

Land use changes in the urban growth process after a tsunami using RS and GIS: A case of Banda Aceh, Indonesia

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(1) Purpose: The main purpose of this study is to examine the land use changes in the post-tsunami urban growth process of Banda Aceh, Indonesia.

(2) Data and methods: This study was conducted in the administrative area of the City of Banda Aceh, Aceh Province (Fig. 1; 5° 16' 15" N - 05° 36' 16" N and 95° 16' 15" E - 95° 22' 35" E). This city has an area of about 60 km² and its urban area is located at 0.8 m above sea level on average, with a population of 255,243 (2012). Because the city of Banda Aceh is close to a subduction zone, it is very vulnerable to earthquake and tsunami.

Land use changes were detected from a time series analysis of satellite images of 2005 and 2009. The satellite images were obtained from the Aceh Regional Planning and Development Board and the data of population were obtained from the Central Bureau of Statistics, Aceh Province. Geographic Information Systems (GIS) facilitated the analysis of urban growth process using available Quickbird satellite images.

The characteristics of the land are divided into urban built-up area (BU), vegetation (VA), grass/crop land (GL), and water body/wet land (WB). Built-up area is defined as the area where buildings and infrastructures are established. Vegetation is the land which is dominated by trees. Grass/crop land is the place where the vegetation is dominated by grass, while water body is defined as water areas such as rivers, sea, and wet land is a land area which is saturated by water, like fish pond that are within the administrative area of the city.

(3) Results and discussion: The land use statistics derived from the analysis are shown in Table 1:

Table 1: Land use changes based on class category

Classes	2005		2009	
	ha	%	ha	%
Built-up area (BU)	1,324.14	22.08	2,559.75	42.68
Vegetation (VA)	1,303.73	21.74	1,378.61	22.98
Grass land (GL)	1,915.66	31.94	1,218.45	20.31
Water body/wet land (WB)	1,454.36	24.25	841.08	14.02
Total	5,997.89	100.00	5,997.89	100.00

The growth of built-up area nearly doubled during the four years. But vegetation increased only by one percent. This suggests that the increase of built-up area has not been matched with the carrying capacity of the environment. In addition, population growth was very fast. In 2005, the population of the city was 177,881, whereas in 2009 it increased to 212,241 (approximately 19% within 4 years). The increase of built-up area was due to human needs, especially residential purposes.

(4) Conclusion: In the city area which was hit by the 2004 tsunami, the growth of built-up area was rapid, especially for the provision of housing and urban infrastructure. There is a need to balance the built-up area with the quality of environment, which plays an important role in a complex urban ecosystem, for aesthetic, recreational, and economic benefits.

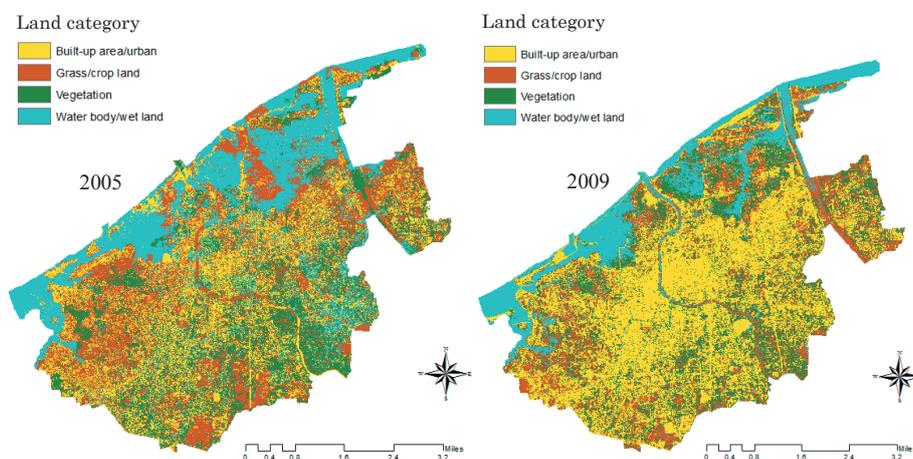


Fig. 1: Land use maps in Banda Aceh, Indonesia, for 2005 and 2009