Land Use/Cover Changes in Selected Regions in the World
Volume II

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III. Land Cover Change in Jabotabek Region

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1. Introduction

General land use and cover change in Indonesia has been predominated by two trends, namely deforestation and urbanization-suburbanization. Indonesia has more than 120 million ha of tropical forest, the second largest area after Brazil. Deforestation significantly causes loss of species diversity and ultimately leads to species extinction, and to disruption of the hydrological cycle. It also contributes significantly to global warming and greenhouse effect.

In contrast to urbanization in the West, urbanization of metropolitan regions in Southeast Asian countries is often characterized by uncontrolled urban expansion and chaotic land use (Yokohari et al., 2000). Agglomeration and growth of population in the center of the region often lead to expansion of urbanized areas beyond rural areas, which are dominated by agricultural activity. This expansion has resulted in land use conversion from agriculture to urban uses and the emergence of a new landscape in Asia characterized by a mix of agricultural and non-agricultural land uses (McGar, 1991; Sul and Zeng, 2001).

During the last 25 years, remotely sensed data have been used extensively to monitor environmental change, to map land cover, and to monitor urban expansion (Kawamura et al., 1998; Jim, 2000). This study presents the results of research project on LUCCE in the capital city of Indonesia, carried out at the Faculty of Agriculture, Bogor Agricultural University (IPB). The research is devoted to the mapping of land use/land cover of Jakarta Metropolitan Region (also known as Jabotabek) by using combination of remote sensing and in-field data of different spatial and temporal resolution.

Our main objective was to study temporal change and spatial distribution of land cover change within Jabotabek. We carried out the study in three stages by using GIS and remote sensing software packages. First, to analyze land cover change from remote sensing data. Second, to conduct spatial and temporal analysis of land cover change in the study area. Third, to discuss the driving forces of land cover change in the region.

Jabotabek is located in the northern part of Java island and comprises 7 administrative areas within 3 provinces (Figure 1 and 2). The first province is Jakarta (Daerah Khusus Ibukota). The second is West Java Province, consisting of the municipalities of Bogor and Bekasi, and the districts of Bogor and Bekasi. The third is Banten Province, which before 2001 used to be a region of West Java Province, and comprises the municipality of Tangerang and district of Tangerang. This metropolitan region, covering an area of about 6,752 km², is the largest urban agglomeration in Indonesia. The study area is situated along the northern coast and mountainous western part of Java. The altitude varies from 0 to 3,000 m. Three types of landform exist: the northern lowlands of the coastal plain along Jakarta Bay, the central plateau, and the southern uplands and mountainous areas.

We studied temporal change in land use within Jabotabek by using Landsat MSS and TM data. Several studies have shown the utility of such data in land use surveys (Batam & Yusof, 2001; Jl, 2001).

Landsat MSS image data for 1972 and 1983 and Landsat TM data for 1991 were sourced from the Tropical Rain Forest Information Center (Michigan, USA), a NASA’s Federation of Earth Science Information Partners (funded by Lab. of Landscape Ecology & Planning, The University of Tokyo). Landsat TM 2001 was sourced from Indonesian National Institute of Aeronautics and Space (LAPAN). Topographic maps for 1990 (scale 1:25,000), used for geometric correction of the images, and aerial photographs for 1993 (1:50,000) were obtained from the National Coordination Agency for Surveys and Mapping (Bakosurtanal), Jakarta, Indonesia. GIS data sets were sourced from National Land Bureau (BPN), Jakarta, Indonesia. We carried out this study in several stages by using GIS and remote sensing software packages (Arc-Info 7 and ERDAS 8.3). First, we geometrically corrected the images of 1972, 1983, 1991 and 2001 by using the Bakosurtanal topographical map and a GIS vector data set from National Land Bureau (BPN), Jakarta, Indonesia. The data were transformed to the Universal Mercator (UTM) coordinate system using the Clarke 1880 spheroid in conformity with the topographic map. The root-mean-square error tolerance was set at a maximum of 1 ft.

Second, we joined two overlapping Landsat scenes for each year of Jabotabek area to create a single image for each date by mosaic the individual images. For the Jabotabek region, GIS vector data was superimposed on Landsat raster data within the modeler process in ERDAS. The accuracy of geometric information in vector data and raster data of Landsat images is necessary for the successful superimposition of mosaic images of Jabotabek.

Third, we prepared maps on land cover through supervised classification of the images. Then, we make spatial distribution of land cover change since 1972 to 2001.
Figure 4. Comparison of Land Use Classes
The rapid population growth and economic development in these regions threatens national efforts to preserve prime rice-producing areas. We found that built-up areas were encroaching on agricultural land, especially in the fringes of Jakarta city and the two adjacent satellite cities, Tangerang and Bekasi (Figure 2). The decrease of agricultural land in Bekasi is around 31,616.85 ha, followed by Tangerang (31,103.32 ha) and Bogor (15,022.12 ha). According to Zain (2002) the ratio of built-up areas in the range 5-20 km increased from nearly 20% in 1972 to more than 80% in 2001. We found that housing developments dominated in these areas especially since the boom in property business in the beginning of the 1990s. The low prices and high access to the center of trade in these areas became the determining factors for conversion.

3. Jabotabek Region and Urbanization-suburbanization

Jabotabek Region is the largest urban concentration in Indonesia. The growth of the city has always been integrated with that of its surrounding areas (Botabek Region). Jabotabek's share of the national population is continuing to increase. In 1961, the population of Jabotabek Region was about 6.1% of the national population, but by 2000 it had reached more than 11% (Figure 7 and Table 2). Botabek Region has contributed significantly to this growth, especially since the 1990s.

Table 2. Share of Jakarta and Botabek Regions to National Population

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Jakarta City</td>
<td>Population</td>
<td>2,99</td>
<td>3,84</td>
<td>4,31</td>
<td>4,57</td>
<td>4,78</td>
</tr>
<tr>
<td>Bogor</td>
<td>Population</td>
<td>7,30</td>
<td>9,42</td>
<td>11,21</td>
<td>12,54</td>
<td>13,69</td>
</tr>
<tr>
<td>Tangerang</td>
<td>Population</td>
<td>7,99</td>
<td>10,12</td>
<td>12,54</td>
<td>13,69</td>
<td>14,73</td>
</tr>
<tr>
<td>Bekasi</td>
<td>Population</td>
<td>18,37</td>
<td>23,35</td>
<td>28,39</td>
<td>29,56</td>
<td>30,72</td>
</tr>
<tr>
<td>Total</td>
<td>Population</td>
<td>40,93</td>
<td>56,42</td>
<td>73,54</td>
<td>78,29</td>
<td>82,23</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Population</td>
<td>197,37</td>
<td>265,00</td>
<td>343,40</td>
<td>392,40</td>
<td>402,50</td>
</tr>
</tbody>
</table>

Figure 7. Population Growth of Jabotabek

Until the 1960s, Jakarta city was the main destination for national migration, and had the highest population growth rate in the country. During 1961-1971, the population of the city increased almost about 57%. In the1970s, the local government of Jakarta City declared the city as closed for any migrants, in attempts to control population growth. The policy has succeeded in stopping in-migration to the city. Immigrants to Jakarta were mainly lower class (in term of economic and education level) and young (Rustandi and Pasjui, 2000). Most of the migrants were motivated to move by economic reasons. About 71% of migrants are economically active and working (91.9%), but many studies showed a significant number of disguised unemployment. The informal services sector provides most of the employment.

Since the 1970s, the population growth rate of Jakarta has slowed down. Between 1971 and 1981, it grew 43.3%, between 1981 and 1991 at 33.2%, and between 1991 and 2000 it was only 11.3% (Table 3). However, these figures do not mean that growth rate of the urban population within the boundaries of Jakarta has slowed; a lot of the new growth is concentrated just outside the boundaries of the city. The development of Jakarta's suburbs is the result of the suburbanization process, especially through the expansion of new housing and industrial areas. This is because urban areas of the Botabek region are absorbing more than their share of the growth of the city (Jakarta City), especially due to the accelerated growth of Tangerang and Bekasi (east and west

Spatial analysis over the range 0 to 5 km from the city center by Zain (2002) showed an increase of built-up areas with time where ratio of the most developed areas showed a rapid increase from nearly 70% in 1972 to more than 90% in 1997. We identified that Jakarta is located in this range. Generally, the area of agriculture land use in our study area decreased from 1972 to 2001 (Table 1). We found that in the Jakarta area, land cover change from agriculture to urban areas reached the highest rate while the agriculture land convert to urban areas around 34,060 ha. Development of office buildings, commercial establishments, and services were dominant in this core as the center of economic growth in Indonesia.
Figure 5. Land Use Classes in 2001

Figure 6. Land Use Change: 1972 to 2001
Each of Jakarta's urban centers, from the core to the much smaller tertiary centers.

Since 1990, the population of Botabek passed out the population of Jakarta City (Figure 9). In spite of a relatively high population growth, the amount of out-migration outpaced the amount of in-migration. During period 1990-1995, the gap between out-migration and in-migration for Jakarta City widened. In the period, out-migration exceeded 823,045 (9.0% of Jakarta's population), while in-migration was 594,342 (6.5%). Despite steady overall growth in the population of Jakarta City, Central Jakarta District experienced negative growth of -1.4% in the period 1990 to 1990 and -3.0% in the period 1990 to 1995, while the population of Jakarta City's other districts continued to increase. The decrease in population in the center of Jakarta simply indicates a process of out-migration.

During the period 1975-1997, Jakarta City experienced rapid economic growth (9.0% per year in average). Since the 1980s, its suburban areas experienced more than 12% economic growth on average (1984-1997). In 1997, the country faced a monetary crisis which caused negative growth (-15% on average). The Jakarta Province region suffered more (-18%) than the country as a whole. Many scholars believed that there was a strong relationship between the crisis and the suburban property booming in 1997.

Table 3. Population, density and areas of Jabotabek region

<table>
<thead>
<tr>
<th>Year</th>
<th>Indicator</th>
<th>Area (km²)</th>
<th>Jakarta (km²)</th>
<th>Bogor (km²)</th>
<th>Tangerang (km²)</th>
<th>Bekasi (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>Population</td>
<td>2896123</td>
<td>1688448</td>
<td>907935</td>
<td>971817</td>
<td>364145</td>
</tr>
<tr>
<td></td>
<td>Density</td>
<td>1880</td>
<td>4604</td>
<td>2468</td>
<td>463</td>
<td>697</td>
</tr>
<tr>
<td></td>
<td>Rate</td>
<td>1.7%</td>
<td>1.9%</td>
<td>1.6%</td>
<td>1.7%</td>
<td>1.7%</td>
</tr>
<tr>
<td>1997</td>
<td>Population</td>
<td>2896123</td>
<td>1688448</td>
<td>907935</td>
<td>971817</td>
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<td>1.7%</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

There has been a process of systematic demolition of kampungs in Jakarta for many years, particularly in the central part of the city, forcing many of the former inhabitants to move to other areas. Most of the lower-classes have moved only short distances (intra-city migration), whereas the middle- and upper-classes have tended to escape from the kampung areas to more distant and less populated areas. Only the middle- and upper-classes can afford such a move, especially when it is to the suburbs (Somartri, 1995) and become commuters as a consequence. The poor are prevented from moving into the suburbs by the high cost of suburban housing. Costs are high because of legally required minimum standards for structure size, lot size and building methods (Stanback, 1991). Consequently, the outward migration of the middle- and upper-classes dominate the process of suburbanization in the Jakarta metropolitan area (Rustiadi et al., 1999).

![Figure 9. Population of Jakarta City and Botabek Region](image)

![Figure 10. Gross Domestic Product of Jakarta City and Botabek Region](image)

The conversion of rural land to urban use in the suburbs of Jakarta is mainly by land and building development in the private sector, and can be divided into formal and informal private development (Archer, 1994). Real-estate companies carry out most formal development. Informal private development of land, which is not held under a registered title, and is therefore outside the land use regulatory control system, takes place around existing kampung or urban settlements and along public roads. About 70% of the new construction in Jakarta's suburbs is developed informally by the owners themselves.

4. Concluding Remarks

Jakarta as capital city of Indonesia with rapid economic growth became a magnet and attractive area for Indonesian people. Growth of population and urbanization in Jakarta plays an important role on land cover change, not only in Jakarta itself, but also in Jabotabek Region as a whole. The agglomeration process and urban expansion of Jabotabek Region are not to continue for several years but have passed the fastest growing period. Land use conversion in the region, especially from this
country’s prime agricultural land to urban activities, will still continue. The and use conversion problem has been a concern of national planners but there is no significant action has been taken. Over-urbanization in Jakarta and its surrounding districts has been encouraged by a national urban-bias policy and by centralized development planning. In the Jabotabek region, this policy has impacted on several environmental and social problems such as frequent flooding, air and water pollution, congestion, urban sprawl, etc. Therefore, there is great need for decision-makers to understand the trend, magnitude, and characteristics of land use cover changes in the region in their attempt to cope with the problems. An accurate spatial description of land use-cover change described in this paper is hoped to contribute to such needs.

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