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Analysis of Land Cover Change and Projection of Settlement Land in Sepaku District, Indonesia

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Abstract

The relocation of the capital city of Indonesia to Sepaku District, North Penajam Paser Regency, East Kalimantan will have an impact on all existing aspects. Land cover in Sepaku District has decreased from year to year. The area of vegetated land cover in Sepaku District is assumed to be decreasing due to the relocation of the New Capital City (NCC) to the area, which will have a negative impact on the environment. Therefore, this study aims to determine the level of land cover change in Sepaku District and discuss how the condition of land cover in Sepaku District after the construction of the New Capital City (NCC). The method in this study uses GIS (Geographical Information System) analysis and descriptive analysis. The data used are land cover data from 2009 to 2019 to find out changes in land cover and population data from BPS to project the population. Based on the results of the analysis of land cover data from 2009 to 2019 there was a change from scrubland to industrial forest plantations of around 26000 ha. In addition, there was no significant change in the area of built-up land. However, the results of population projections show that Sepaku Sub-district will experience a significant increase in built-up land cover after the construction of the New Capital City (NCC).

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INTRODUCTION

Kalimantan Island was designated as the New National Capital area after the state of the nation address delivered by President Joko Widodo on August 16, 2019. East Kalimantan became a province of the New State Capital City due to the region's low level of disaster risk (Setyawan, 2019). The Governor of East Kalimantan, Isran Noor, confirmed that the New National Capital will be located in Sepaku District and Samboja District. Sepaku District is a strategic area because it is bordered by West Kutai Regency in the West and Paser Regency in the South. In addition, Sepaku District is directly adjacent to Balikpapan City in the east and is not far from Samarinda City in the north. The land area to be used for the construction of the National Capital City is 256,180.87 ha. Of this area, as much as 56,180.87 ha will be used to build the New National Capital core area, and 5,644 ha will become the central government area (Slamet, 2019).

The move of the capital is assumed to have an impact on reducing the vegetation land cover in Sepaku District and even the surrounding areas. That is considering that some countries that have moved the capital have experienced massive built-up land growth, such as Nigeria and Myanmar (Enoguanbhor et al., 2019 & Oo et al., 2019). Changes in vegetation land cover into massive built-up land will cause changes in hydrological properties such as hydrographic characteristics, discharge, and coefficients of a stream (Latuamury et al., 2012). That will increase the potential for disasters such as floods. In addition, changes in vegetation land cover into massive built-up land can also cause the Urban Heat Island phenomenon because the increase in temperature in plains with built-up land cover in the form of settlements will reflect heat in higher amounts than the vegetated land cover (Nadira et al., 2019).

Sepaku Subdistrict, located on the island of Kalimantan, is one part of the world's lungs. The island of Kalimantan is allocated at least 45% of its land to be used as forest, which is the world's lungs (Lestari, 2012). In addition to being used as the world's lungs, the land is intended to preserve endemic or non-endemic biodiversity found on the island of Kalimantan. In addition, there are many types of land cover in the form of plantation forests in Sepaku District, which private companies and local communities own. According to Jalil (2022), local communities in the Sepaku sub-district have an average of two hectares of land in the form of plantation forests. The increasing number of plantation forest ownership by local communities from time to time can indirectly hinder the development of NNC in the Sepaku District, which is the center of NNC. That makes it necessary to conduct a study to determine changes in land cover and potential changes in vegetation land based on the needs of settlements. Therefore, this study aims to analyze land cover changes in Sepaku District as the New National Capital City (NCC) and analyze the potential for increasing the area of settlements based on minimum settlement needs.

METHOD

The study location in this study is Sepaku District. Sepaku is one of the sub-districts in Penajam Paser Utara Regency, East Kalimantan Province, which is located between 116º48'–55º09' E and 0º54' N –44º76' S. Sepaku Subdistrict has a total land and sea area of 1,172.36 km^2 with an area height of more than 500 meters above sea level. Sepaku District is directly adjacent to Loa Kulu District (Kutai Kartanegara Regency) to the North, Samboja District (Kutai Kartanegara Regency) to the East, West Balikpapan District (Balikpapan City) to the South, and Kali Panjang District (Paser Regency) to the West (BPS, 2021).

This research method uses quantitative research. Quantitative research is a method to answer research problems related to data in the form of numbers. Based on the research objectives of data analysis and collection techniques, the research method is divided into two parts, namely:

Land Cover Change Analysis

The data used in the analysis of land cover change is the land cover data of Sepaku District in 2009 as secondary data published by the Ministry of Environment and Forestry of The Republic of Indonesia (KLHK). Land cover data for 2019 was obtained from the visual interpretation of Landsat-8 satellite imagery. The mapping process is carried out by updating the 2009 land cover map based on the appearance of satellite imagery in 2019 (Fariz et al, 2020).

The data will be analyzed by the overlay method. The overlay method is the ability to place graphics on one map above another, which is an essential procedure in geographic information system (GIS) analysis. This method is used to obtain information on the comparison of land cover in Sepaku District in 2009 with 2019.

Figure 1. Research Location

Settlement Needs Analysis

In 2009 – 2010 it experienced an average population growth of 10.58 percent. Maridan Village dominates the population distribution in Sepaku District, which Telemow Village and Tengin Baru Village follow. If we look at the population density by area in the village in Sepaku District, Maridan Village has a denser population. According to the Population Office of East Kalimantan Province, the total population in Sepaku District in 2009, 2019, and 2020 was 27,910 people, 35. 592 inhabitants, and 37,171 inhabitants.

Geometric methods obtain population projections by 2030. It is assumed that the geometry method uses the basis of compound interest calculations (Adioetomo et al., 2010). This geometry method is based on the ratio of population growth to the annual average. Here is the formula for the geometry method:

$$P_t = P_0 (1+r)^t$$

Description :

P_t = number of inhabitants in the year
P_0 = number of inhabitants in the base year
r = population growth rate
t = time period between the base year and year t (in years)

After obtaining population projection data, the next step is to calculating the needs of settlements. The number of settlement needs can be sought with the results of population projections plus the number of ASNs (State Civil Apparatus) who moved from DKI Jakarta and then multiplied by 36.2914 m2. The number of ASNs moving from DKI Jakarta is targeted at 2350 people (Hamdani, 2021; Sembiring, 2021), while the figure of 36.2914 m^2 is the need for space land stipulated in SNI 03-1733-2004 concerning Urban Environmental Planning (BSN, 2004).

RESULT AND DISCUSSION

Land Cover Change in Sepaku District

Land cover in Sepaku District in 2009 was dominated by shrubs, plantations, and transmigration land with successive areas of 54506 ha, 26535 ha, and 13340 ha. However, the area of thickets and plantations in Sepaku District was reduced by a significant amount in 2019. That is due to the growing area of plantation forest and secondary dryland forest. Plantation forest land and secondary dryland forests in 2019 have an area of 28453 ha and 14644 ha. Based on this data, the area of thickets of land that has changed planting forests is around 26000 ha. The growing number of plantation forests indicates that the land in Sepaku District is suitable for planting plants as a primary material in industrial activities. Plantation forests have the benefit of being able to produce large amounts of wood and being able to reduce pressure arising from the reduction of natural forests. However, plantation forests can cause losses if the plant planting is only one species on the land of former natural forests with a large number of species. Plantation forests that continue to grow in the area are based on several reasons, including the views of pulp and wood producers regarding natural forests that cannot be used as raw materials in the production process and the interest of the Indonesian Government in encouraging the economic sector through plantation forests (Pirard et al., 2016).

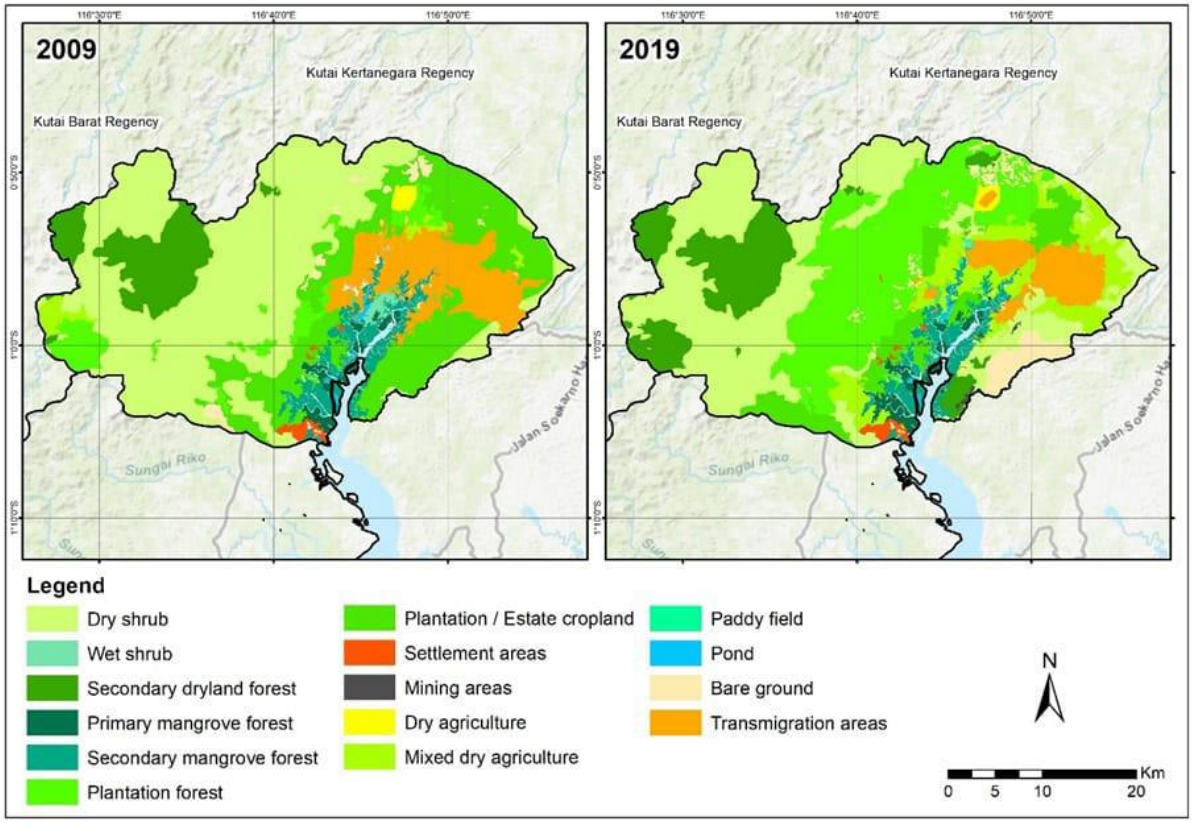

Figure 2. Land Cover of Sepaku District in 2009 and 2019

Table 1. Land Cover of Sepaku District

Land Cover	2009		2019	
	Area (ha)	%	Area (ha)	%
Shrub	54506,49	44,37	38269,89	30,65
Plantation / Estate cropland	26535,17	21,60	9294,30	7,44
Transmigration	13340,19	10,86	7445,29	5,96
Secondary dryland forest	10456,25	8,51	14644,26	11,73
Secondary mangrove forest	5526,59	4,49	6004,88	4,80
Plantation forest	5398,86	4,39	28453,86	22,79
Mixed dry agriculture	1719,19	1,39	11341,09	9,08
Primary mangrove forest	1499,53	1,22	3002,54	2,40
Bare ground	1471,42	1,19	4378,92	3,50
Settlement	732,96	0,59	808,59	0,64
Wet shrubSwamp scrub	648,02	0,52	267,55	0,21
Dryland farming	617,37	0,50	435,95	0,34
Pond	282,77	0,23	254,11	0,20
Paddy Field	96,93	0,07	242,29	0,19

In addition to plantation forests, secondary dryland forests in 2019 experienced a significant amount of land expansion compared to 2009. Secondary dryland forests are forests that grew as a result of succession over previous forest destruction. According to the East Kalimantan RAD in 2018, secondary dryland forests can produce carbon reserves of 101.63 tons/ha. Although primary and secondary mangrove forests can produce more significant carbon reserves than secondary dryland forests (162 tons/ha and 116 tons/ha), the land area of secondary and primary mangrove forests was only 52.856% and 14.340% of secondary dryland forests in 2009. The percentage of land area from secondary and primary mangroves to secondary dryland forests in 2019 was 41% and 20,503%, respectively. Changes in land cover in Sepaku Subdistrict in 2009 and 2019 are described in Table 1.

If we look at the land cover of Sepaku District between 2009 and 2019, there was no significant expansion of built-up land cover, only an increase of around 75.63 ha. However, the move of Indonesia's national capital from DKI Jakarta to East Kalimantan Province, Penajam Paser Utara Regency, Sepaku District will impact the area of built-up land cover. Of the 256180.87 ha of land used to construct the New National Capital City, one of the lands used to construct IKN is plantation forests (Fajar, 2019). Vegetation land cover converted into the built-up land cover will cause changes in hydrological properties, increase the potential for natural disasters, and give rise to the Urban Heat Island phenomenon.

The capital's relocation is expected to directly impact the Bukit Soeharto National Park, which is about 20 km from Sepaku District. Besides, there are indirect impacts such as on mangrove and peat ecosystems. Deforestation emissions from these direct and indirect impacts are around 50 MtCO2e and 2,326 MtCO2e, equivalent to 2.7–126% of greenhouse gas emissions in Indonesia from 2014 (Teo et al., 2020). Therefore, IKN should be designed while maintaining forest ecosystems. This concept is called Forest City, which is principled in conserving natural resources and animal habitats, connected to nature, low-carbon development, adequate water resources, controlled development (Anti-Sprawl Development), and community involvement in realizing Forest City (Mutaqin et al., 2021). This forest city is a concept that will be integrated into the IKN master plan; the Smart City concept will also be integrated (PPID KLHK, 2019).

The Interests of Settlements In The District of Sepaku

Sepaku Subdistrict, as an area of the New National Capital of Indonesia, requires built-up land in the form of a relatively large settlement. That is based on the population in Sepaku District, which increased significantly after being announced as an area of the New National Capital. That way, the number of settlements in the Sepaku District must be directly proportional to the number of residents. Projection of settlements needs to be done because the construction of settlements requires land that will be converted to function. After the results of the projected needs of settlements are found, the government can find ways to develop settlements without opening vegetation land as a source of land for settlements to be built. Population projections need to be carried out to determine the needs of settlements in the Sepaku District. Population projection is carried out by estimating population data and composition in the future. Population projections are obtained based on fundamental calculations of the components of the population growth rate, such as deaths, births, and migration. The three components can be determined by the age structure of the population and the number of inhabitants in the future. Data sources to determine the need for population projections were obtained from the Population Service, PP, and PA Prov. East Kalimantan and The Ministry of Home Affairs' Clean Consolidated Data (CCD). Population growth was obtained using population data in 2010 and population data in 2020. The results of the population growth of the Sepaku District from 2010-2020 can be seen in Table 2.

Table 2. Comparison of The Population of Sepaku District in 2010 and 2020

Population in 2010 (inhibitant)	Population in 2020 (inhibitant)	Accretions (%)
30863	37171	0,02

After obtaining population growth data, calculate the projection of the number of residents in Sepaku District in 2030 and add to the number of ASN targets transferred from DKI Jakarta. This calculation found that the total population of Sepaku District in 2030 is around 47119 people (Table 3).

The increase in population in Sepaku District will later impact the need for possible land increases. The need for residential land in Sepaku District in 2030 can be known in value by multiplying the number of residents by 36.3. The value of 36.3 was obtained from SNI 03-1733-2004, which stipulated that the minimum land for settlements was 36.2914 m^2. The calculation results show that by 2030 around 171.04 ha of land will be needed for settlements. That shows that by 2030 it is assumed that there will be a change of land into residential land covering an area of 36.1 Ha (Table 3). If in 2030 there is the potential for an increase in the minimum settlement area of 36.1 ha, then the area of built-up land in Sepaku District will increase significantly.

Table 3. Population Project and Residential Land Settlements

Population projection in 2030 (inhibitant)	Residential Land Settlements by 2030 (ha)
47119	171,04

This research still has many limitations. The first is the need for settlements in the future that do not consider the number of ASN families migrating from DKI Jakarta. That is considering that there is no valid data on the potential number of people who migrated from DKI Jakarta. The second is that the area studied only Sepaku District does not involve the entire Penajam Paser Utara Regency and Balikpapan City. That is considering that the capital will impact the surrounding area. Therefore, this research needs to be developed based on the limitations that we have conveyed. In addition, land change studies should also be analyzed projectionally using Cellular Automata analysis, such as research by Nurhidayati et al. (2017), Fariz et al. (2020) and Permatasari et al. (2021), so that land cover changes can be seen spatially.

CONCLUSION

From 2009 to 2019, the enormous land cover change in Sepaku District was the increase in plantation and secondary dryland forests. The built-up land cover did not significantly expand, which only increased by about 75.63 ha. However, the move of Indonesia's national capital from DKI Jakarta will significantly increase the built-up land cover. That is considering that by 2030 it is projected that the total population of Sepaku District will be 47119 people, which results in the potential for land change into settlements covering an area of 36.1 ha. The results obtained from the projection process can be underestimated because, until now, it has not been determined with certainty how many ASN will be migrated from DKI Jakarta to Sepaku District.

This research still has many limitations, such as the need for future settlements that do not consider the number of ASN families migrating from DKI Jakarta and the narrow study area (only Sepaku District). We suggest that research needs to be developed based on the limitations we have presented.

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