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Land use and land-cover changes of conservation area during transition to regional autonomy: Case study of Balairaja Wildlife Reserve in Riau Province, Indonesia

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ABSTRACT Land use and land-cover change is a prominent issue for tropical forest management in South East Asian countries. However, the issue has seldom been addressed in Indonesian forest management policies even after the collapse of Soeharto regime and the so-called regional autonomy or decentralization in 1999. Regional autonomy aimed to achieve better management of forest areas. Unfortunately, in the implementation of regional autonomy, forest area encroachments were increasing leading to deforestation. There are many explanations behind the situation related to social-economy and the internal factors of the management capacity. However, insufficient spatial time series data to support the analysis was rarely realized. The paper presents land use and land-cover changes based on spatial and time series data from 1985 to 2004 of Balairaja conservation area (Balairaja Wildlife Reserve in Riau Province). We analyzed the data regarding historical processes of encroachment into conservation area, coupled with time series Landsat imageries. From the findings of the study, we made some conclusions. First, the government neglected the existence of local communities when the conservation area was established and resulted in unresolved conflicts. Second, small farmers were increasingly interested in clearing the forests for perennial crops, due to high price of oil palm and rubber as well as high demand for logs: Third, insufficient management capacity of conservation area in terms of number of personnel and facilities.

INTRODUCTION

Political changes in Indonesia

Indonesia faced an economic crisis in 1997, which

resulted in social and political turmoil and eventually President Soeharto was replaced by President Habibie in 1998. In President Habibie's era, regional leaders claimed to share revenue between the central and regional governments. Those regional leaders explicitly stated their intention to secede from the Republic of Indonesia if their demands were not met. In such a situation, the MPR (*Majelis Perwakilan Rakyat*/People's Consultative Assembly) issued Decree of MPR No. 15 of 1998 on the fair management of regional autonomy, regulation, division, and use of national resources. The decree was a mandate for the government to implement regional autonomy, including management, division of authority and use of natural resources, which was previously centralized. Following the decree, in May 1999, Law (*Undang-undang*) No. 22 of 1999 on Regional Government and Law No. 25 of 1999 on Financial Balance between the Central and Regional Government were enacted.

Up to December 1999, the measure to create local autonomy did not reach a significant outcome. Regulations to strengthen the implementation of autonomy were incomplete, whereas demands came from the regions to implement the regional autonomy immediately. Under those conditions, the House of Representatives finally urged the central government to implement the law immediately and it has been realized since January 1, 2001. The central government needed two years for transition and to prepare the supporting regulations for the implementation of autonomy. Although the legal apparatus to support the implementation of decentralization were not yet been completed, the central government started to step into the implementation of Law No. 22 of 1999 and Law No. 25 of 1999 (later the Law No. 22 of 1999 was replaced by Law No. 32 of 2004 and Law No. 25 of 1999 was replaced by Law No. 33 of 2004). Implementation of the Law No. 32 of 2004 on regional governments led to the change of central, provincial,

and District (*kabupaten*)/City (*kota*) authorities. Central government is still in charge of some important issues such as the national security, international relations, justice, security, religion and monetary and fiscal policies. Provinces became autonomous regions having relatively minor roles. Provinces managed the coordination of the district and the cross-district policies. If necessary, provinces had the authority to manage issues which could not be handled by the districts and/cities.

Technical Implementation Unit (UPT) is the representative of the central government at the provincial level. Central government instruction (line of command) went just as far as the provincial level through the Minister of Internal Affairs and the relation of the province (governor) with the district/city was only coordinative in nature (line of coordination).

Changes in the authority on forest issues

The implementation of Law No. 22 and Law No. 25 of 1999 resulted in the situation that authority of departments in the central government is transferred to regional governments. The Forestry Regional Offices were eliminated from the provinces, but the Department of Forestry is still in charge in the regions through its technical implementation units, namely the Watershed Management Offices (*Balai Pengelolaan Daerah Aliran Sungai/BPDAS*), Forest Area Consolidation Offices (*Balai Pemantapan Kawasan Hutan/BPKH*), Natural Resources Conservation Offices (*Balai Konservasi Sumberdaya Alam/BKSDA*), National Park Offices (*Balai Taman Nasional/BTN*), Forest Products Management Monitoring Offices (*Balai Pemantauan Pengelolaan Hutan Produksi/BP2HP*), Watershed Management Technology Offices (*Balai Teknologi Pengelolaan Daerah Aliran Sungai/BTPDAS*), Research and Development of Forestry Plant Offices (*Balai Penelitian dan Pengembangan Tanaman Kehutanan/BPPTK*), Reforestation Technology Offices (*Balai Teknologi Reboisasi/BTR*), Research and Development of Forestry (*Balai Penelitian dan Pengembangan Kehutanan/Litbanghut*), Natural Silk Offices (*Balai Persuteraan Alam/BPA*), Seeds Technology Offices (*Balai Teknologi Perbenihan*), Forestry Training Offices (*Balai Latihan Kehutanan/Diklat Kehutanan*), and Seeds and Forest Plant Offices (*Balai Perbenihan dan Tanaman Hutan/BPTH*).

Implementation of Law No. 32 of 2004 is based on Government Regulation No. 38 of 2007 on Sharing of Governmental Roles between the Central Government, Provincial Government, and District/City Government

(replacement of Government Regulation No. 25 of 2000). Under this government regulation, responsibility of forest management is decentralized to the regional governments, especially the district level. Almost all the decisions related to exploitation in production forests (*hutan produksi*) and protection forests (*hutan lindung*) are under the authority of district governments, which are supported by guidance from the provincial governments. Meanwhile, the Governor's decision is required if coordination among the districts is needed, for example in the case of business permit acquisition on production forest where the areas are part of two or more districts. The central government is still holding the decision on national planning for forest areas, such as establishment of forest areas and changes in the status and functions of forest areas. In most cases, the central government only provides criteria and indicators for forest management to ensure its sustainability. According to this government regulation, the district becomes very dominant in forest management, primarily in the management of production and protection forests.

Regional autonomy was directed to achieve better management of forest areas. However, at the beginning of the implementation of regional autonomy, the numbers of forest conflicts were increasing. There were 43 cases before the promulgation of regional autonomy law (period 1997-1998) and then they increased to 205 cases of conflict during the transition period of decentralization (period 1999-2001). During the early stage of implementation (period 2002-2003) the number of conflicts decreased to 66 cases, in fact the figure was still higher than the period before the promulgation of regional autonomy law (Wulan et al. 2004). There were many explanations behind the conflicts, for example unresolved forest area border, financial crisis that led to poverty, law uncertainty during the transition period of regional decentralization, and limited capability of the forest area administration institution. However, insufficient spatial and time series data to support the analysis was rarely realized.

In this study, Balairaja was selected as a case study due to the availability of Landsat data time series and also socio-cultural as well as historical context. The objective of this study is to collect facts on the encroachment of conservation areas (wildlife reserve), during transition and implementation periods of regional government autonomy. We are convinced that utilizing time series of Landsat imagery, data, supported by the historical and statistical data, can improve our understanding of the problem of forest conversion, especially encroachment of

wildlife/nature reserve area.

METHODS

Location

The study was conducted in Balairaja Wildlife Reserve, Riau Province, covering an area of about 18,000 ha. The reserve is situated within the concession block of the Corporation of Pacific Caltex Indonesia (PT. CPI). The wildlife reserve was stipulated under the Minister of Forestry Decree No. 173 issued on June 6, 1986. It was designated for Elephant and Sumatra Tiger habitat conservation.

Analysis of land use and land-cover changes

Land use and land-cover data were obtained from interpretation of time series Landsat images, from 1985 to 2004 (Table 1). Interpretation of Landsat images were conducted by employing supervised classification with maximum likelihood method. Land use/land-cover change analysis was conducted by overlay analysis. Process of image interpretation and analysis were conducted by ERDAS Imagine software. Ground truth was conducted by employing Global Positioning System (GPS) to collect information of recent land use/land-cover. The information was used as guidance for image geo-correction and image interpretation.

Field observations

Field observations were conducted to collect information on social conditions of the site and management of the reserve. Related information was also collected and cross-checked from news papers, reports, focus group discussions and deep interviews with some key persons. Focus group discussions were conducted at 3 villages, namely Pinggir, Petani, and Pematang Pudu Village. Pinggir Village is the oldest settlement of Sakai tribe (Suparlan, 1995), Petani and Pematang Pudu Villages are the expansion of the Sakai tribe settlement. Deep interviews were conducted with key persons of each village.

RESULTS AND DISCUSSION

The dynamics of social conditions of the reserve and its surrounding areas

Factors that contribute to land-cover changes within the reserve area can be categorized into internal factors and external factors. Both factors contributed to forest area encroachment either directly or indirectly. Internal factors are availability of infrastructure, human resources, and budget for management of conservation area. On the other hand, external factors are demands of timber or palm oil, which ensure high market value. Changes of socio-political circumstances such as policy changes are also categorized as external factors. In the study area, both internal and external factors can be found.

Based on Suparlan (1995), since the Dutch colonial period, the study area and its surrounding areas have been inhabited by Sakai tribe. Their settlements usually developed near the coast or around the river. The settlement is now situated within the area of Balairaja is Pinggir Village. In 1924, Standard Oil Company of California (Socal) was given a concession in Riau and the study area, which is now a nature reserve of Balairaja, was situated within the concession. In 1936 the company became N.V. Nederlandsche Pacific Petroleum Maatschappij (NPPM) (a merger between Texas Oil Company (Texaco) and Socal). Five years later, the company drilled into the formation that would become the Duri Field (Chevron Texaco, 2005a). During the World War II in 1944, another oil well was drilled near Minas Village by Japanese troops and it was found that the well was the largest oil field ever discovered in Southeast Asia. In fact, it was interrupted by the war and Indonesia's subsequent struggle for independence. After independence, the mining concession was given back to the Caltex Pacific Company (CPC), a new name for NPPM, and production begun in 1952. In 1963 the name Caltex Pacific was replaced by Caltex Pacific Indonesia Company (PT. CPI) (Chevron Texaco, 2005b).

After the access to forest areas became possible through road development for oil exploration and

Table 1. Landsat data description.

Year	Types of satellite sensors	Acquisition Date
1985	Multi Spectral Scanner (MSS)	August 2, 1985
1989	Landsat TM (Geo Cover)	Composite images
1992	Landsat Thematic Mapper (TM) Path 127/Row 59	January 7, 1992
2000	Landsat Enhanced Thematic Mapper (ETM) Path 127/Row 59	April 26, 2000
2004	Landsat Enhanced Thematic Mapper (ETM) Path 127/Row 59	March 4, 2004

exploitation, Sakai tribe started to move their settlements near the road. They built new settlements, and left some villages with very few people. Some old villages of the Sakai tribe still existed, because of two reasons: their location was near the road and the villages still have important positions in their market system (Suparlan, 1995). Petani Village at Pinggir Sub-district (*Kecamatan*) was one of the new settlements built by the Sakai tribe. They practiced swidden cultivation, primarily for food crops and rubber as a cash crop. This forest was then claimed by Sakai tribe as their customary forest. Spreading rubber cultivation was supported by the Smallholder Rubber Provincial Office, which was established in 1958 and was changed into Smallholders Plantation Office in 1970. In the same year, the Social Department implemented a program called Isolated Tribe Resettlement (*Program Pemukiman Kembali Masyarakat Terasing/PKMT*) in Pematang Pudu Village at Mandau Sub-district. This program provided permanent houses for the Sakai communities, in order to settle their living. Table 2 shows the chronology of some important events related to land use change.

After the implementation of the investment policies in 1977, 1978, and 1980, the government issued forest concession rights to 3 concession companies, namely PT Rokan Timber, PT Mandau Abadi, and PT Chandra Dirgantara (Fig. 1). This effort had given access to the local people to enter the forests, resulting in significant growth of economic activities. As time passed, more people had access to the forest in the study area. A community leader said that Javanese and Bataks started to enter the Balairaja area in 1982. They started to practice permanent agriculture and grow rubber plants. Due to the success of this rubber gardening, the technique was then imitated by Sakai communities which had previously no knowledge of rubber gardening.

In 1986, after the concession ended, the area was designated as a wildlife reserve based on the Ministry of Forestry Decree No. 173/Kpts-II/1986. In this decree, part of Pematang Pudu Village and Pinggir Village became part of Balairaja Wildlife Reserve. Surrounding the reserve, are 3 concessions namely: PT Rokan Timber (since 1977), PT Rokan Permai Timber (since 1977), and PT Rimba Rokan Lestari. Even though the area was designated as part of wildlife reserve, in 1986 and 1989 the central government still issued permission to PT CD and PT DJL to operate oil palm plantations there. This triggered the return of Javanese people in 1990. Approximately 90 households of Javanese origin went into Petani Village of Mandau Sub-district, engaged in cutting

down the forest of Balairaja Wildlife Reserves, and grew oil palm in the area. The oil palm plantation areas became larger as time passed, because law enforcement was not working optimally. The peak of looting of Balairaja Wildlife Reserves areas was in 1997 when an economic crisis hit Indonesia.

Trend of land use changes (1985-2004)

Land use changes have taken place in Balairaja Wildlife Reserves from 1985 to 2004 (Fig. 2). From 1985 to 1992, the rate of deforestation was relatively moderate, but it increased from 1992 to 2000. On the other hand, rubber and oil palm plantation grew rapidly in the same period. This phenomenon was probably related to the multidimensional crisis that happened during economic crisis period in 1997 and 1998. At that time, local people were encroaching natural and planted forests in many parts of Indonesia. The spatial distribution of land use and land-cover changes in 1985, 1989, 1992, 2000 and 2004 are presented in Fig. 3, Fig. 4, Fig. 5, Fig. 6, and Fig. 7, respectively.

1985-1989 Period

In the period 1985-1989, land use and land-cover changes took place most likely to fulfill wood/logs needs. This can be seen from the size of land which was not taken care of in the form of bushes, weed, and open land compared to the size of land used as cultivation areas (Table 3). There was no regulation or government policy related to this phenomenon directly, instead there was a new settlement of Javanese and Batak established in 1982 at Pematang Pudu Village which was growing bigger.

1989-1992 Period

In the period 1989-1992, land use changes took place obviously for agricultural needs, which were indicated by the increasing areas of rubber and oil palm plantation and swidden cultivation areas that were originally forest, bushes, grasses, and bare land (Table 4). During this period the government allowed sand mining within the nature reserve area. Meanwhile, a lot of immigrants entered the reserve to cultivate rubber and oil palm (Table 2). We need to pay attention to conversion of forest into huge bare land. There are some explanations. First, bare land that was detected from satellite Landsat actually was cleared areas for plantation (rubber and oil palm). Second, it included bare land of sand mining area, and third it was burnt area of shifting cultivation.

Table 2. The important events and their implication to Balairaja Wildlife Reserves.

No	Year	Description
1.	1924	Oil Exploration in Sumatra by Standard Oil Company of California (Socal)
2.	1936	Socal merged with Texas Oil Company (Texaco) and Socal) to be N.V. Nederlandsche Pacific Petroleum Maatschappij (NPPM)
3.	1941	Oil Drilling in Duri by NPPM
4.	1944	Oil Field Drilling of Minas by Japanese troops
5.	1952	First Production of Caltex Pacific Company, a new name of NPPM
6.	1958	Establishment Smallholder rubber provincial office of Riau Province (Jawatan Karet Rakyat)
7.	1963	PT. Caltex Pacific Became PT. Caltex Pacific Indonesia
8.	1964	Sakai Tribe entered the area currently known as Petani Village, Pinggir Sub-district
9.	1970	As response of plantation development, Smallholder Rubber Provincial Office was changed into Smallholder Plantation Office of Riau Province.
10.	1970	Isolated Community Resettlement Program (PKMT) by Social Departement which provided houses for the Sakai Ethnic group in Pematang Pudu Village.
11.	1974	In Petani Village schools started with voluntary fee. This school was initiated by the village leaders
12.	1977/78	Forest Concession Right was granted to PT. Rokan Timber and Mandau Abadi
13.	1980	Agriculture Minister Decree No 228/Kpts/Um/4/1980 on Forest Concession Rights Operation of PT Chandra Dirgantara
14.	1982	Javanese and some Bataks and Sakais with totally 68 households (<i>kepala keluarga</i> /KK) started to go into Pematang Pudu village. Forests were dominant at the side of concrete road (Currently this location is under the Women Empowerment Program of Bengkalis district).
15.	1986	Balairaja was designated as wildlife reserve area based on Ministry of Forestry Decree 173/Kpts-II/ and part of Tengganau Village Mandau Sub-district situated within Balairaja resrve areas, on which 300 people live. The community has started grow oil palm at small scale, approximately one hectare per family
16.	1986	PT CD joined rubber and oil palm business, of which was part of the reserve.
17.	1989	PT DARMALI JAYA LESTARI (PT DJL) went into the areas and grew rubber on the land that they rented from the locals, which was part of it belongs to Balairaja wildlife reserves. When manager of PT DJL was substituted, gradually they changed the rubber plants to oil palm in Tengganau village
18.	1989	Joint Letter of Mining and Forestry Ministers No. 969. K/05/M. PE/1989 and No. 429/Kpts-II/1989 on the legalization of mining activities on conservation land, specifically Natural and Wildlife reserves
19.	1989	Joint Letter of Mining and Forestry Ministers No. 969. K/05/M. PE/1989 and No. 429/Kpts-II/1989 on legalization of mining activities on conservation land, specifically natural and wildlife reserves.
20.	1998	Letter of Director General of PHPA No. 547/DJ-VI/Binprog/1998: 10 oil fields of PT CPI were stated under the authority of Balairaja wildlife reserves & PT CPI got permission on the seismic activities and oil well in Balairaja wildlife reserves
21.	1990	About 90 households of Javanese group went into Petani Village, Mandau Sub-district and entered to Balairaja wildlife reserves by growing oil palm in the area.
22.	1993	In Tengganau village the Ministry of Agriculture provided a farmer group train for food crops
23.	1997	The peak of economical crisis, whereas people facing difficulties and uncertainty to earn money for their lives.
24.	2004	PERPPU No. 1 on mining within protection forest

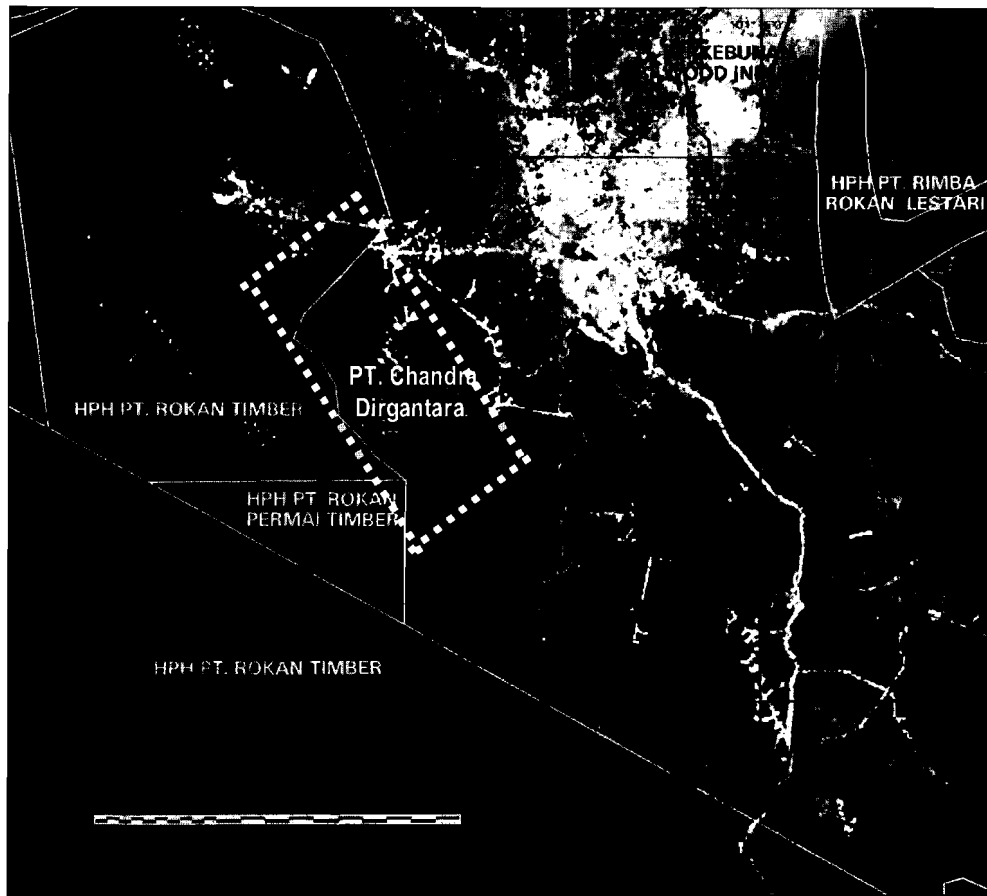


Fig. 1. Land use of Balairaja Wildlife Reserve and its surrounding areas. (yellow: border concession area, red line: plantation; blue line: forest plantation, light green: Balairaja Wildlife Reserve; dash yellow line: PT. Chandra Dirgantara)

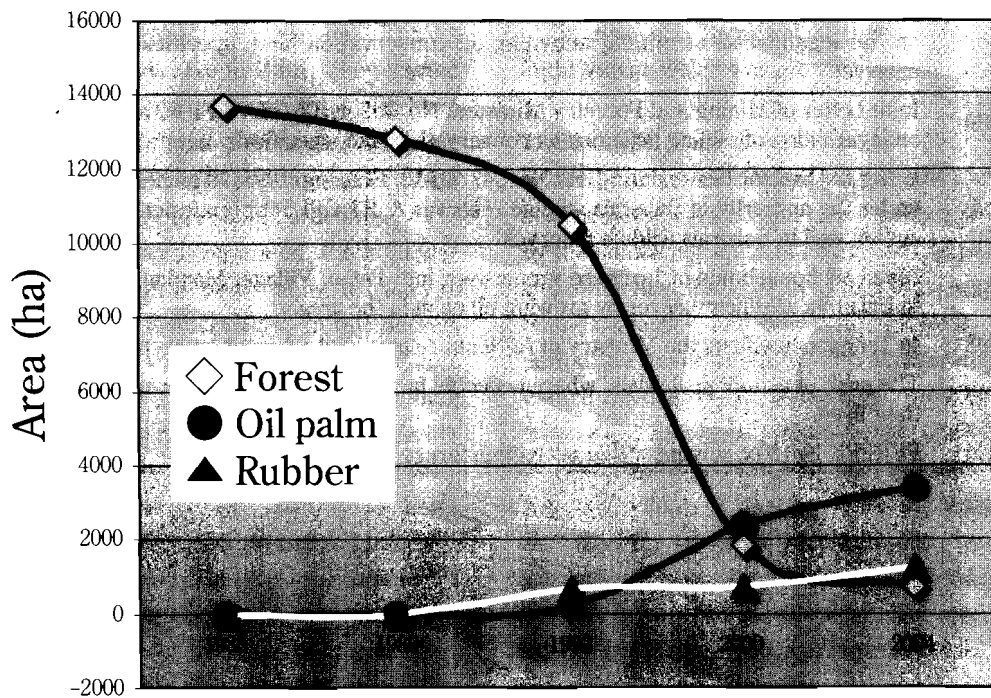


Fig. 2. Changes on forest, oil palm, and rubber plantation.

Table 3. Changes of land use for 1985–1989 (in ha).

		Land use 1985						
		Forest	Bushes	Grass	Built-up	Bare land	Swidden cultivation	Water
Land use 1989	Forest	12782.16	0.00	0.00	0.00	0.00	0.00	0.00
	Bushes	332.55	636.21	50.76	0.00	23.67	0.18	0.45
	Grass	436.59	425.52	665.19	0.00	81.36	4.23	0.63
	Built-up	0.09	1.17	4.32	50.85	1.08	0.09	0.00
	Bare land	108.63	23.40	52.56	0.00	933.21	5.85	2.16
	Swidden cultivation	3.42	1.53	4.14	0.00	8.01	42.75	0.00
	Water	13.59	0.36	0.45	0.00	1.44	0.00	8.10

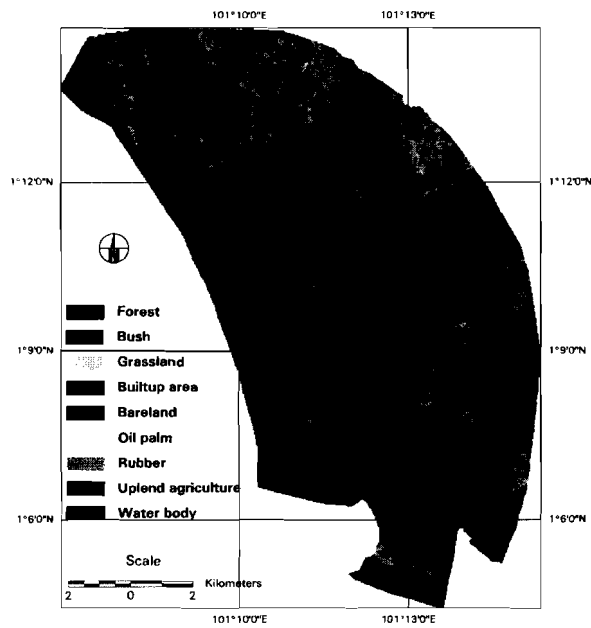


Fig. 3. Land use/land cover of Balairaja Wildlife Reserve in 1985.

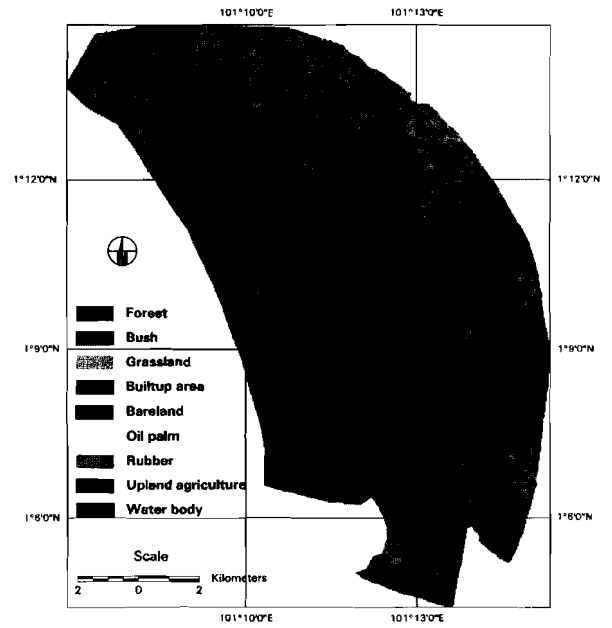


Fig. 4. Land use/land cover of Balairaja Wildlife Reserve in 1989.

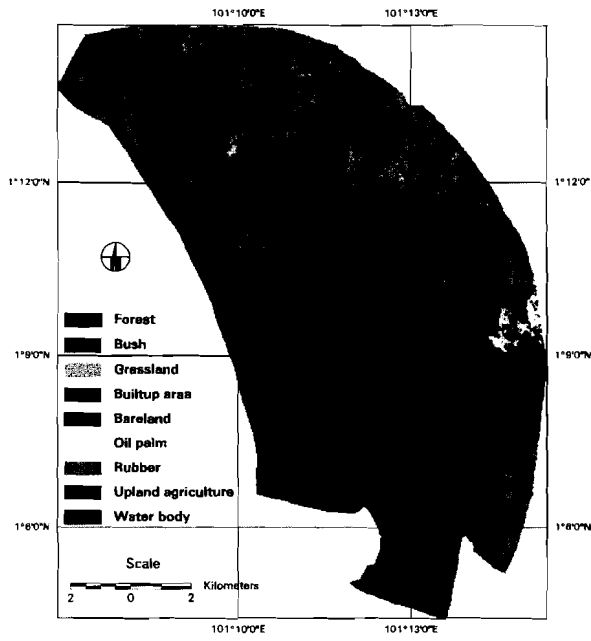


Fig. 5. Land use/land cover of Balairaja Wildlife Reserve in 1992.

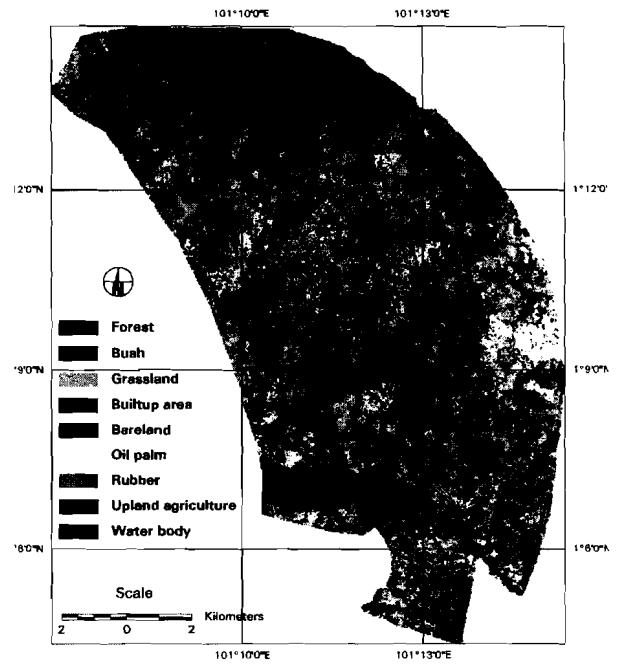


Fig. 6. Land use/land cover of Balairaja Wildlife Reserve in 2000.

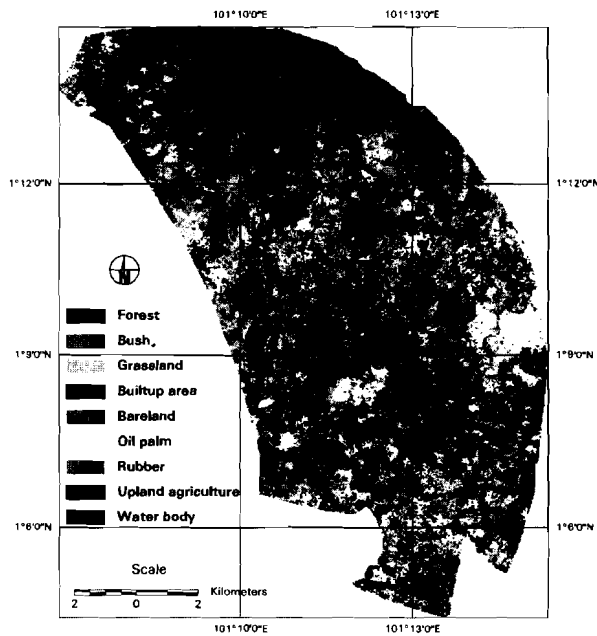


Fig. 7. Land use/land cover of Balairaja Wildlife Reserve in 2004.

Table 4. Changes of land use for 1989–1992 (in ha).

		Land use 1989						
		Forest	Bushes	Grass	Built-up	Bare land	Swidden cultivation	Water
Land use 1992	Forest	10529.01	0.00	0.00	0.00	0.00	0.00	0.00
	Bushes	418.68	361.17	351.45	0.00	241.83	6.30	5.13
	Grass	484.20	289.62	546.12	0.00	361.98	20.25	5.31
	Built-up	8.91	2.43	12.24	57.69	9.63	1.71	0.09
	Bare land	653.22	122.04	239.94	0.00	192.42	10.80	4.32
	Oil palm plantation	60.57	39.69	42.66	0.00	19.62	1.44	3.78
	Rubber plantation	255.33	127.26	177.21	0.00	115.56	4.50	3.06
	Swidden cultivation	264.06	92.52	229.50	0.00	173.43	14.67	1.98
	Water	97.38	11.70	19.17	0.00	13.95	0.36	0.90

2000–2004 Period

The period 2000–2004 was the end years of transition period and early implementation of decentralization. During this period, conversion of land for oil palm and rubber plantation was continued, but the pace became fairly slow and conversions of bush and grass into plantation were more significant than that of forest. This fact indicated that it has been difficult to continue further forest conversion because the existing forests have already become scarce (Table 5).

We need to notice from Table 5 that some parts of the oil palm plantation were changing into bush/grass again. There are two possible explanations. First, the converted land was not suitable to grow oil palm, so the cultivation failed and the land was left. Second, the plantations were damaged by wild animals or fires. The conversion of forest into oil palm has been occurring in many parts of Sumatra. Casson (1999) found that farmers

tended to plant cash crops of higher prices during the financial crisis, such as oil palm.

Management aspects of the reserve

The condition of the reserve had also depended on the aspects of management. There were four aspects, namely program, personnel, budget, and facilities. We did not find any written document on the program of the reserve. Only one person was in charge of controlling the reserve. Considering the extent and the accessibility of the area, the number of personnel was totally insufficient. Finances were also very limited, at only Rp. 626.65 per ha. Moreover, working facilities, such as field offices, were not available.

CONCLUSIONS

Encroachment into the reserve occurred more during

Table 5. Land use changes 2000–2004 (in ha).

		Land use 2000								
		Forest	Bushes	Grass	Built-up	Bare land	Oil palm plantation	Rubber plantation	Swidden cultivation	Water
Land use 2004	Forest	705.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Bushes	262.71	202.14	74.43	0.00	18.72	67.05	17.91	46.17	2.25
	Grass	179.19	368.64	613.62	0.00	95.94	228.69	53.55	169.83	1.53
	Built-up	98.91	117.00	218.25	273.60	165.87	69.30	18.54	135.18	4.77
	Bare land	249.03	304.83	699.66	0.00	2749.50	227.70	85.50	603.63	16.83
	Oil palm plantation	187.56	488.16	575.28	0.00	281.97	1240.65	201.24	403.56	2.97
	Rubber plantation	105.66	151.02	204.75	0.00	157.86	235.35	192.33	212.04	2.07
	Swidden cultivation	68.58	197.28	350.28	0.00	497.34	293.40	140.49	1274.22	4.32
	Water	7.92	1.44	0.81	0.00	19.35	1.53	0.45	3.24	15.03

the transition period to regional autonomy than in other periods. However, land-cover changes analysis showed that the encroachment had occurred since long before the transition period. The communities had already settled within the area before the designation of the reserve/conservation area. Such condition has created long term conflicts in the wildlife reserve management. This is inline with the claims by Yamauchi (2005). He found that conflicts are mainly caused by improper forest management, which sometimes neglects interests of local or traditional communities and have no recognition of the rights of the traditional community.

The financial crisis in 1997/1998 brought about more encroachment. Sunderlin (1999) found that economic condition of two-thirds of the people in forested areas has been worsened due to the crisis. Another finding that can be classified as an external factor is that small farmers were increasingly interested in clearing forests for perennial tree crops rather than raising food crops in shifting cultivation due to high price of oil palm and the high demand of logs. Casson (1999) also found similar results in the other areas.

Moreover, un-synchronized visions and management approaches on the government side were also observed as internal factors of land use changes. In Balairaja Wildlife Reserve area, the government has given the concessions to the companies, even though the area was situated within the reserve.

To conclude, we noticed some important points. First, encroachment in Balairaja Wildlife Reserve is the impact of unresolved conflicts since the reserve was established. Second, the changes of government policies could not control deforestation or encroachment of Balairaja Wildlife Reserve, due to the fact that there was weak management and capacity insufficiency of the reserve. Third, regulation approach/law enforcement was difficult to implement because the reserve can not be easily accessed by forest rangers, due to the limited number of personnel and facilities. This is related to the political economy that is not discussed in this paper.

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