



# Application of Geographic Information Systems for Analysis of Rice Agricultural Land Resources Potential in Paser Regency as a Supporting Area for the Capital City Nusantara

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## ABSTRACT

The relocation of the State Capital from DKI Jakarta to the Ibu Kota Nusantara (IKN), East Kalimantan brought new problems, one of them was agricultural problems. The increase in population in IKN also increases the need for food which threatens food security. East Kalimantan region, which is mostly peatland and plantation land, is not suitable for use as rice farming land, so it is necessary to analyze the potential of rice supporting areas for IKN to ensure food needs in IKN are met. Areas that support IKN rice include Paser Regency, North Penajam Paser Regency, and Kutai Kartanegara. This study aims to analyze the potential of natural resources in one of the IKN buffer areas, namely Paser Regency as a food supply area, especially rice. The parameters to be analyzed are land cover, soil type, topography, and slope. The analysis was carried out using a geographic information system (GIS) with the overlay method so that potential areas were obtained to be developed as rice farming areas so that they could meet the food needs of IKN. The results of the overlay analysis of Paser Regency obtained 3 classifications of potential land for agriculture. Land with no potential is 242.22 km<sup>2</sup>, quiet potential is 5,779.42 km<sup>2</sup>, and very potential land is 4,230.51 km<sup>2</sup>.

**Keywords:** *IKN, Geographic Information System (GIS), Overlay, Food*

## 1. INTRODUCTION

In 2019, President Joko Widodo announced the relocation of the nation's capital city from DKI Jakarta to the Ibu Kota Nusantara (IKN), East Kalimantan [1]. Displacement nation's capital city brings new problems, one of them is in the agricultural sector, with the movement of the capital city, there is an increase in the population in East Kalimantan, resulting in increased food demand in the region. According to Law No. 3 of 2022 Regarding IKN [2], states that the IKN area only provides 10% of 75% of its open area to be used as a food

supply area. According to the Ministry of National Development Planning [1], in the early stages, the number of people who will move to IKN is 500,000 people. This will threaten food security in the new capital city or IKN, if the management and distribution of agricultural products are uneven.

The land area in East Kalimantan is mostly plantation land which causes most of the soil to become acidic due to continuous fertilization. In addition, most of the land on the island of Kalimantan is dominated by peatland which has high acidity with a pH between 3-5 [3]. It is

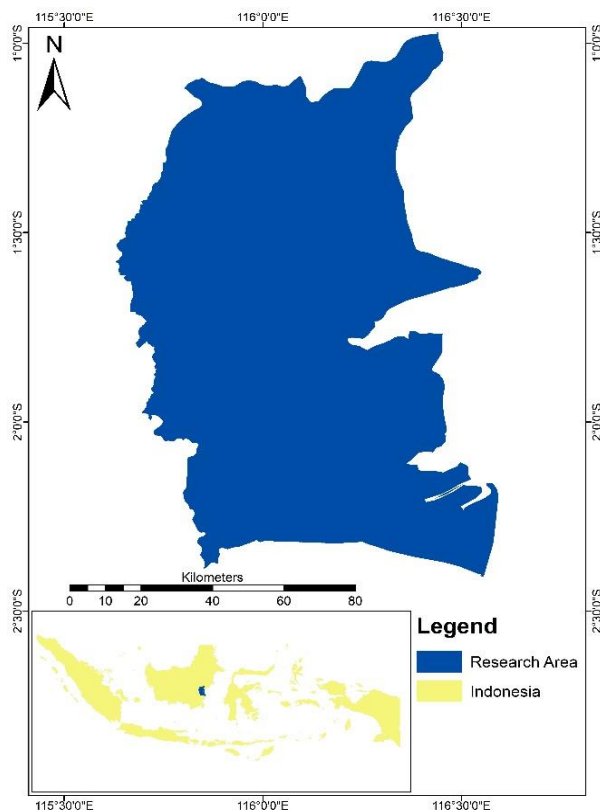
necessary to do a mapping of land potential analysis in East Kalimantan, especially in the buffer areas for rice needs in IKN. This study aims to map and analyze the potential of natural resources in one of the IKN buffer areas, namely Paser Regency as a food supply area.

The research was conducted using a geographic information system (GIS) where data on land cover, topography, slope, climatology, and soil types were analyzed to understand the pattern, so that an assessment of the potential of land resources in the IKN buffer area could be carried out [4]. The analysis is carried out by using the overlay method, which is an information system in the form of a map that is combined, so that more specific information is obtained [5].

## 2. METHODS

### 2.1 Study Area

Paser Regency is located in East Kalimantan Province, Indonesia Figure 1. Paser Regency which has an area of 11603.94 km<sup>2</sup> is one of the Regency in East Kalimantan Province which is located in the southernmost part, precisely at positions 0° 48' 29.44" – 2° 37' 24.21" South Latitude and 115° 37' 0.77" – 118° 1' 19.82" East Longitude. The capital of this district is located in Tana Paser [6].



**Figure 1** The Map of the Study Location is in Paser Regency, East Kalimantan, Indonesia.

### 2.2 Data

Research is carried out in 3 stages, that is preparation, data collection, and processing data. Collected data is secondary data. Required data in the study is as following:

#### 2.2.1 Land Cover Map

Image data retrieval and processing for making map cover land, use Google Earth Engine (GEE) which is an analysis platform geospatial based on Clouds that make it possible for the user to visualize and analyze image satellite [7]. The making of land cover maps in this study was carried out using Citra Sentinel 2. Since launched in 2015, Citra Sentinel 2 has been used for map cover land monitoring change cover land. With the use of classification guided Citra Sentinel 2 can produce map cover accurate land up to 80% on a global scale [8].

#### 2.2.2 DEM Data

Digital Elevation Model (DEM) is a digital image where each matrix point has a value that corresponds to its height above sea level [9]. DEM images are used to create elevation maps and slope maps. The classification of elevation maps based on the Junghuhn climate classification [10] can be seen in Table 1. The slope map refers to the regulations of the Ministry of Forestry [11]. The slope classification is divided into 5 classes which are shown in Table 2.

**Table 1.** Junghuhn Climate Classification

Climate	Elevation (ASL)	Type Plant
Tropical	0 – 600	Rice, corn, coffee, coconut, tobacco, sugar cane, and rubber trees
Sub-Tropical	600 – 1500	Rice, tobacco, tea, coffee, quinine, and vegetables
Moderate	1500 - 2500	Coffee, tea, and vegetables
Cold	>2500	No cultivated plants

**Table 2.** Slope Classification Refers to the Regulations of the Ministry of Forestry.

class	Slope (%)
1	>45
2	25 – 45
3	15 – 25
4	8 – 15
5	0 - 8

### 2.2.3 Soil Type Map

Soil type map refers to a digital soil map from FAO-UNESCO. The digital land map of the world uses a scale of 1:5,000,000, with geographic projections (latitude – longitude) intersecting with templates containing features of coastlines, lakes, rivers, and glaciers [12].

## 2.3 GIS

A Geographic Information System (GIS) is a tool for processing and analyzing geographic data, as well as to analyze several parameters so that new information is obtained. GIS can be used in various sciences, one of which can be used to create topographic, geological, and epidemiological data related to humans [13].

### 2.3.1 Overlays

The overlay method is a method where several information systems in the form of maps are combined so that new information is obtained. The overlay is done by stacking 2 or more different types of maps [5].

### 2.3.2 Determination classification analysis potency

Determination of the classification results from the analysis of the potential of agricultural land in the IKN buffer area using the Sturgess method [5], where each map of the suitability of agricultural land is given a value. The sum of each class interval using the equation:

$$K = 1 + 3.3 \text{ Logn} \tag{1}$$

$$K_i = (X_t - X_r) / K \tag{2}$$

Information:

$K_i$  : Interval Class

$X_t$  : Highest Data

$X_r$  : Lowest Data

$K$  : Number of Classes

$n$  : Number of Parameters

## 3. DATA RESULT

### 3.1 Land Cover Map

The land cover map of Paser Regency processed using GEE with the CART method is shown in Figure 2. The area of the six classes of Paser Regency can be seen in Table 3. The results of the analysis of the land cover map accuracy test obtained an overall accuracy value of 70.64%. The results of the land cover analysis in Paser Regency resulted in six land cover classes, water class with an area of 1124.66 km<sup>2</sup>, residential class 148.99 km<sup>2</sup>, rice field class 1300.15 km<sup>2</sup>, dry land class 74.37

km<sup>2</sup>, forest class 4957.46 km<sup>2</sup>, and garden class 3998.30 km<sup>2</sup>.

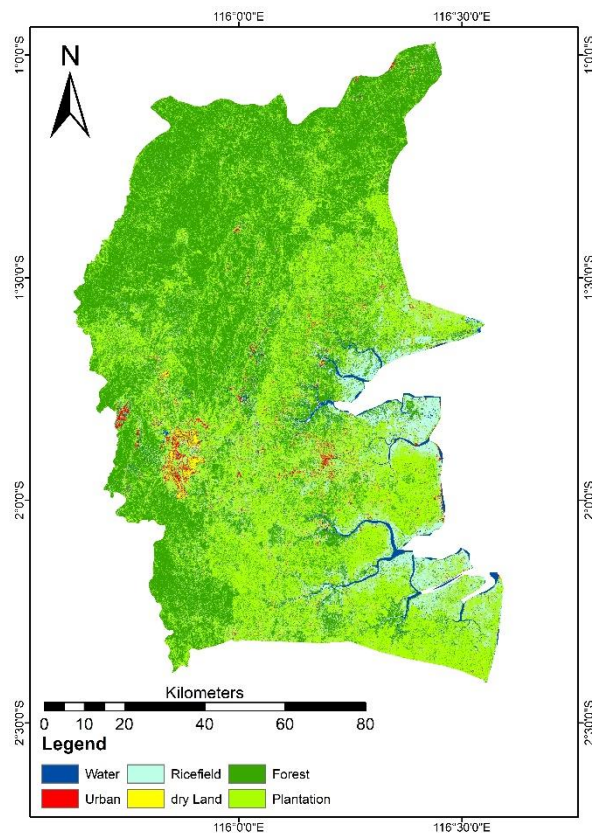


Figure 2 Land Cover Map of Paser Regency.

Table 3. Land Cover Map Area Classification Results

No	Class	Area (km <sup>2</sup> )
1	Water	1124.66
2	Urban Area	149.00
3	Ricefield	1300.15
4	Dry Land	74.37
5	Forest	4957,46
6	Plantation	3998,30

### 3.2 Land Elevation Map

Land elevation maps were made using DEM data, classification based on Junghuhn climate type [10], While in Paser Regency there are 2 classes, namely tropical class (0 – 600 m) and medium class (600 – 1500 m). Based on Figure 3, most of the Paser Regency area is suitable for use as an agricultural area because it has a tropical climate.

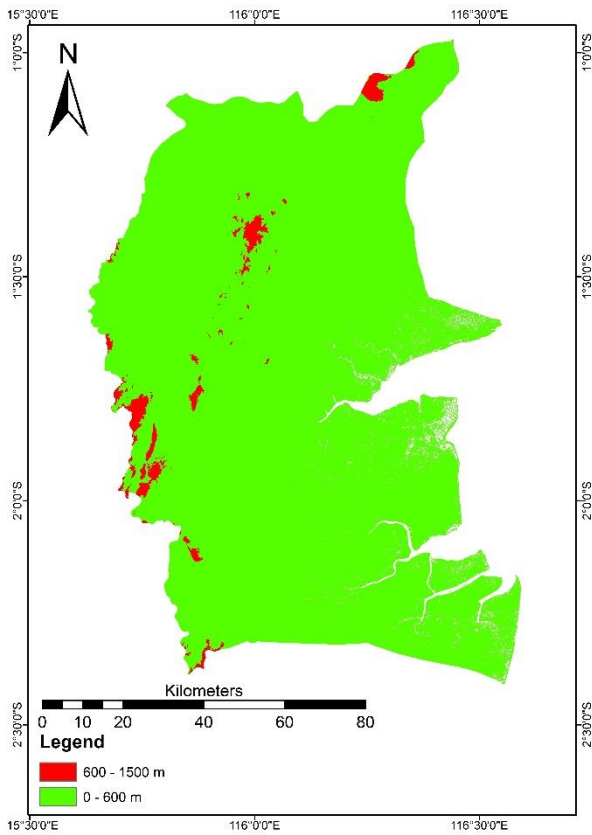


Figure 3 Elevation Map of Paser Regency.

### 3.3 Land Slope Map

The land slope map was created by processing DEM data using the QGIS 3.22.7 application. On the slope map, there are 5 classes as shown in Table 2. The slope with the highest value is Class 1 which is in mountainous areas to the west and north of Paser Regency. While class 5 has the gentlest slope, the majority of which are near the coast which is in the east of Paser Regency. Class 5 with a slope of 0 – 8% is the most ideal area to be used as agricultural land. The land slope map of Paser Regency can be seen in Figure 4.

### 3.4 Soil Type Map

The soil type map used is a soil type map from FAO. Paser Regency is classified based on 3 types of soil, namely, (1) Soil type Acrisols; (2) Cambisols Soil Type; (3) Soil type Fluvisols. The soil type map of Paser Regency can be seen in Figure 5.

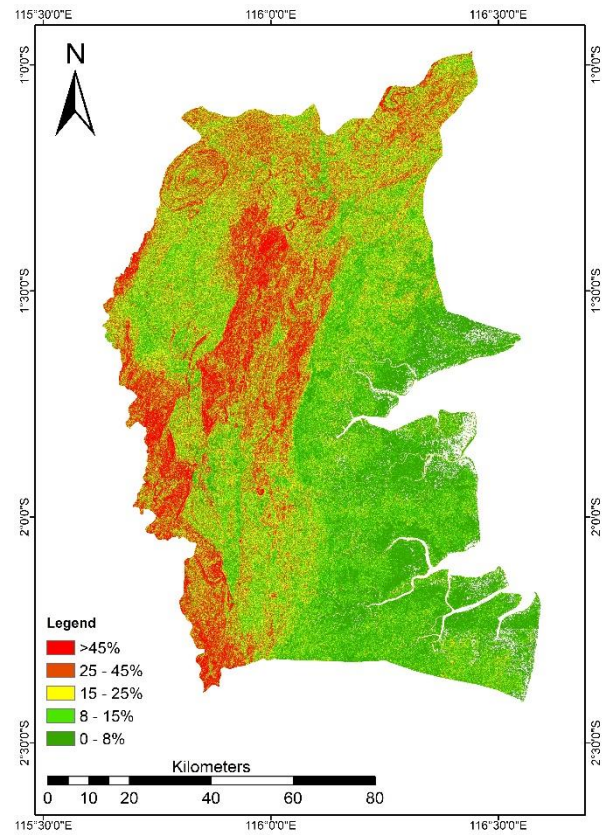


Figure 4 Slope Map of Paser Regency.

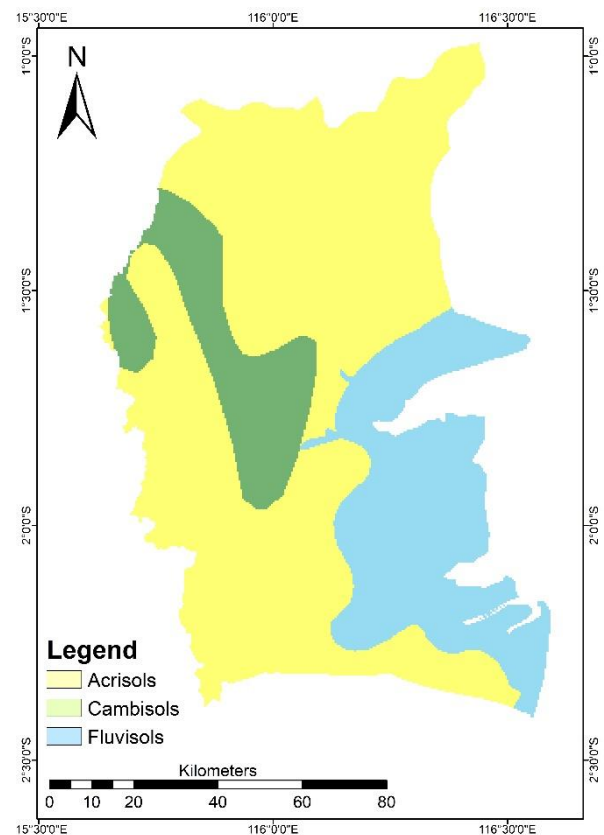
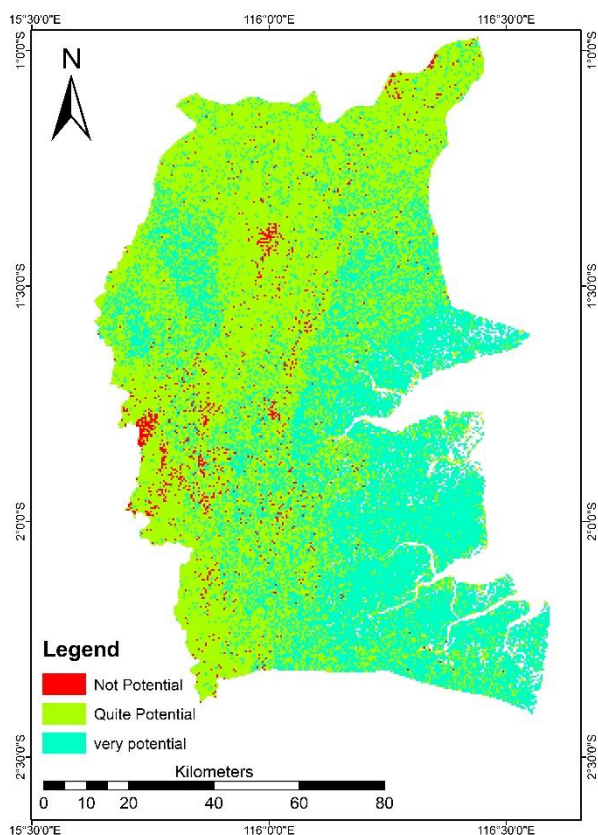


Figure 5 Soil Type Map of Paser Regency.



### 3.5 Overlays

Overlay analysis was carried out by combining land cover maps, elevation maps, slope maps, and soil type maps. Based on Equation 1, the overlay map with 4 parameters (land cover, elevation, slope, and soil type) produces 3 classes as shown in Figure 6. The results of the overlay analysis show the lowest score of 3 and the highest score of 15, so the interval value is obtained in class 4. Reclass is carried out based on class intervals so that the value of 3 – 7 is included in the class of land suitability of less potential with an area of 242.22 km<sup>2</sup>. Values 8 – 11 are included in the land suitability class with potential. with an area of 5,779.42 km<sup>2</sup>. Values 12–15 are included in the land suitability class with a very potential area of 4,230.51 km<sup>2</sup>. The land suitability value shows whether the area has the potential as agricultural land or not based on the 4 parameters applied.



**Figure 6** Overlays Map of All Parameters.

## 4. CONCLUSION

In this study, an analysis of the potential of agricultural land was carried out to support food security in IKN. Paser Regency as a buffer zone for IKN rice has a very high potential to be used as agricultural land. Paser Regency has an area of 4,230.51 km<sup>2</sup> which is very potential to be used as agricultural land based on land cover, elevation, slope, and soil type. With a potential reserve area of 5,779.42 km<sup>2</sup>, it is hoped that Paser

Regency can supply food needs in the Capital City Nusantara. Management of agricultural areas must be carried out properly followed by good management to increase agricultural productivity.

## AUTHORS' CONTRIBUTIONS

**Degita Fahmi Brillyansyah:** Methodology, Formal analysis, Writing – original draft.

**Sahid Susanto:** Conceptualization, Validation, Interpreting, Writing – review & editing.

**Lely Fitriana:** Validation, Interpreting, Data collecting.

**Muhamad Khoiru Zaki:** Validation, Interpreting, Writing – review & editing.

**Chandra Setyawan:** Validation, Interpreting, Writing – review & editing.

**Ngadisih:** Validation, Interpreting, Writing – review & editing.

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