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Deforestation of Gunung Sebatung protected forests using geographic information system in Kotabaru District, South Kalimantan Province, Indonesia

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Abstract

The protected forest of Gunung Sebatung is located on Laut Island, one of the small islands in the province of South Kalimantan. Surrounding protected forests there are 14 villages and Kotabaru district centers city centers in Kotabaru district. They carry out cultivation activities in the area claimed to be hereditary activities to meet daily needs, so that they cannot be stopped. The problem that has occurred to date is deforestation in the form of increasing land tenure and illegal logging, so that the function of forests as a buffer of life does not function optimally. The purpose of this study was to estimate the amount of deforestation in protected forests of Gunung Sebatung. The research method used is remote sensing of SPOT satellite in 2010 and 2018 and field survey using transect method. The results of this study indicate that the protected forests of Gunung Sebatung from an area of 7,561.95 ha, around 4,900.47 ha (of 64.8%) are still in the form of secondary natural forests whose species composition describes the characteristics of Kalimantan's tropical rainforest, and the remaining around 2,661.5 ha (of 35.2%) have changed their land cover for agricultural cultivation and mixed gardens. In 2010 the measured forest area was 5,759.46 ha and in 2018 measured 4,900.47 ha, resulting in deforestation covering 858.99 ha or 1.86% per year. The floristic composition found was from *Dipterocarpaceae* family, namely: *Shorea montigena*, *Shorea leprosula*, *Shorea multiflora*, *Dipterocarpus spp* and Non *Dipterocarpaceae* such as *Eusideroxylon zwageri*, *Vitex pubescens* and other natural species. There are still quite a lot of trees > 50 cm in diameter.

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Introduction

Forest is a land with a certain area which consists of various plants and animals forming an ecosystem and interdependence. Forests are defined as an alliance between woody plants or trees and animals in an association with their environment which is able to create a local climate in a complex energy cycle, so that it is ecologically different from conditions outside the forest.

Based on Law No. 41 of 1999 concerning Forestry article 1 states that protected forests are forest areas that have a primary function as protection of life support systems to regulate water management, prevent flooding, control erosion, prevent sea intrusion, and maintain soil fertility. Protected forests can be used for the use of the area, utilization of environmental services, and collection of non-timber forest products through the granting of business licenses. The current protected forests in 1997-2002 experienced a rate of deforestation caused by illegal logging and land conversion of 10% per year, while production forests were 5% per year (Badan Planology, 2002 in Ginoga *et al.*, 2005).

The protected forest area of Gunung Sebatung Kotabaru Regency is a protected forest located on Laut Island, one of the small islands in the Province of South Kalimantan. The role of the Kotabaru Regency government so far in the management of Gunung Sebatung Protected Forest is very large, especially in utilizing protected forest areas as providers of limited water and tourism resources. The presence of the community around protected forest areas is actually there to be a spirit to maintain the importance of the existence of forests as a buffer of life, but they also conduct mixed crop cultivation activities between forestry plants with plantation crops or agriculture which is now known as agroforestry (Lestari and Winarno, 2014). Agroforestry activities in the protected forest area of Gunung Sebatung are claimed as hereditary activities. Forest management in Kotabaru District at this time has been done well, although it has not achieved the

results as expected. The problems faced are always dynamic, as a result of rapid population growth in this area. Forest utilization activities by humans are the direct cause of deforestation (Nawir, *et al.*, 2008). The impacts arising from forest destruction are increasing levels of carbon emissions, loss of flora and fauna and global climate change. Loss of flora diversity due to forest destruction in turn results in the occurrence of genetic erosion, namely the reduction of endemic species which generally have a narrow geographic distribution (Whitmore, 1993). According to the Ministry of Forestry, tropical forests in Indonesia in the 2009-2011 period experienced deforestation rates of 0.4 million ha per year, while primary deforestation in the period 2000-2012 was 0.5 million ha per year (Margono, *et al.*, 2014). Tropical forests in Papua cover an area of 68.7 million ha, a deforestation rate of 1.39 million ha during 1985-1997 and 0.6 million ha during 2000-2005 (Departemen Kehutanan, 2007). Terrestrial inventory of deforestation requires a lot of money, energy, and time, so remote sensing technology is needed. The integration between remote sensing technology and geographic information system (GIS) is very useful in spatial analysis of the condition of the earth's surface (Danoedoro, 2012). In addition, remote sensing images describe objects, regions, and phenomena on the surface of a wide, and permanent region (Sutanto, 1986).

Materials and methods

Study Site

Geographically the protected forest of Sebatung covering an area of 7,561.95 ha lies in the coordinates of the Universal Traverse Mercator (UTM) zone 50S between 408,410 to 418,559 meters East and 9,623,610 - 9,641,811 meters North or geodetically between 03°14'25.2" - 3°24'17.8" South Latitude and 116°10'31.8" - 116°16'01.0" East Longitude. Administratively, the Gunung Sebatung protected forest is located in three sub-districts, namely sub-district of East Pulau Laut, North Pulau Laut and Central Pulau Laut, Kotabaru District, South Kalimantan Province.

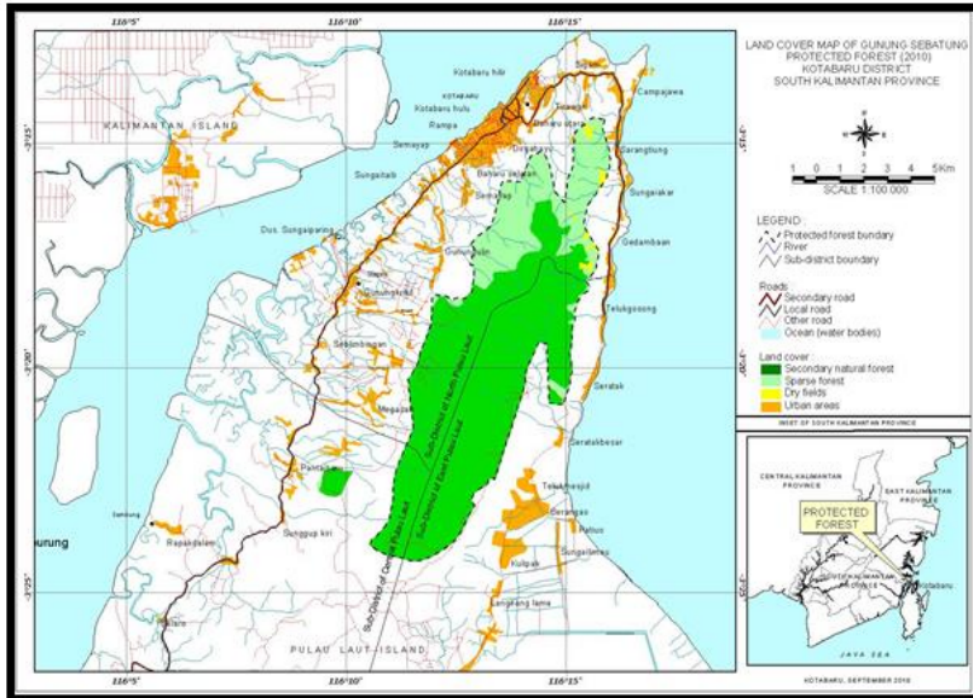


Fig. 2A. Spatial Distribution Map of Gunung Sebatung Protected Forest in 2010.

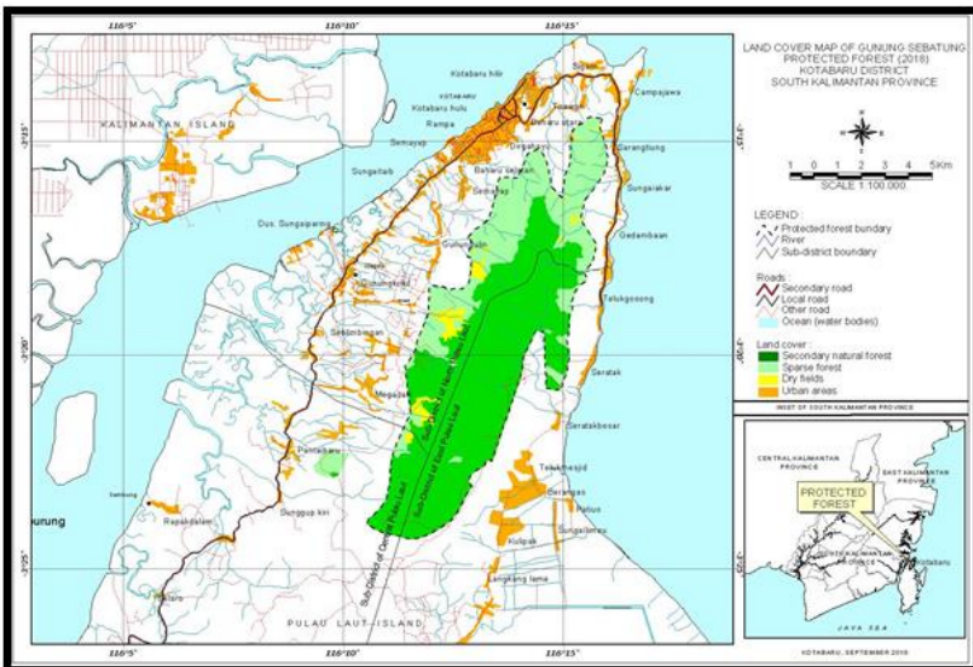


Fig. 2B. Spatial Distribution Map of Gunung Sebatung Protected Forest in 2018.

Materials

The materials needed include the digital topographic map scale 1: 50,000 as a base map. Imagery of SPOT 5 of 2010 and 2018 with a spatial resolution of 2.5 m, which is used by the Department of Forestry, South Kalimantan Province. We used computers for spatial analysis and digital mapping using Geographical Information System (GIS), Compass to determine the azimuth direction, Global Positioning System (GPS) for spatial position,

Data Collection and Analysis

The data required in the form of primary data by sampling method and secondary data by utilizing the spatial data from the institutions. Primary data is collected directly from the field by researcher, while secondary data is collected indirectly through another party; either individuals or institutions. Sampling was done by line observations followed by the mapping unit representation which consists of land cover from the images in 2010 and 2018. Potential observations were made on secondary natural forests. Transect made the cut contour of East-West direction in secondary natural forests. The lines are made to represent the condition of ecological site on the lower land to the upper land. Correction of land cover in the field is directly carried out on a map to improve the delineation of land cover.

Observation of the floristic composition of Gunung Sebatung protected forest was carried out using a lined path method as an example placed in 3 locations. The locations in question are 5 sample plots in the Gunung Ulin village area, 20 sample plots in the Sebelatihan village and 10 sample plots in Teluk Gosong village, then the data obtained are analyzed descriptively using tabulations.

Results and discussion

SPOT-5 satellite image interpretation results with 2.5 meter spatial resolution in Kotabaru Regency (2018) and observations in the field, there are 4 types of land cover that can be identified, namely: secondary natural forest, sparse forest, Dry fields and urban

areas. Previously, satellite imagery in 2010 only showed 3 types of closures, at that time there was no urban areas in protected forests.

The pattern of the distribution of secondary natural forests between 2010 and 2018 is almost the same, namely the distribution of secondary natural forests is found in the southern protected forest area. Deforestation occurs from the north and west, where there are many access roads into protected forest areas and from this direction close to the distribution of village locations. This is consistent with the opinion of Nawir *et al.*, (2008) that humans are the direct cause of deforestation.

Local peoples utilize protected forest areas for Dry fields, which is spread in the northern part of protected forests precisely in sub-district of North Pulau Laut. According to Lestari and Winarno (2014) that the general presence of people in forest areas is to conduct mixed crop cultivation activities, namely between forestry crops and plantation crops or agriculture, which is now known as agroforestry.

Deforestation occurs a lot in sub-district of North Pulau Laut, because this sub-district is the capital city of Kotabaru district, the center of economic activities, education and government center, so that practically this sub-district according to BPS-Statistics of Kotabaru Regency (2018) is the most numerous and most densely populated.

In 2010 the area of secondary natural forest was still quite extensive, covering an area of 5,759.5 ha and in 2018 it was reduced to 4,900.5 ha. Over a period of 8 years the area of forest has been deforested by 859 ha or the magnitude of the deforestation rate of Gunung Sebatung protected forest is 1.86% per year. When compared with the rate of deforestation in Papua of 0.17% per year (Ministry of Forestry, 2007), deforestation in the protected forests of Gunung Sebatung is relatively high. This is suspected because in addition to natural factors in Papua which are quite difficult, also because the population density is still

low. Compare this with the national level of deforestation of protected forests in the 1997-2002 period caused by illegal logging and land conversion by 10% per year (Badan Planologi, 2002 in Ginoga *et al.*, 2005). Graphically the land cover in the Gunung Sebatung protected forest in 2010 and 2018 is as shown in Fig. 1, while the spatial distribution is as shown in Fig. 2.

Based on satellite imagery 2018, currently forests in the protected forest area of Gunung Sebatung cover an area of 7,561.95 ha, around 4,900.5 ha (64.8%) are still in the form of secondary natural forests whose species composition describes the characteristics of tropical rain forest structures, around 2382.1 ha (31.5%) has been amended its use for Dry fields. Even in a protected forest around 2.5 ha (0.03%) has turned into a urban areas, known as the Gunung Sesapit settlement.

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Access to the Gunung Sesapit settlement is a 2.5 meter wide cemented footpath made by community members. These settlements are included in the Tirawan village sub-district of North Pulau Laut with a total of 15 family heads and inhabited since 2002.

This place became a Habib recitation place held every Friday night and Sunday night. According to public information that before this settlement existed, this place was *Imperata cylindrica* grassland which often burned, after they settled here the species of *imperata cylindrica* grassland was gradually converted into rubber plants / fruit gardens and fields.

Cultivating activities for residents around the protected forest of Gunung Sebatung are the main activities to fulfill their daily needs, besides farming and vegetables planting. The availability of flat land in this area is very limited spread along the coastline around Laut island, a possible alternative is to utilize protected forest land for agricultural activities, even though they realize their actions are not justified.

According to the provisions of settlements in protected forest areas are actually not allowed, because the existence of settlements can reduce the role of protected functions which should be maintained as a buffer of life in the subordinate area. It is hoped that the settlement on Gunung Sesapit will not grow and expand even further, in this case the role of extension from the Forestry instution to be further improved. With a land slope of > 25% it is actually very dangerous and not feasible for residential locations.

The type of forest ecosystem in the Gunung Sebatung Protected Forest area is a type of lowland tropical rain forest ecosystem, because the elevation is <500 m above sea level, which occupies most (77%) protected forest areas, while a small portion (23%) is a type of upperland tropical rain forest ecosystem.

The floristic composition of natural forest compilers in upperland protected forest areas because their presence is not accessible to the survey team, is only relying on information from the community. According to them the floristic composition between natural forests in protected areas of lowlands and upperlands is no different. This can be explained other than because the height is not too far apart, namely the highest elevation is only 710 meters above sea level, also because physical factors have almost the same effect in this protected forest area, both in terms of climate, soil and geology.

The floristic composition of Gunung Sebatung protected forest compilers obtained from field observations and information from local communities

found 52 species of flora consisting of 24 families. When detailed from 52 types of flora there are 49 species of species that compose secondary natural forests, while 3 types are sparse forest. Of a total of 24 families can be divided into 9 types of *Dipterocarpaceae* family, 6 types of famil *Moraceae*, 4 types of family *Euphorbiaceae*, 3 types of family *Lauraceae*, 2 types of families *Verbenaceae*, and 1 type of family *Verbenaceae*, *Anacardiaceae*, *Bombaceae*, *Sterculiaceae*, *Dellianiaceae*, *Mimosaceae*, *Myrtaceae*, *Ebenaceae*, *Guttiferae*, *Rutaceae*, *Rosaceae*, *Burseraceae*, *Vitaceae*, *Myristicaceae*, *Fagaceae*, *Pandanaceae*, *Anacardiaceae*, *Piperaceae*, and *Palmae* and there are 7 types of unknown relatives.

The types that are known based on information from the local community at the top of Gunung Sebatung are *Shorea laevifolia*, *Shorea quiso*, *Shorea multiflora*, and Ironwood trees with a large size and there are also regeneration with relatively good conditions, while the types of vegetation other than this type and ironwood regeneration based on observations made in the sample path.

Of the 52 types of vegetation found, there are types of ironwood and types of *Shorea sp* which are native types of natural forests valuable or valuable, both in terms of economic value and historical value. Today its presence in South Kalimantan is rare to find, so it needs special attention to be preserved and developed in this location. Ironwood and other types of *Shorea sp* producing resin have been used by the local community to sell when there is a demand for resin, although this does not mean that other natural species are ignored.

The existence of other native species must be preserved so that the typical species that exist in the forests of Gunung Sebatung are maintained or not changed too much, so that the floristic conditions of sebatung protected forests can become a miniature condition of tropical rain forests in South Kalimantan.

The secondary natural forest ecosystem in Gunung Sebatung protected forest is in relatively good condition. This is indicated by the findings of several types of understorey, relatively large forest regeneration and the presence of large trees with diameters ranging from 50 cm to 95 cm, including red *Shorea sp* and *Shorea montigena* trees. small species are not found at the tree level but are found at the level of seedlings and saplings. This type of ironwood for tree level according to residents is still relatively large at the top of Gunung Sebatung. Around the waterfall Seratak is still found Ironwood, *Shorea spp* and *Dipterocarpus spp* which are > 1 meter in diameter and are maintained by local residents.

Viewed from the aspect of structure, at the time of observation there are types that are only found at one level, two or three levels of growth, but none are found at all levels of growth, namely seedling, sapling, poles, and trees.

Conclusion

Gunung Sebatung protected forest has 4 types of land cover that can be identified, namely: secondary natural forest, sparse forest, Dry fields and urban areas. Previously, satellite imagery in 2010 only showed 3 types of land cover, and there was no settlement in protected forests. Deforestation occurs from the north and west, where there are many access roads into protected forest areas and from this direction close to the distribution of village locations. Local residents utilize protected forest areas for Dry fields. Deforestation occurs mostly in sub-district of North Pulau Laut, because it is the capital city of Kotabaru district, the center of economic activity, education and government center. In 2010 the area of secondary natural forest was still quite extensive, covering an area of 5,759.5 ha and in 2018 it was reduced to 4,900.5 ha. Over a period of 8 years the area of forest had been deforested by 859 ha, so the rate of deforestation of the protected forest of Gunung Sebatung was 1.86% per year. The deforestation rate is relatively large because the role of protected forests is the only source of clean water for residents of towns

and villages around protected forests that must be conserved.

The type of forest ecosystem in the Gunung Sebatung Protected Forest area is a type of lowland tropical rain forest ecosystem.

The floristic composition of the Gunung Sebatung protected forest compiler was found as many as 52 types of flora consisting of 24 families. When detailed from 52 types of flora there are 49 species of species that compose secondary natural forests, while 3 types are types of Sparse forest communities. From a total of 24 families can be divided into 9 types of the *Dipterocarpaceae* family, 6 types from the family Moraceae, 4 types of the family *Euphorbiaceae*, 3 types of the family Lauraceae, 2 types from the family Verbenaceae, and 1 type from other families and there are 7 types of unknown his family. Of the 52 types of forest vegetation found, there are species of *Eusideroxylon zwageri* and types of *Shorea sp* which are native species of natural forest valuable or valuable, both in terms of economic value and historical value.

The recommendations that can be given are that there must be government efforts to reduce and even stop the deforestation rate of protected forests sebatung, because in addition to being a source of clean water, also as a miniature of the remaining tropical tropical rainforests for natural laboratories for research, education and ecotourism.

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