Geographic information system change forest mangrove primary at Districts Merauke

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Abstract. Mangrove forests are the main types of plants with excellent ability to store and absorb carbon. Merauke Regency is one of the districts with the largest mangrove forest in Indonesia. The results of calculations in this study use Geographic Information System technology in 2012 the primary area of primary mangrove forest reached 195,401, 20 ha and in 2016 the total area of primary mangrove forest reached 210,310 ha. The most dominant addition of primary mangrove forest occurred in the Waan sub-district reaching 3,862.01 Ha with an area of 71,199.99 Ha and the most dominant decline in forest area occurred in the Merauke sub-district reaching 0.12 Ha with an area of 1,195.12 Ha.

1. Introduction
Increasing the content of carbon dioxide (CO₂) which is influenced by various types of factors including the result of reduced forest area which functions as an absorber of CO₂ in the atmosphere (air) which results in global warming [1]. Global Warming is very influential in human life. Forests have a very important role in neutralizing air and reducing the impact of global warming through the effects of greenhouse gases (GHG) [2]. Merauke Regency is one of the largest areas in Indonesia, geographically the location of Merauke Regency is between 137 ° - 141 ° East and 6 ° 00'-9 ° 00'LS, with an area of 45,071 Km² 11% of the province of Papua [3].

The primary mangrove forest is a type of plant with good ability to store and absorb carbon. The ability of this mangrove forest makes this type of plant the most dominant in the reforestation process because the population of this plant is very easily found in coastal areas [4]. Changes in carbon deposits that are affected by the extent of mangrove forests are interesting to study, but the process of calculating changes in carbon deposits is very dependent on the extent of existing forests [5].

Along with the development of information technology in the modern era, making technology as a tool that can be used to calculate the area of an area, be it forests, land, water, swamps, settlements, etc [6]. Geographical information system (GIS) is a spatial-based technology capable of mapping the area of a region. Geographical information systems also can carry out the process of developing or improving spatial based data or visual intelligence. In its development, GIS can be implemented in various forms to map-server or GIS-server [7]. This research applies GIS technology in calculating forest area and its changes, by utilizing remote induction data in the form of land cover maps containing types of land catchments, namely primary mangrove forests.
2. Methods
This study presents information about changes in the extent of primary mangrove forests that occur. Along with the increasingly rapid development of information technology, GIS is one of the spatial-based technologies that can answer all the challenges of today's technology needs [8]. Utilization of GIS technology in calculating changes in a forest area that occur by utilizing software, ArcGis 10.3 and Qgis las palmas 2.18.20. The methodology used in this study is as follows:

2.1. Interview
The interview method used in this study is conducting interviews with relevant parties, namely the stakeholders about the geographic information of Merauke Regency, and the current condition of mangrove forests, and the process of maintaining mangrove forests that exist in this area, from replanting to the stage of handling tidal-prone areas by reforesting specifically on coastal areas by planting mangroves, because this plant not only functions as an absorber and carbon sink but has a function to maintain the coastline from abrasion and resist wave waves from the ocean and as an ecosystem balancer [9].

2.2. Research Online
This research uses references from various sources, both international and national journals and ebooks. Search references are used to add insight and knowledge from the author in developing insight and update knowledge, which is related to the development of information technology. Information system.

2.2.1. Geographic Information System (GIS). Gis is a spatial based technology consisting of Hardware, Software, Brainware which is used in displaying spatial-based information. The ability of GIS in conducting spatial analysis in calculating changes in forest area and calculation of carbon deposits has been carried out in the district of Merauke. the flow of the data extraction process in the form of tables and attributes in this study is explained in figure 1 [10].

![Figure 1](image1.png)

**Figure 1.** The relationship between objects and their attributes

The process of data analysis using the same classification method, namely primary dryland forest obtained from the data maps of Merauke district land cover in 2012 and 2016. The research procedures used in this study are displayed in the form of images 2 [11].
Figure 2. Flowchart procedure research

The type of data used consists of spatial data (map administration, land cover map) and non-spatial (area). Spatial data consists of a Name object, Id, and Year attributes. The table design can be seen in Table 1.

Table 1. Design Table

| Name      | Type   | Length |
|-----------|--------|--------|
| ID        | Varchar| 4      |
| NAMAOBJ   | Text   | 50     |
| FORESTYPE | Text   | 50     |
| FORES_12  | Varchar| 50     |
| FOREST_16 | Varchar| 50     |
| LG_AREA   | Varchar| 20     |
| STATUS    | integer| 5      |

Land cover data after being analyzed is overlayed with administration maps of each existing sub-district. From the 20 existing sub-districts, data obtained from 12 sub-districts that have primary mangrove forests due to the geographical conditions of this region are around the river and coastal areas. Calculation of area using the calculator geometry found in the ArcGis 10.3 application then the data is converted into Hectare (Ha) units and the database from the analysis and conversion results is extracted into XML files so that the data can be processed in graphical form. in figure 3.
3. Results

The ability of geographic information systems in processing data is an advantage in the world of information technology. In this study the authors applied GIS in calculating the extent and change of mangrove forests, using applications ArcGis 10.3 and Qgis las palmas 2.18.20 [12]. The data used in this study is the data of Merauke regency land cover in 2012 and 2016 obtained from the Merauke Regency Planning and Development Agency (BAPPEDA), data then Analisis with Union, Merge, or Combination processes that function to conduct analysis and aggregation (aggregation) elements of primary mangrove forest in each sub-district area [8]. Data from the analysis are presented in tables 2 and 3, and the results of the calculation of forest area and changes are shown in Figures 4 and 5.

Table 2. Forest Mangrove Primary Tahun 2012

| Name Object | Large Area | Large Forest | Year |
|-------------|------------|--------------|------|
| Naukenjerai | 905.86     | 112          | 2012 |
| Merauke     | 1,445.63   | 1,195        | 2012 |
| Kimam       | 4,630.30   | 65,815       | 2012 |
| Waan        | 2,868.06   | 71,200       | 2012 |
| Semangga    | 326.95     | 1,000        | 2012 |
| Malind      | 490.60     | 2,034        | 2012 |
| Kurik       | 977.05     | 2,817        | 2012 |
| Ilwayab     | 1,999.08   | 14,615       | 2012 |
| Tibanji     | 5,416.84   | 24,658       | 2012 |
| Nggutu      | 3,554.62   | 957          | 2012 |
| Okaba       | 1,560.50   | 5,772        | 2012 |
| Tubang      | 2,781.18   | 5,227        | 2012 |
Table 3. Forest Mangrove Primary year 2016

| Name     | Object | Large Area (Ha) | Large Forest (Ha) | Year |
|----------|--------|-----------------|-------------------|------|
| Naukenjerai | 905.86 | 112.00          | 2016              |
| Merauke  | 1,445.63 | 1,195.00       | 2016              |
| Kimam    | 4,630.30 | 65,998.00      | 2016              |
| Waan     | 2,868.06 | 75,062.00      | 2016              |
| Semangga | 326.95  | 1,000.00       | 2016              |
| Malind   | 490.60  | 2,018.00       | 2016              |
| Kurik    | 977.05  | 4,219.00       | 2016              |
| Ilwayab  | 1,999.08 | 14,855.00     | 2016              |
| Tabonji  | 5,416.84 | 24,880.00      | 2016              |
| Ngguti   | 3,554.62 | 956.00         | 2016              |
| Okaba    | 1,560.50 | 5,770.00       | 2016              |
| Tubang   | 2,781.18 | 5,245.00       | 2016              |

Based on the data from the analysis above, data on the extent of forest cover are shown in the form of Table 4 and Figures 4, 5 and 6.

Table 4. Change Forest Mangrove Primary Year 2012 and 2016

| Name     | Large Forest Mangrove Primary (Ha) | Status (Change) | Information |
|----------|------------------------------------|-----------------|-------------|
|          | 2012 | 2016 |                           |
| Naukenjerai | 111.63 | 112.00 | 0.37 | 1 |
| Merauke   | 1,195.12 | 1,195.00 | 0.12 | 2 |
| Kimam     | 65,815.11 | 65,998.00 | 182.89 | 1 |
| Waan      | 71,199.99 | 75,062.00 | 3,862.01 | 1 |
| Semangga  | 999.76  | 1,000.00 | 0.24 | 1 |
| Malind    | 2,033.87 | 2,018.00 | 15.87 | 2 |
| Kurik     | 2,816.70 | 4,219.00 | 1,402.30 | 1 |
| Ilwayab   | 14,615.31 | 14,855.00 | 239.69 | 1 |
| Tabonji   | 24,657.86 | 24,880.00 | 222.14 | 1 |
| Ngguti    | 956.86  | 956.00  | 0.86  | 2 |
| Okaba     | 5,772.00 | 5,770.00 | 2     | 2 |
| Tubang    | 5,227.00 | 5,245.00 | 18    | 1 |

Column status explains the value of forest change that occurs, while column information explains the status of the change. In column information If it is worth 1 (one) then there is an increase in the amount of forest and if it is worth 2 (two) then there will be a decrease in the amount of forest.
Figure 4. Map Mangrove Primary Year 2012

Figure 5. Map Forest Mangrove Primary Year 2016

Figure 6. Map Change Forest Mangrove Primary at Districts Merauke Year 2012 and 2016
The output of this study produces information about the area of primary mangrove forests in 2012 and 2016 and changes in a forest area that occur, this information can be seen in Figure 7.

![Figure 7. Output system information generated.](image)

4. Conclusion
This research produces information about forest area and changes that occur. Based on the results of calculations and analysis using GIS technology The largest change in forest area (addition) is in Waan sub-district reaching 3,862.01 Ha with an area of 71,199.99 Ha and the most dominant decline in forest area occurs in Merauke sub-district reaching 0.12 Ha with 1,195.12 ha.

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