Important Value of Economic Potency Mangrove Using NDVI Satellite High Resolution Image To Support Eco Tourism Of Pamurbaya Area (Case Study: East Cost of Surabaya)

B M Sukojo* , H Hidayat and D Ratnasari

Departement of Geomatics Engineering, Faculty of Civil Engineering and Planning, Sepuluh Nopember Institute of Technology (ITS) Surabaya, Indonesia

bangunms@gmail.com

Abstract. Indonesia is a vast maritime country; many mangrove conservations is found around coastal areas of Indonesia. Mangroves support the life of a large number of animal species by providing breeding, spawning and feeding. Mangrove forests as one of the unique ecosystems are potential natural resources, supporting the diversity of flora and fauna of terrestrial aquatic communities that directly or indirectly play an important role for human life in economic, social and environmental terms. East Coast Surabaya is an area with the most extensive and diverse mangrove ecosystems along the coast of Surabaya. Currently Pamurbaya used as a recreational object or nature tourism called eco tours. Utilization of mangrove ecosystem as a place of this eco tour bring positive impact on economic potency around pamurbaya area. So, to know the value of the economic potential of mangrove ecosystems for support of nature tourism Pamurbaya region needs to study mapping mangrove ecosystem conditions in the East Coast area of Surabaya. Mapping of mangrove conditions can use remote sensing technology by utilizing satellite image data with high resolution. Data used for mapping mangrove ecosystem conditions on the east coast of Surabaya are high resolution satellite image data of Pleiades 1A and field observation data such as Ground Control Point, soil spectral parameters and water quality. From satellite image data will be classification of mangrove vegetation canopy classification using NDVI vegetation index method using algorithm formula which then will be tested correlation with field observation data on reflectant value of field and water quality parameter. The purpose of this research is to know the condition of mangrove ecosystem to know the economic potential of mangrove ecosystem in supporting Pamurbaya nature tourism. The expected result of this research is the existence of basic geospatial information in the form of mangrove ecosystem condition map. So that can be used as decision makers to find out how big economic potential of mangrove ecosystem in supporting nature tourism Pamurbaya beside that can be used as reference research related mapping, conservation and development of mangrove ecosystem.

Keywords: Correlation, NDVI, Mangrove, Remote Sensing

1. Introduction

Indonesia became the country with the most extensive mangrove forest in the world. According to [13] in 2005 Indonesia has 3 million ha of mangrove forest. Mangrove is a complex ecosystem consisting of flora and fauna in coastal areas or sea tidal boundaries. Mangrove is an influential vegetation in coastal

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

ecosystems. Because Indonesia is a vast maritime country, so much found mangrove conservation around the coastal areas of Indonesia.

Mangrove is a plant community or an individual plant species that forms a community in tidal areas. Mangrove forests are a type of forest that is naturally affected by tidal seawater, flooded during high tides and free from puddles during low tides. The mangrove ecosystem is a system consisting of biotic and abiotic environments interacting within a mangrove habitat. The mangrove forest ecosystem is complex and dynamic, but labile. Complex because of its ecosystem in addition there is mangrove vegetation, is also a habitat of various animals and aquatic biota. Dynamic because the mangrove forest can grow and develop and continue to succeed in accordance with changes in its natural place of growth [16].

Mangrove forest management as a form of conservation of natural resources and coastal waters resources is necessary considering the mangrove forest ecosystem functions physically to keep the coastline stable, protecting the beach from erosion (abrasion), storm and wave dampers, sediment catchers, Rahmawaty in Suci, (2011), while the biological mangrove functions according to [3] as a spawning or shrimp area for shrimp, crabs, shellfish and others, as the area for shelter, nesting and breeding.In addition to ecologically functioning mangroves also function socioeconomically, Rahmawaty in Suci (2011) mangroves as a source of livelihood, production of various forest products such as wood, charcoal, medicine, building materials and handicrafts, natural attractions.

Mangrove ecosystems are found throughout the coastal city of Surabaya, one of which is the East Coast of Surabaya (Pamurbaya) which is a protected area. Pamurbaya is known as the remaining green open space and a fortress to protect Surabaya from the threat of abrasion, sea water intrusion, and land subsidence. Besides, Pamurbaya is also used as a recreational object of nature tourism or so-called eco tour. Utilization of mangrove ecosystem as a place of eco this tour brings a positive impact on the economic potential around the pamurbaya region. To know the economic potential value of mangrove ecosystem in supporting eco-tourism Pamurbaya area can be done by mapping mangrove ecosystem condition in East Coast area of Surabaya by using remote sensing technology that is by utilizing satellite image data of high resolution.

Mangrove ecosystem is one of the objects that can be identified by using remote sensing technology. The geographical location of the mangrove ecosystem located in the land and sea transition areas provides a distinctive recording effect when compared to other land vegetation objects. The recording effect is closely related to the spectral characteristics of the mangrove ecosystem, to the extent that identification requires a separate transformation. In general, for vegetation detection transformation used vegetation index [8].

In this study will map the condition of mangrove ecosystem by studying the condition of mangrove ecosystem vegetation based on Normalized Difference Vegetation Index (NDVI) value using remote sensing technique using satellite imagery. Also in this study the NDVI image value will be validated with field data. From the results of this study is expected to provide a spatial information about the condition of mangrove ecosystems used to determine the economic potential value of mangrove ecosystems in supporting eco-tourism Pamurbaya region. In addition, this research is expected to be used as reference material for research related to the field of mapping, conservation and development of mangrove ecosystem.

2. Materials and Methods

The location of this study included in the land suitability area for mangrove conservation, geographically located at coordinates 7˚15'19,60 "LS - 7˚17'13,25" LS 112˚48'35,69 "BT - 112˚48 ' 40.72 "east of East Coast Surabaya.

2.1. Data Used

The data used in this research are Pleiades 1B satellite image 2015, Map of RBI 1: 25,000, GCP checking data field, Test data sample parameters.

2.1.1 Data Collection Stages

Data used in this research are Pleiades 1B image 2015 from this data will be made a net design for measurement of GCP point in field and sampling location.

2.2. Stages of Data Processing

2.2.1 Geometric Correction

Geometric correction aims to reduce geometric errors resulting in geometric corrected images. This technique is required to determine the position of the image in accordance with the coordinates of the map or the coordinates of the earth. In this research geometric correction on Aster and Landsat-8 image is done with vector map of RBI 1: 25.000 by taking GCP point coordinates in same area with image. While geometric correction on Pleiades 1B image is done by making the design of the net on the image then do the measurement of GCP point field. Geometric correction is correct if the RMS Error value is less or equal to one pixel [24], it means the image has been corrected geometrically.

2.2.2 Radiometric Correction

Radiometric corrections include radiometric calibration and atmospheric correction. The radiometric calibration converts the DN (Digital Number) to Reflectance i.e. the process of changing the Pixel value to an image originally worth DN in the change to Reflectance. Then the atmospheric correction by the method of Gain of Set.

2.2.3 Cropping

Cropping is done to facilitate the image processing, and only covers the research area. So, minimize the image area to be processed. Cutting by area or area coverage of coastal mangrove ecosystem of North Surabaya.

2.2.4 Vegetation Index

Vegetation index indices vegetation index is done by entering the vegetation index algorithm. In this study using the algorithm Normalized Difference Vegetation Index (NDVI). NDVI algorithm as follows:

$$\text{NDVI} = \frac{NIR\text{-}RED}{NIR+RED} \quad (1)$$

Information :
NIR = Near infrared spectral band value
RED = The value of the red spectral band
the process of incorporating this vegetation index algorithm will produce an image spectral value between -1 to 1.

2.2.5 The Claasification of Terelia

Furthermore, the classification of terelia by entering the value range of each type of vegetation health.

Table 1. The Classification of Terelia

Class	NDVI Range	Satisfaction Level
1	0 s.d 0,32	Avicennia
2	0,32 s.d 0,42	Bruguera
3	>0,42 s.d 1	Rhizopora

IOP Conf. Series: Earth and Environmental Science **98** (2017) 012035 doi:10.1088/1755-1315/98/1/012035

Field observations included taking Parameter Samples (water and soil), Samples of parameters taken are soil and water physically and chemically. Chemically sample of water and soil parameters is done by laboratory test to know PH and salinity, then result of correlation test between index value of vegetation (reflectan) with value of parameter test result. From the tabulation data will be calculated correlation value.

2.2.6 Correlation Test

Correlation test is done on parameter sample and Spectral Ground. Correlation test is done by connecting the value of test result of parameter sample and Spectral Ground value with vegetation index value in the image so it can know the relation form. If the PH value is high, Salinity is low, with a high vegetation index value then it has a positive relationship and vice versa.

2.2.7 Analysis

At this stage we analysed the correlation value between vegetation index value with parameter sample test in the field. Furthermore, carried out the final stage of research, namely the preparation and writing of the report and its map information. Map obtained in this research is map of mangrove ecosystem scale 1: 5.000.

3. Results

3.1 Image Improvement by Image Fusion Data Method (Pansharpening) on Pleiades image

The incorporation of low resolution multispectral images and high resolution panchromatic images is of great importance for remote sensing and mapping applications. Usually the panchromatic image has a wide wavelength ranging from the visible spectrum and near infrared, whereas the multispectral image only includes a narrow spectrum. However, multispectral images have more than three spectral bands, while the panchromatic image has only one spectral band. So by combining the two images are obtained multispectral image that has a high spectral resolution and high spatial information as well. The image integration in this research is done by using Gram-Schmidt transformation method, where each image is multispectral and georefenced choreographic image, so firstly done the co-registration of the images. Figure 1. is a view of the merging of Multispectral and Panchromatic images of Pleiades 1B. Here is a view of the image of Satellite image of Pleiades 1B

Figure 1. (a) Multispectral Images of Pleiades 1B, (b) Panchromatic Image Peliades 1B, (c) Pleiades 1B Image Fusion Result

3.2 Determination of the Number and Distribution of Soil Control Points

The Soil Control Point (GCP) should be planned on a specific object, clearly visible in the image and easily recognizable in the field or object on the surface of the earth which changes relatively slowly /

permanently, for example: roads, street corners, areas of striking colors, buildings / monuments that are easily identifiable or recognizable.

Figure 2. Location Selection of GCP Placement in Building Corner

Figure 3. Location Selection at Ujung Jembatan

In the process of image rectification process, it is needed the right number of ground control points, so that the implementation of measurement in the field is not too long (Yudha, 2015). The number of ground control points is cultivated according to need, with considerations such as area size, mapping area relief condition, cost, and tools to be used for the measurement to be carried out efficiently.

The determination of the GCP point is also attempted to spread to the outermost position of the image to be performed koreksigeometrik. In this study, the number of GCP used is 8 points. Here is the GCP point spread:

Figure 4. Spread of GCP Point on Pleiades 1B Image

Based on Figure 4. Control Point Land / GCP in this study amounted to 8 GCP, and there are 13 baselines.

Table 2. Length between GCP

Baseline	**Length (km)**
GCP 1 - GCP 2	1,311
GCP 1 - GCP 3	1,916
GCP 1 - GCP 4	2,069
GCP 2 - GCP 3	1,705
GCP 4 - GCP 3	1,393
GCP 4 - GCP 5	1,753
GCP 4 - GCP 6	1,590
GCP 3 - GCP 5	1,581
GCP 6 – GCP 5	0,873
GCP 6 - GCP 7	1,825
GCP 6 - GCP 8	1,835
GCP 5 - GCP 7	1,797
GCP 8 - GCP 7	0,796

Based on Table 2. the distance between GCP is 0.873-2.069 km, can be seen if the points used are in accordance with the standard distance between points used by the BIG, where 3-4 km for a relatively flat area and 2-3 km for hilly areas, and study areas in the area of the village of Wonorejo, Surabaya, which includes a relatively flat area.

3.3 Calculation of Strength of the Net (Strength of Figure / SoF)

To determine the position of the ground control point (GCP) for the purpose of geometric correction required the planning and calculation of strength of the net (Strength of Figure / SoF). SoF (Strength of Figure) is a geometric power (form) of a triangular circuit that determines the spread of errors in network flattening. The geometric strength of a good triangular web is mirrored by the small price of the SoF and will ensure thoroughness of the whole jarring. The smaller the power factorof the net, the better the net configuration will be, and vice versa. Here is a net design and SoF calculation on Pleiades 1B image.

Figure 5. Net Design on Pleiades Image 1B

SoF calculation using parameter alignment method. Based on the design of nets in figure 5. and the value of SoF is 0.5938, it can be said if the calculation of the SoF meets the tolerance of ≤ 1. In this case, the strength factor of the net value of the smaller the better the network configuration and vice versa (Anjasmara, 2005). The matrix of the SoF calculation can be seen in Appendix 1.

3.4 Ground Control Point (GCP) Measurement Results

GCP was measured in the field using the Topcon Hyper Pro Geodetic GPS tool with a static method with 40 minutes of observation. Here are the coordinate results obtained from field measurements.

Table 3. Ground Control Point Data (GCP) Field Measurement Results

Point	***GROUND CONTROL POINT*(GCP)**	
	X (m)	**Y (m)**
GCP 1	697694.529	9191696.257
GCP 2	697740.773	9190389.81
GCP 3	699407.414	9190800.332
GCP 4	699721.094	9192151.699
GCP 5	701088.897	9190613.219
GCP 6	701281.548	9191748.465
GCP 7	702795.57	9190703.69
GCP 8	703107.998	9191437.327

The measurement data in Table 3. is the result of retrieving coordinate data which has been done post processing using Topcon Tools software v.7.5.1.

3.5 Independent Check Point (ICP) Measurement Results

The ICP point is used to test the accuracy of the geometric accuracy of the corrected image. The number of ICP points dimabil by 13 points, whose distribution is adjusted to the standard distribution of ICP point by BIG (Geospatial Information Agency) on Spatial Plan Validation module. Here is a picture of the sample point depth taken:

Figure 6. Distribution of Test Point Accuracy in Pleiades Image 1B Rectification Result

ICP was measured in field using Topcon Hiper Pro GPS tool with static rapid method with observation for 10-20 minutes and radial geometry. Here are the coordinate results obtained from field measurements:

Table 4. Independent Check Point (ICP) Results of Measurement Reports

Point	INDEPENDENT CHECK POINT (ICP)	
	X (m)	Y (m)
ICP 1	697,911,493	9,190,670,503
ICP 2	698,867,089	9,190,861,748
ICP 3	699,812,476	9,190,842,260
ICP 4	700,801,105	9,190,906,203
ICP 5	701,461,131	9,190,963,780
ICP 6	702,220,809	9,190,787,287
ICP 7	702,887,550	9,191,368,168
ICP 8	702,118,056	9,191,249,111
ICP 9	701,042,913	9,191,675,572
ICP 10	699,612,522	9,191,669,395
ICP 11	699,021,604	9,191,585,024
ICP 12	698,044,366	9,191,413,773
ICP 13	697,546,610	9,190,950,773

3.6 Coordinate Point Control on the Image

The control point coordinates (x, y) in the satellite imagery are used for the transformation process during geometric correction. Here are the control point coordinates (x, y) on satellite imagery:

Table 5. Image Coordinate Data of Pleiades 1B

Point	CONTROL POINT	
	X (Pixel)	**Y (Pixel)**
GCP 1	15133,5	32135,0
GCP 2	15237,0	34758,5
GCP 3	18554,5	33906,0
GCP 4	19168,0	31186,0
GCP 5	21906,5	34254,0
GCP 6	22280,0	31970,0
GCP 7	25306,0	34042,5
GCP 8	25922,5	32563,5

3.7 Results of Image Rectification

To find out how big the value of GCP error, it must be done image rectification process. Things to consider when performing the image rectification process is at the time of determining the GCP point of the image, try the dots to be determined on the image in accordance with the points measured in the field so that will get a minimum error value. The rectification process uses order 1 and 2nd order polynomials. This is applied equally to both imagery, so that the comparison can be known. At least 1st order polynomial required 3 GCP and for polynomial 2nd order requires 6 GCP minimum, while for 3rd order polynomial required minimum 10 GCP. Therefore, because the number of GCP used in this study is 8 GCP, so the most appropriate is the order 1 and 2nd order polynomial methods. In addition to the number of control points available, there are also other factors that influence the selection of order, such as the topographic state of the region as well as errors or distortions on the image to be rectified (Yudha, 2015). To know the accuracy of the image rectification, it can be seen from RMSE (Root Mean Square Error) value per pixel unit in image [24]. RMSE shows the degree of error by comparing GCP coordinates of transformation with actual coordinates in this case ie the coordinates of GPS measurement results. The following is the result of the Pleiades 1B image rectification process using the 1st order polynomial method and the 2nd order:

Table 6. RMSE Value of Geometric Correction Result of Satellite Images of Pleiades 1B

Point	RMSE (Pixel)	
	Polinomial Orde 1	**Polinomial Orde 2**
GCP 1	0,328	0,231
GCP 2	0,309	0,136
GCP 3	0,293	0,173
GCP 4	0,215	0,143
GCP 5	0,524	0,218
GCP 6	0,205	0,151
GCP 7	0,344	0,215
GCP 8	0,356	0,242
Total	2,575	1,508
Mean of RMSE (Pixel)	0,322	0,188

In Table 6. The average RMSE value for Pleiades 1B with 8 GCP images is 0.322 pixels for 1st order polynomial method and 0.188 pixel for 2nd order polynomial method. Thus, the Pleiades 1B image rectification process is acceptable because it meets the given tolerance of ≤ 1 as suggested.

3.8 Geometric Accuracy Test

The geometric accuracy test is obtained by finding the residual measurement data in the field which is the coordinate point of the Geodetic GPS measurement and the coordinate point of the rectified satellite image. The geometric accuracy test is performed on Pleiades 1B satellite images rectified in each method, ie 1st order and 1st order polynomial methods. Here is a list of ICP coordinates obtained from the image interpretation:

Table 7. Coordinate Data of ICP (Interpretation) on Satellite Images of Pleiades 1B

Point	ICP COORDINATIC POINT (INTERPRETATION)			
	Image of Polynomial Recapitulation Result of Order 1 Image		Image of Result of Polynomial Recondition of Order 2	
	X (m)	**Y (m)**	**X (m)**	**Y (m)**
ICP 1	697911,8	9190669,9	697911,9	9190670,0
ICP 2	698867,4	9190862,0	698867,4	9190862,0
ICP 3	699812,7	9190842,4	699812,8	9190842,0
ICP 4	700801,7	9190907,1	700801,4	9190905,4
ICP 5	701460,5	9190964,2	701461,3	9190963,9
ICP 6	702219,3	9190788,0	702220,2	9190787,0
ICP 7	702886,5	9191368,5	702886,5	9191368,4
ICP 8	702118,1	9191249,9	702118,2	9191249,5
ICP 9	701042,8	9191675,5	701043,3	9191675,6
ICP 10	699612,3	9191669,5	699612,8	9191669,5
ICP 11	698043,9	9191413,9	698043,9	9191413,9
ICP 12	697545,9	9190950,5	697546,0	9190949,9
ICP 13	697911,8	9190669,9	697911,9	9190670,0

After obtained image image rectification image, then next is done RMSE calculation, to know how big shift of coordinate of point (residue) in that image. In RMSE calculations for geometric precision tests, 12 points are used because ICP 11 points can not be used because the results do not meet the tolerance. At the point of ICP 11 there is an error in the measurement, where there is no epoch with receiver 1, so the measurement of ICP 11 is absolute, which according to [1] absolute method is not in high accuracy (precision position up to several meters), while required for accuracy testing This geometric is less than 0.5 meters accurate, since the spatial resolution of the Pleiades 1B satellite image is 0.5 meters. The following is the result of the processing of the geometric accuracy test of Pleiades 1B satellite images.

Table 8. Geometric Accuracy Test Results Satellite Image Pleiades 1B Rectification Results

POINT	GEOMETRIC RESEARCH TEST POINT			
	Image of Polynomial Recapitulation Result of Order 1		Image of Result of Polynomial Recondition of Order 2	
	Residue X (m)	**Residue Y(m)**	**Residue X(m)**	**Residue Y(m)**
ICP 1	0,310	0,573	0,393	0,479
ICP 2	0,285	0,243	0,263	0,236
ICP 3	0,177	0,126	0,366	0,305
ICP 4	0,562	0,874	0,265	0,815
ICP 5	0,650	0,447	0,130	0,130
ICP 6	1,501	0,727	0,623	0,286
ICP 7	1,068	0,343	1,032	0,212
ICP 8	0,002	0,752	0,134	0,436
ICP 9	0,079	0,089	0,372	0,008
ICP 10	0,187	0,064	0,303	0,057
ICP 12	0,482	0,169	0,505	0,175
ICP 13	0,681	0,301	0,656	0,885
RMSE (m)	0,806		0,647	

Based on the calculation of RMSE geometric accuracy test of satellite image of Pleiades 1B result of rectification in Table 8. The value of RMSE 0,806 on the image of the 1st order polynomial rectification and on the image of the 2nd order polynomial rectification is 0,647 meter.

3.9 Image Feasibility Analysis

Based on the Technical Specification of 2014 Country Map Map by BIG, village maps can be made on a scale of 1: 2,500, 1: 5,000 and 1: 10,000. For the requirements of horizontal geometry accuracy that must be met in the process of making a village map that meets the standard accuracy of the map in accordance with Perka BIG No. 15 Year 2014.

Table 9. Horizontal Village Map
(Source: PerKa BIG No. 15 Year 2014)

No.	Scale	No. Scale (CE90 in m)		
		Class 1	**Class 2**	**Class 3**
1	1 : 10.000	2	3	4
2	1 : 5.000	1	1,5	2,5
3	1 : 2.500	0,5	0,75	1,25

Based on Table 9. The high resolution satellite imagery used for village map design is said to meet the standard accuracy of the village map if the horizontal accuracy is ≤ 5 meters (grade 3).

Table 10. Results Calculation of Horizontal Accuracy on Satellite Images of Pleiades 1B

Results Calculation of HORIZONTAL ACCURACY (m) (CE90 = 1,5175 x RMSE)		
	Polynomial Order 1	**Polynomial Order 2**
PLEIADES 1B	1,222	0,982

Therefore, based on the multiplication of RMSE value with the coefficient of accuracy (1,5175), the horizontal accuracy of the 1B poliomial image is 1,222 meters. The 2nd horizontal polynomial method is 0.982 meters. Based on Table 10. the image feasibility as the basis for making the village map, Pleiades 1B satellite image meets the requirements of making a 1: 2.500, 1: 5.000 and 1: 10.000 village map.

3.10 Correlation Test
After processing NDVI and soil and water parameters test, the correlation test is done.

Table 11. Soil Analysis Data

Point	**Coordinate**		**NDVI**	**N**	**P**	**K**	**pH**	**Salinity (ppt)**
	X	**Y**		**%N**	**%P**	**(ppm)**		
R1	683,759.63	9,204,052.30	0.7595	1.08	0.21	0.026	6.9	4.43
R2	683,772.81	9,204,058.97	0.7089	0.61	0.2	0.019	7.15	0.29
R3	683,787.79	9,204,064.44	0.7165	0.65	0.26	0.021	6.9	1.31

Table 12. Data Analysis Water Table

Point	**Coordinate**		**NDVI**	**pH**	**Salinity (ppt)**
	X	**Y**			
R1	683,759.63	9,204,052.30	0.7595	7.2	0.21
R2	683,772.81	9,204,058.97	0.7089	7.45	0.81
R3	683,787.79	9,204,064.44	0.7165	7.35	1.46

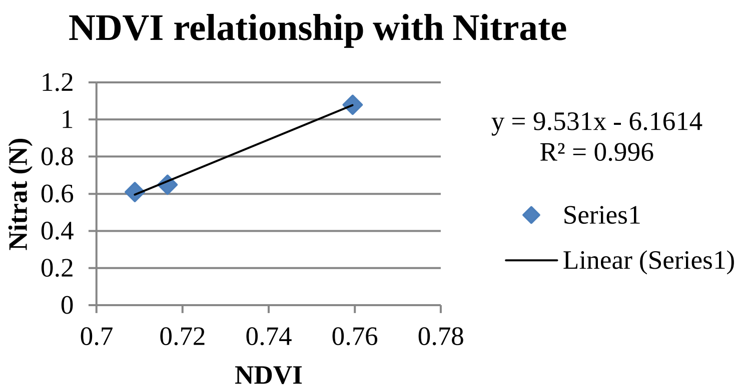

Figure 7. NDVI relationship with Nitrate

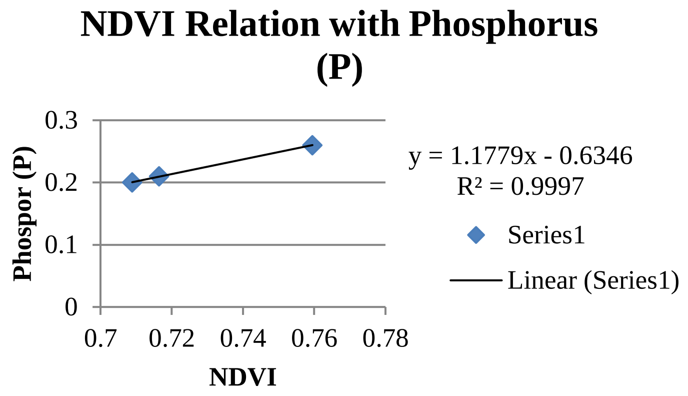

Figure 8. NDVI Relationship with Phosphor (P)

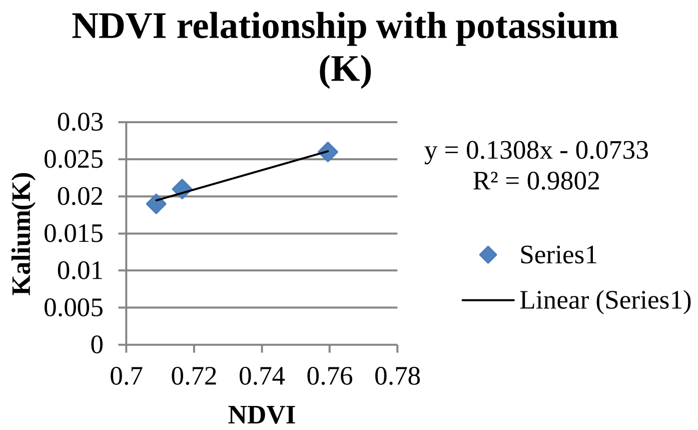

Figure 9. NDVI relationship with potassium

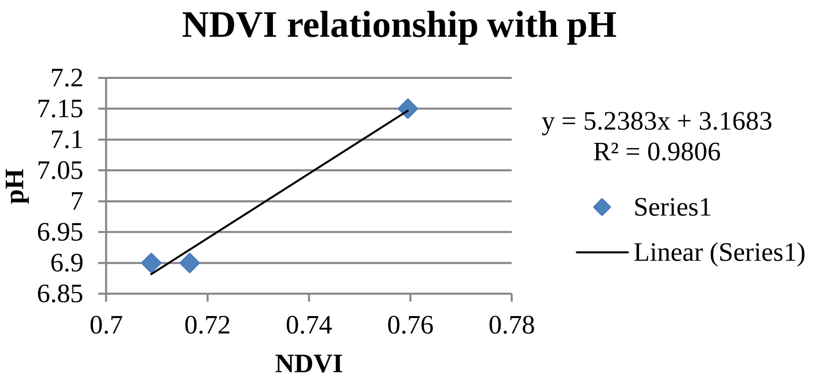

Figure 10. NDVI relationship with pH

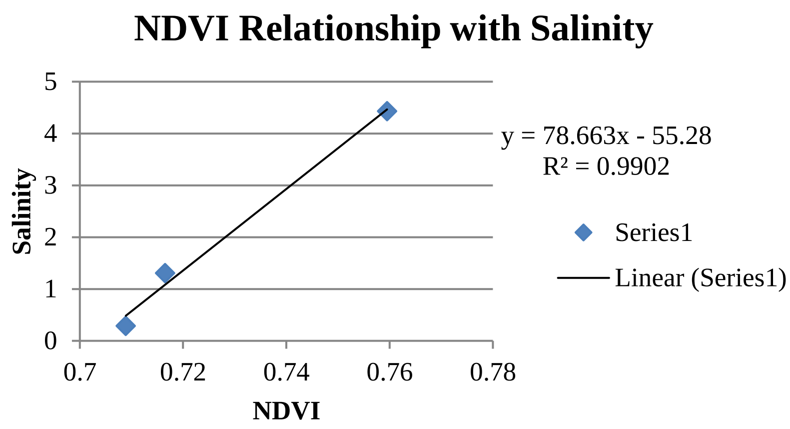

Figure 11. NDVI Relationship with Salinity

The results of the correlation test between NDVI with Nitrate, Phosphorus, Potassium, pH, High Salinity with value (R) of 0.99, 0.99, 0.99, 0.99.0.99 this shows that there is a strong relationship between NDVI value and NPK nutrient, pH , salinity. Correlation coefficient marked positive mean relation of NDVI value with one way nutrient parameter, if NDVI value is higher then NPK, pH, salinity is also higher because mangrove ecosystem requires NPK nutrient for photosynthesis process. Plants containing N, P, K, pH, enough salinity leaves will be greener. This greener leaf causes a higher reflectant value in the image.

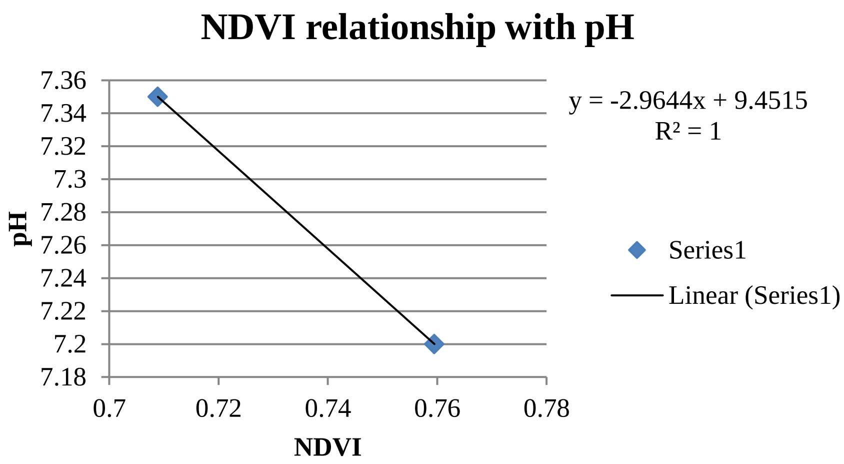

Figure 12. NDVI relationship with pH

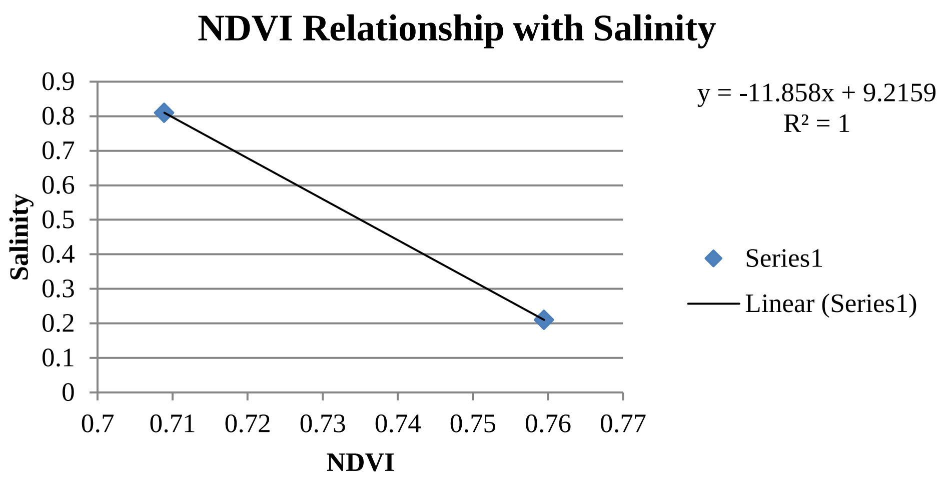

Figure 13. NDVI Relationship with Salinity

The NDVI correlations with water parameters include correlations with very strong relationships with a value (R) of 0.99, 0.99, respectively. The correlation coefficient of NDVI with pH parameter and positive salinity means the higher the NDVI value, the higher the pH value and the water salinity. So the parameters are closely related to the mangrove ecosystem is pH and Salinity.

4. Discussion

4.1 Result of Rectification

Based on result of rectification, in Pleiades 1B image with order 1 polynomial method got RMSE value 0,322 pixel and with method of polynomial of order 2 got value RMSE 0,188 pixel. whereas the RMSE value per largest point is 0.524 on Pleiades 1B. In the 2nd order polynomial method the RMSE value per the smallest point of 0.136 on the image leiades 1B. While the RMSE value per largest point of 0.242 on the image of Pleiades 1B. Based on the results of processing, the RMSE image of Pleiades 1B better methods used for geometric correction of images of Pleiades 1B are 2nd order polynomial methods.

4.2 RMSE based on The Geometrical Accuracy

Based on the geometric accuracy test using ICP points, the RMSE value in Pleiades 1B image is 0.806 meters on the rectification image of 1st order polynomial method. While the rectification image of the 2nd order polynomial method is obtained RMSE in Pleiades image 1B 0,647 meter.

4.3 Result of Rectification

For the feasibility of high-resolution imagery for making village maps, Pleiades 1B satellite images meet the requirements of making a village map with a scale of 1: 2.500, 1: 5.000 and 1: 10.000.

4.4 The Correlation Test

The results of the correlation test between NDVI with Nitrate, Phosphorus, Potassium, pH, High Salinity with value (R) of 0.99, 0.99, 0.99, 0.99.0.99 this indicates that there is a strong relationship between NDVI value and NPK , pH, salinity. Correlation coefficient marked positive mean relation of NDVI value with one way nutrient parameter, if NDVI value is higher than NPK, pH, salinity is also higher because mangrove ecosystem requires NPK nutrient for photosynthesis process. Plants containing N, P, K, pH, enough salinity leaves will be greener. This greener leaf causes a higher reflectance value in the image.

4.5 The NDVI Correlation with Parameters
The NDVI correlation with water parameters includes correlation with very strong relation with value (R) of 0.99, 0.99, respectively. The correlation coefficient of NDVI with pH parameter and positive salinity means the higher the NDVI value, the higher the pH value and the water salinity. So the parameters are closely related to the mangrove ecosystem is pH and Salinity.

5. Conclusion
Based on geometric (area) and radiometric (classification) image processing for Pleiades 1B image with scale 1: 5000 obtained mangrove species dominated by *Rhizophora sp.* With an area of 966,45 Ha. The value of economic potency of *Rhizopora sp* Rp. 773.160.000/year with assuming a 25-year cutting cycle.

References
[1] Abidin H Z 2002 *Survei dengan GPS* (Jakarta: Pradnya Paramita).
[2] Abrams Michael, S Hook and B Ramachandran 2002 *ASTER user Handbook Version 2* Jet Propulsion Laboratory 4800.
[3] Arifin 2003 *Hutan Mangrove Fungsi dan Manfaatnya* (Yogyakarta: Kanisius).
[4] Badan Informasi Geospasial 2014 *Peraturan Kepala Badan Informasi Geospasial Nomor 15 Tahun 2014 Tentang Pedoman Teknis Ketelitian Peta Dasar* Cibinong-Bogor.
[5] Badan Pusat Statistik 2015 *Kecamatan Bulak Dalam Angka 2014* (Surabaya: Badan Pusat Statistik).
[6] Badan Perencanaan dan Pembangunan Kota *Rencana Detail Tata Ruang (RDTR) Kota Surabaya 2010* Pemerintah Kota Surabaya Surabaya.
[7] Campbell J B and R H Wynne 2011 *Introduction to Remote Sensing (5th Ed.)* (New York The Guilford Press)
[8] Danoedoro Projo 1996 *Pengolahan Citra Digital Teori dan aplikasinya dalam bidang Penginderaan Jauh* (Yogyakarta: Fakultas Geografi UGM).
[9] Departemen Kehutanan 1999 *Undang – undang kehutanan Pasal 1 Ayat (1) Nomor 41*.
[10] Departemen Kehutanan 2003 *Buku Panduan Rehabilitasi Lahan dan Perhutanan Sosial* Penerbit Badan Penelitian dan Pengembangan Kehutanan (Jakarta: Departemen Kehutanan)
[11] Ecoton 1998 *Panduan Pengenalan Ekosistem Mangrove Pantai Timur Surabaya* (Surabaya: Ekoton).
[12] Fandeli C and Mukhlison 2000 *Pengusahaan Ekowisata* (Yogyakarta: UGM).
[13] FAO 2007 *The World's Mangroves 1980–2005* Forest Resources Assessment Working Paper No. 153 Food and Agriculture Organization of The United Nations, Rome.
[14] Hakim Luckhman 2004 *Dasar Dasar Ekowisata* (Malang: Bayumedia Publishing).
[15] Indica Mangifera 2010 *Perubahan Luasan Mangrove dengan Teknik Penginderaan Jauh di Taman Nasional Sembilang Kabupaten Banyuasin Propinsi Sumatera Selatan* (Palembang: Teknik Kelautan FMIPA Universitas Sriwijaya).
[16] Kusmana C 1995 Manajemen Hutan Mangrove di Indonesia *Prosiding Simposium Penerapan Ekolabel di Hutan Produksi Jakarta*, 10-12 Agustus 1995.
[17] Kovacs J M *et al* 2009 Evaluating The Condition of a Mangrove Forest of The Mexican Pacific Based on an Estimated Leaf Area Index mapping Approach *Environ Monit Assess* **157** pp 137-149.
[18] Kusumaningrum T E 2013 *Analisa Kesehatan Vegetasi Mangrove Berdasarkan Nilai Normalized Differencce Vegetation Index (NDVI) Menggunakan Citra Alos* (Surabaya: Teknik Geomatika FTSP-ITS).
[19] Landgrebe D 2003 *Signal Theory Methods In Multispectral Remote Sensing* (New Jersey: John Willey & Sons Inc).
[20] LAPAN 2015 *Spesifikasi Citra Satelit Pleiades* http://pusfatekgan.lapan.go.id/wp-content/uploads/2015/02/Informasi-Satelit-PL.pdf. (diakses November 09, 2016).
[21] Liang S 2004 *Quantitative Remote Sensing of LandSurface* (New Jersey: John Willey & Sons

Inc).
[22] Lillesand T M, Kiefer R W and Chipman J W 2004 *Remote Sensing and Image Interpretation* Fifth Edition (New York: John Wiley & Sons).
[23] Moko G I 2011 *Evaluasi Perubahan Tutupan Lahan Wilayah Perairan Pesisir Surabaya Timur Sidoarjo Dengan Menggunakan Citra Satelit Multitemporal* (Surabaya: Teknik Geomatika FTSP-ITS).
[24] Purwadhi S H 2001 *Interpretasi Citra Digital* (Jakarta: Grasindo).
[25] Sugiyono 2008 *Metode Penelitian Kunatitatif Kualitatif dan R&D (*Bandung: Alfabeta).
[26] Sumich J L 1992 *An Introduction to The Biology of Marine Life* Fifth Edition (New York: Wm. C. Brown Publishers).
[27] USGS 2015 <URL: http://Landsat.usgs.gov/band_designations_ Landsat_satellites.php>. Diakses tanggal 1 November 2016, jam 10.22.