Land use change after Tsunami, Cherng Talay Sub-district, Thalang, Phuket, Thailand

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Abstract

The aim of this study was to monitor land use and land cover changes before and after Tsunami disaster event in 2004, in Cherng Talay Sub-District, Thalang District, Phuket, using Landsat-7 ETM+ and THEOS image for years 2002 and 2011 respectively. Land use and land cover were classified into five categories, including forest area, urban area, agriculture area, water body, and other areas. The result shows that urban area and agricultural lands have been expanding rapidly during the 10-year period whereas forest conservation areas, water bodies, and other areas exhibited a decrease tendency. The policy-driven tourism development is a key factor regulating such changes. In this issue, policy makers and local authorities should pay more attention on impacts of urbanization on natural ecosystem. Those involve bringing this study to the consideration of land use decisions and the development of the urbanization coupled with land use sustainability.

Key words: Remote Sensing, Land use and land cover, Urbanization, Phuket, Tsunami

1. Introduction

After the Tsunami disaster event on 26 December 2004, the Thai government has encouraged and revived tourism industry in Phuket. Since then, tourism activities not only have renewed in the entertainment areas devastated during the Tsunami event but also have expanded to neighboring areas that are situated on the higher terrain. Rapid tourism growth can result in extensive urban expansion and accelerating economic development (Natthachai, 2006).

Expanding of real estate business on the highland and on the beaches has been increasing to serve a purpose of convenient and sea view accommodation. As a result, real estate's entrepreneur has attempted to find out foothill slope area and on the beaches for the construction of accommodation. This may create problems of the invasion foothill slope area, wildlife conservation areas and coastal plains for the expansion of the urban area and the hotel industry(Gerlach Jr, 2004; Chutipong, 2008). The region of Cherng Talay Sub-District, Thalang District, Phuket is facing such problem.

The objective of this study was to monitor land use and land cover changes before and after Tsunami (2002-2011) in Cherng Talay Sub-District, Thalang District, Phuket. Our results of the study would help to control forest encroachment, invade public land and apply for planning the land-use sustainable development in the future.

2 Methods

2.1 Study Area

Cherng Talay Sub-District is located in Thalang District in Phuket Thailand, between 7.99778º *N* and 98.29281º *E*. It covers an area of approximately 37.1 square kilometers or 23,187.5 acres.

Topography is the foothills, sea cliff, sea front area, and mountain's long ridges parallel to the coast. The climate is equatorial zone climate. Two seasons include rainy season and summer (Cherng Talay Sub-District Administrative Organization, 2012).

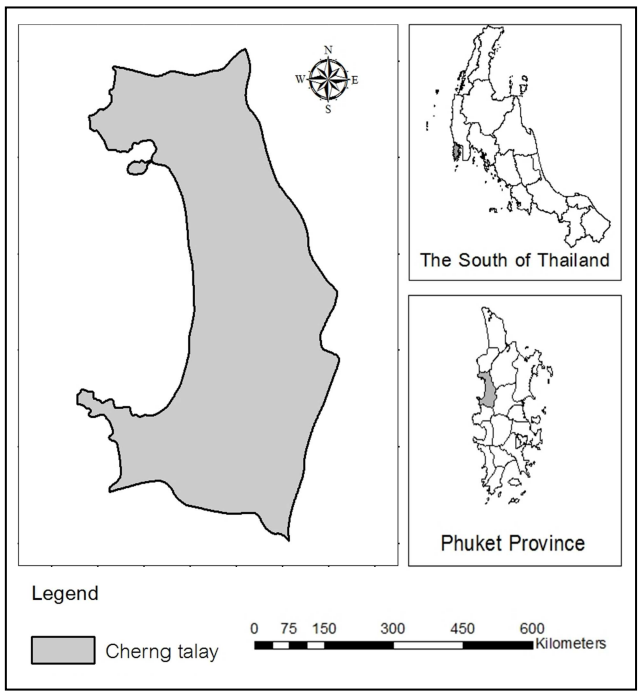

Figure 1: The study area of Cherng Talay Sub-District in Phuket province.

2.2 Data sets

The satellite images used in the study were the Landsat-7 ETM+ image in 2002 and the THEOS image in 2011, obtained from the USGS Earth Resoures Observation and Scicnce Center and GISTDA Thailand, respectively. The dataset with 30 m was acquired on 15 January 2002 and with 15 m resolution on 28 February 2011.

2.3 Data preprocessing, classification, and change detection

The resolution of THEOS image is 15 meter and the Landsat image is 30 meter. The

resolution of Landsat image has been adjusted into 15 meter by Pan sharpening method. The Landsat satellite image in 2002 was acquired at three different resolutions. The multispectral bands (bands 1-5, 7) are collected at 30 meters, the thermal band (band 6) is collected at 60 meters, and the panchromatic band (band 8) is collected at 15 meters. For the Pan sharpening we have applied the spatial information, the high-resolution grayscale band and color information in the multispectral bands to create a high-resolution color image and increase the resolution of the color information in the data set to match that of the panchromatic band (15 meters).

Satellite image data were geometrically corrected to remove spatial distortions by transforming all images into the same size and projection value, using the images to images method with the 2011 image as a base map.

Land use and land cover change classification; a 5-class classification system was designed with consideration of the land use properties of the study area as agricultural area, forest area, urban area, water body, and other areas. The supervised classification was adopted in this study using maximum likelihood method. Groups of contiguous pixels were selected as training samples and created two sets of ground truth samples for each image, one of which used as training data set; the other used as testing data set for accuracy assessment. For the two-year images, a number of sampling regions for each category were selected based on the visual interpretation of a false color composite along with available information from the Google Earth and Google map.

These datasets were then randomly divided for classifier training and accuracy assessment. Accuracy an assessment: in this process, overall accuracy and Kappa coefficient will be tested.

Change detection was then employed to detect the differences between each pair of LULC maps**.** Change detection was then employed to detect the differences between 2002 and 2011 LULC maps.

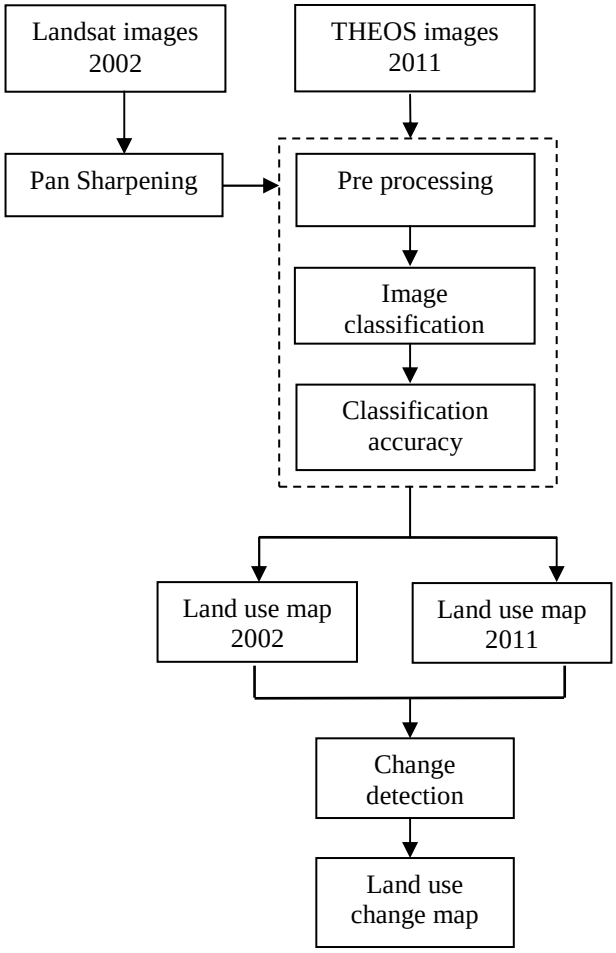

Figure 2: The study process.

4. Results

The results of classifying land use/land cover in Cherng Talay Sub-District, Thalang District in Phuket Thailand, are illustrated in Figure 3 and classification summary of land use changes is shown in Table 1. Land use change detections between two-year maps are shown in Tables 2. The accuracy and overall coefficient for classification products from THEOS and Landsat-7 ETM+ were 90.05% and 88.52%, respectively, with Kappa coefficient of 0.88 and 0.86 for years 2002 and 2011, respectively. During the 10-years period, the most changes were urban areas, accounting for 37.46% increasing. Agricultural lands also increased whereas a decline in other areas, water bodies, and forest conservation areas were pronounced.

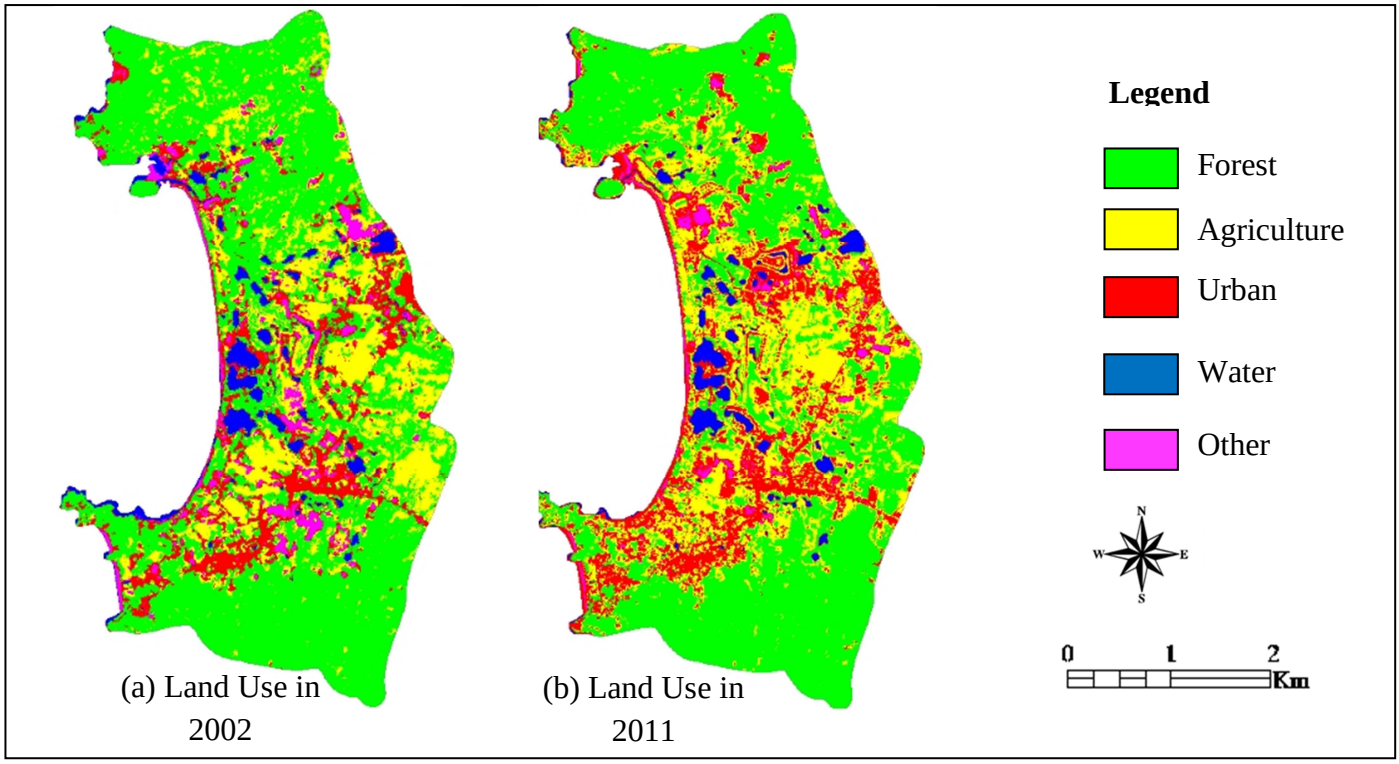

Figure 3: Maps of land use classifications of Cherng Talay Sub-District in Phuket province; (a) Land use 2002, (b) Land use 2011,

Table1: Land use classification in 2002 and 2011.

Land use type	Area (Square kilometers)			
	2002 (sq km.)	2011 (sq km.)	2002 (%)	2011 (%)
Forest	20.38	18.02	57.59	50.92
Water	1.46	1.12	4.11	3.17
Urban	4.75	6.53	13.42	18.45
Agricultural	7.20	9.02	20.35	25.50
Other	1.60	0.69	4.53	1.96
Total	35.39	35.38	100	100

Table 2: Detections of land use changes between 2002 and 2011, expressed as percentages.

2011	2002				
	Forest	Water	Urban	Agricultural	Other
Forest	69.36	10.46	14.72	38.19	15.44
Water	0.74	50.64	3.34	0.56	1.33
Urban	10.33	23.62	43.85	18.46	39.97
Agricultural	18.22	12.06	34.75	40.36	35.77
Other	1.13	2.02	3.23	2.24	7.28
Class Changes	30.63	49.35	56.14	59.63	92.71
Image Difference	-11.58	-22.91	37.46	25.29	-56.77

5. Discussion

The government and private business sectors have promoted tourism activities for tourist attraction, especially after the Tsunami disaster, subsequently land use and land cover in Cherng Talay region have changed considerably over time. Our finding of the policy regulating tourism development is similar to that occurs in other regions (Ozturk, 2010; Petrov 2009; Mbaiwa, 2011; Schubert, 2006).

However, the development will create both advantage and disadvantage that are unavoidable. By the advantage, it will be made available to local incomes. But in the same time it can be made the disadvantage such as a decrease in the amount of the forest area and water bodies, as also being addressed in the present study, in order to expand the urban and tourist accommodation. This may harm human due to flooding or crumble of soil in the future (Blancas et al., 2010; Zhao, et al., 2010; Xiang et al., 2006; Chen et al., 2006). Therefore, any development should be recognizing the advantage and disadvantage. So, if the development in the past had the advantage more than the disadvantage such development should be carried on with a concern about the sustainable development and natural protection and conservation.

Impacts of policy-driven tourism development on ecosystems have been published extensively (Zhong et al., 2011; Davenport, 2006). Similar directions should have been carried out in Cherng Talay region to protect environment in the future and this deserves a further study.

It should be noted that higher resolution satellite imagery would be helpful in identifying subclasses on land use and land cover, especially in urban areas.

6. Conclusions

The objective of this study was to monitor land use and land cover change before and after the Tsunami disaster in Choeng Talay Sub-District, using data from the Landsat satellite image (2002) and THEOS satellite image (2011). The urban areas and agricultural lands have expanded rapidly in the region.

These changes have been caused by tourism development. The developments have both positive and negative impacts depending on appropriate choices of land use. In this issue, policy-makers should pay more attention on impacts of development. Those involve bringing this study to the consideration of land use decisions and the development of the urbanization coupled with land use sustainability.

7. References

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