometric correction of image 2000 is 0.046 pixel and image 2009 is about 0.049 pixel. The máximum value of RMS error by geometric correction is 1 pixel.

3.3. Analysis of Coastal Line Change

For conducting the coastal line changing is by digitising as long as coastal line for every image, so it can be seen the coastal line. From then on, every image overlaid toward image, so it can be obtained the coastal line change and the increasing or decreasing of land area. The result obtained from the overlay is the coastal line change and the increasing or decreasing of land occured in the study area.

In the years 2000 up to 2009, it is occured a maximum displacement of coastal line as far as 704.842 m (in 9 years period), with coastal line displacement as far as 78.315 m yearly. The coastal line displacement will be impacted on the increasing of area as wide as 109,484 Ha with the area increasing 36,494 Ha per year, wether the decreasing area is about 24,218 (Figure 1). The overlay result of image 2000 and 2009 indicate that the increasing area is about 334.453 Ha with increasing rate 37.161 Ha yearly, wether the decreasing area is 32.447 Ha.(Figure 2-3). The coastal line change occured at Surabaya east coast is caused by sediment and coastal abration process. This is caused by river flow from Wonokromo river and Buntung river which carry sediment material flow through the sea. Geographicly, contour of Surabaya east coast is slope slightly with small sea wave, so sea current emerging as long as the coast (longshore current) is also small; then the sediment occured continuously in the whole year.

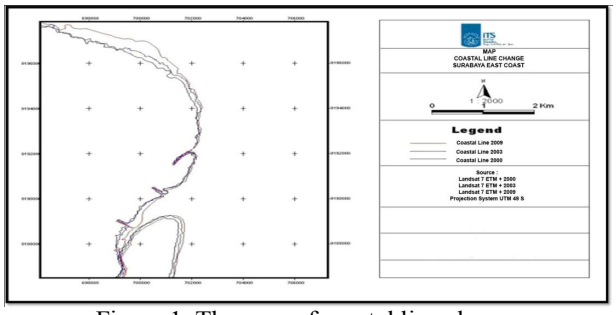

Figure 1. The map of coastal line change

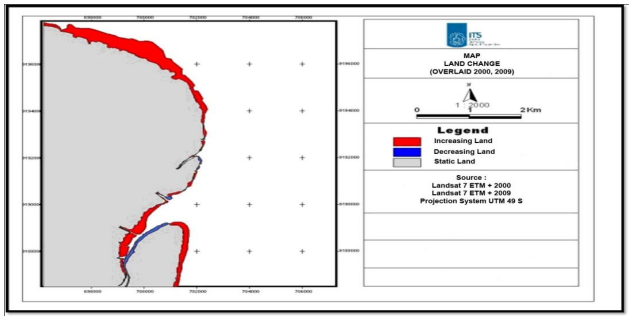

Figure 3. The map of land change
(Overlaid Image in the years 2000 and 2009)

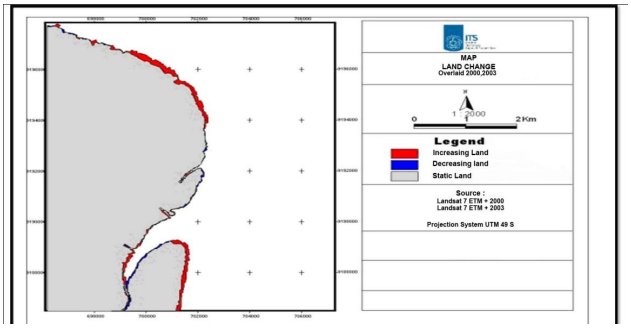

Figure. 2. The map of land change
(Overlaid Image in the years 2000 and 2003

4. Conclusion

During 9 years period (2000 up to 2009), the maximum displacement of coastal line is occured as far as 704.842 meter with displacement rate about 78.315 yearly. The calculation result indicate that the width of upland in the year 2000 is about 3815,691 Ha, and it increase 3905,349 Ha, and in the year 2009 the upland increase as wide as 4115,061 Ha. The overlaid image result in the year 2000 and 2003 indicate that an area increasing is about 109.484 Ha, whereas in the year 2000 and 2009 , the area increasing is about 334.453 Ha with area increasing rate about 37.161 Ha per year. The coastal line change occured in the Surabya east coastal is caused by sedimentation and coastal abrasion process.

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