Geographic Information System Carbon Development Landed on Land of Primary Dry Limits using Method Stock Difference

by Kusworo Adi

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ABSTRACT
Land use emission factor is one of the causes of global climate change The Intergovernmental Panel on Climate Change (IPCC) concludes that most of the global average temperature increase is due to human activities through GHG emissions. GHG emissions come from a variety of sources from agriculture, forestry, and other land uses to a land ecosystem, derived from changes in carbon stock and from non-CO2 emissions as well as from various sources.

Changes in carbon stocks in a Biomass can be calculated using the Stock-Difference method in which carbon stores in a cage are measured at two different times to assess changes in carbon stores. In finding the value of carbon stocks in primary dryland forest is highly dependent on the availability of data that becomes the supporting variable that is the data of forest for each region, then GIS becomes one of the solutions in obtaining data.

Our results conclude that in 2012 and 2016 there was a decrease in carbon savings of an average of 1,842 C tons/ha and an average rate of emission increase of 5,430.73 CO2 tons/ha.

Keywords
Emission, Change carbon storage, Geographic Information System, Stock-difference.

1. INTRODUCTION
The Land use emission factor is one of the causes of global climate change [1]. *Intergovernmental Panel on Climate Change* (IPCC) concludes that most of the increase in global average temperatures occur as a result of human activities through greenhouse gas emissions (GRK) [2]. The Government of Indonesia plans national low emissions development by reducing emissions in the 26 % for the year 2020. Merauke district is one of the districts in Indonesia and has an important role in supporting the national low emission targets development [3].

GHG emissions come from a variety of sources from agriculture, forestry, and other land uses to a land ecosystem, derived from changes in carbon stock and from non-CO2 emissions as well as from various sources. Changes in carbon stock on Biomass can be calculated using the Stock-Difference method in which carbon stores in a cage are measured at two different times to assess changes in carbon stores [4]. Carbon deposits can be determined from the results of land use evaluation and carbon models based on the Remote Sensing and Geographic Information System (GIS) [5]. GIS is a computer-based system capable of collecting, storing, analyzing and presenting data in the form of information in the form of spatial [6]. The design and implementation of GIS can be applied in energy saving and emission reduction for the industrial area [7]. In its development GIS is also able to be applied in analyzing the level of emission increase based on land use pattern. carbon issues become important in national discussions in technology and become a priority topic and also a strategic issue and a focus on education or academic [8]. The GIS-based model with carbon sequestration model is the most commonly used method at present and feasible to be used to integrate spatial-based decision support system model [6]. Based on the above description GIS is able to be applied in displaying information about carbon emissions in forests. In finding the value of carbon stocks in primary dryland forest is highly dependent on the availability of data that becomes the supporting variable that is the data of forest for each region, then GIS becomes one of the solutions in obtaining data. We use this GIS to obtain the values of the variables required to find carbon content in primary dryland forest by applying the stock-difference method of calculating surface carbon stores in primary dryland forest [4]. Our proposed research is Geographic Information System Carbon deposits on the soil in primary dryland forest using Stock difference method in Merauke district.

2. RELATED WORK
Forests are one of the ecosystems that play an important role in the carbon cycle. it is necessary to measure large carbon stocks by applying a discriminant analysis model to generate biomass classification rules. In classification there are three types of variables used are Climate, Geographic and Variable stands [9]. Deposits of carbon stocks in forests (trees) will be higher than other biomass such as soil, leaf litter and spices. Tree biomass is calculated based on tree biomass, above ground level, tree diameter, tree height, and density [10].

The forest that became the focus of this study in knowing the carbon store on the soil in the forest is primary dryland forest. the primary laryngeal forest is defined as a forest condition where there has been no human exploitation action causing a change or expert function [11].

GIS is able to display data and information, in forest planning and management in sustainable forest resource development. broadly GIS provides spatially accessible open source data provided by Open Geospatial Consortium (OGC), enabling users or organizations to develop it based on their needs [12].

3. RESEARCH METHODOLOGY
Changes in carbon deposits in a biomass can be calculated using the Stock-Difference method in which the carbon stores

in a cage are measured at two different times to assess changes in carbon stores.

3.1 Stock - Difference

The Stock-Difference Method is a carbon-based approach model where carbon stores in a cage are measured based on two different time points to assess the change in carbon savings of the equation as follows [4].

$$\Delta C_B = (\Delta C_{t2} - \Delta C_{t1})/(t2 - t1) \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

If the change in carbon stock is estimated on the basis of

ΔC_B	=	Changes in annual carbon savings in the cistern, ton C / year
C_{t1}	=	Carbon deposits in the container at time t1, ton C
C_{t2}	=	Deposits of carbon in the container at time t 2, ton C

per hectare, then the value is multiplied by the total area in each stratum to obtain an estimate of the total change in storage for the cistern.

3.1.1 *Carbon Value Measurement*

Measurement of carbon values in primary dryland forest in some districts in Merauke district is done by converting the area of dryland primary forest with factor volume vegetation. The total value of carbon obtained is multiplied by the carbon-CO_2 conversion factor. The equation for measuring. carbon values are formulated [13].

Total Volume of Vegetation	=	volume vegetation x 1,454 x 0,396
Total Biomass	=	Large cover vegetation x total volume vegetation
Total Carbon	=	total biomass x 0,5
Total CO_2	=	total carbon x 3,6667

3.2 National and Sub National Forest Carbon Reserves

The emission factor (FE) and absorption factor (FS) is the average difference in carbon stocks from each type of land use change. The emission/absorption factor is often calculated based on measurement data of an example (sample), which is averaged to establish a representative of the rate of emission or absorption of an activity under certain conditions [2]. FE shows the value of carbon content difference in the land conversion from high carbon content to land with lower carbon content. The FS shows the value of the carbon content difference in the land conversion from low carbon content to land with higher carbon content.

The magnitude of FE and FS varies depending on the type of site, type of forest or plant, stages of development of stands, and practices of applied forest management (IPCC, 2006). forest classification based on geographical location, forest type, and forest management model applied is necessary to show the diversity and also to reduce uncertainty. Therefore, each country needs to make a more detailed forest cover classification based on its specific condition [13].

3.3 Geographic Information System

Geographic information system (GIS) is a computer-based system that is able to collect, store, analyze and present the data of earth form of information in the form of spatial [6]. On the application of GIS capable of displaying data and information, in forest planning and management in the continuous development of forest sub-forestry. the broad GIS provides spatially accessible open source data provided by the Open Geospatial Consortium (OGC), so as to enable users or organizations to develop it based on their needs [12].

GIS is a combination of databases in the grouping and storage of large geospatial data.. To know the relevance of each attribute used then added layer or layer on the map that is used to describe the relationship of geospatial data in the form of maps [14]. GIS connects spatial objects with their stored attributes.. The set of layers and attribute tables will form the GIS spatial database. Thus the design of the database is essential in the GIS. The database design determines the effectiveness and efficiency of input, processing and output processes. The mutually related layers save different attributes. Each layer contains information based on the spatial attribute, the data of the attribute will be exported and stored in the database Mysql. Whereas the database tables contain nonspatial information that will be stored in the same database with spatial data, so both data can be related or related.. The relationship of the object and its attributes can be seen in Fig 1.

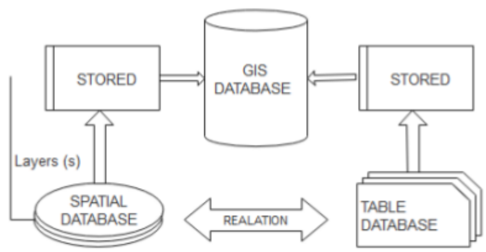

Fig 1. The relationship between objects and their attributes

4. DESIGN OF RESEARCH

4.1 Material and Tools

This study we used the dataset of land cover maps and primary dryland forest in 2012 and 2016, in Merauke district and QGIS Desktop application 2.18.13.

4.2 Research Procedure

Flow Chart of carbon storage calculation.

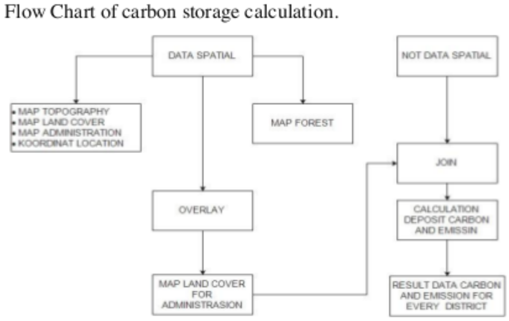

Fig 2. Flow diagram

In Fig 2 above describes the process of calculating the carbon savings that begins by collecting spatial and nonspatial data. Then do the merger (join) spatial and nonspatial data so that can be obtained value from carbon store.

Table 1. Table captions should be placed above the table

Name	Type	Lenght	Detail
ID	Integer	5	ID
NAMAOBJ	String	20	Name Object
Koordinat	Double	20	Koordinat
Luas Wilay	integer	10	An Area
Primer_2012	Integer	20	Land cover 2012
Primer_2016	Integer	20	Land cover 2012
Per_Hut_Pri	Integer	20	Change Land cover
Sim_C_12	Real	20,3	Stash C 2012
Sim_C_16	Real	20,3	Stash C 2016
Per_sim_C	Real	20,3	Change stash C
CO2_12	Real	20,3	CO2, 2012
CO2_16	Real	20,3	CO2, 2016
Per_sim_CO2	Real	20,3	Chage satsh CO2

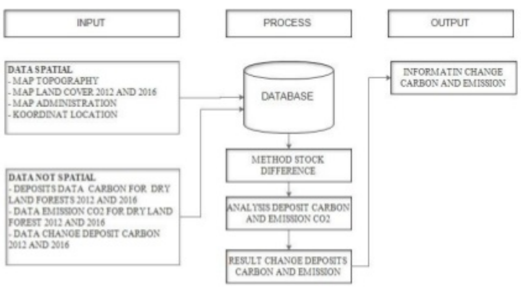

Fig 3. Flowchart information system

Figure 3, describes the process of information system framework that is input, process, and output. In the input, there are two types of data that are spatial data and nonspatial data. In the process part, there is a database and process for calculating carbon stock using stock difference method. While on the part output explains the results to be obtained.

On this issue, we did some experiments to do the calculation of carbon deposits. There are several steps taken to obtain the value of carbon storage. The first step is to collect dataThe data used in our study is the primary forest land cover data due to the geographic condition of primary dryland forest that is almost located in all administrative districts in Merauke Regency.

Merauke Regency is one of the districts located in Papua province, with an area of 4,679,163 hectares and is divided into 20 districts (the same degree of autonomy based on special autonomy and the 1945 Constitution). Based on the results of our classification among the 20 existing districts in Merauke there is 13 district that has primary dryland forests, which is why we conduct research that focuses on primary dryland forest. Map of district administration Merauke can be seen in the following picture.

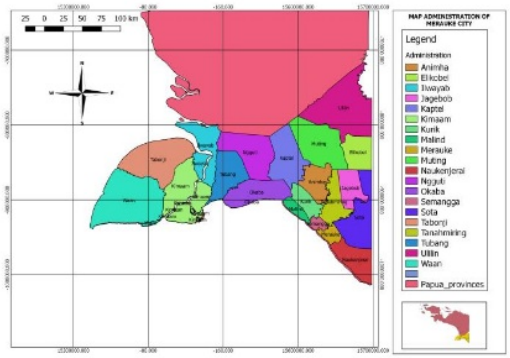

Fig 4. Map Administration district Merauke

In the classification process, we overlay land cover maps and administrative maps, so as to obtain the primary dryland forest area for each district. We present the data in the form of tables, maps, and graphs.

Table 2. Table Large and change the forest primary year 2012 -2016

Distrik name	Year /Ha		
	2012	**2016**	**Change**
ANIMHA	19437,06	19427,47	-9,5873242
ELIKOBEL	38507,57	22660,83	-15846,73181
JAGEBOB	18830,42	18685,30	-145,1144538
KAPTEL	35610,07	36502,97	892,9021188
KURIK	151,54	151,54	0,000182785
NGGUTI	22409,10	21894,92	-514,1797916
OKABA	4904,38	4816,58	-87,80381598
SOTA	18853,70	10133,56	-8720,142179
TANAH M.	19179,99	19115,32	-64,6667153
TUBANG	7652,73	7453,93	-198,8062234
ULILIN	177826,96	184726,94	6899,985745
MUTING	84092,24	66342,49	-17749,75276

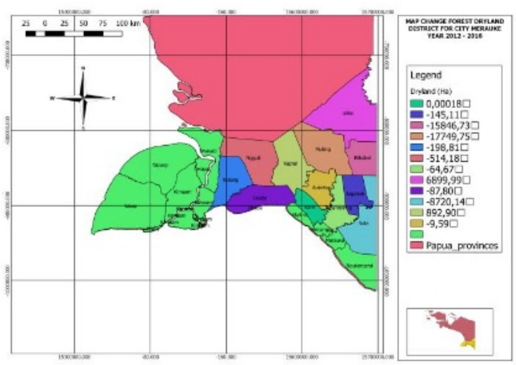

Fig 5. Change forest area dryland primary 2012-2016

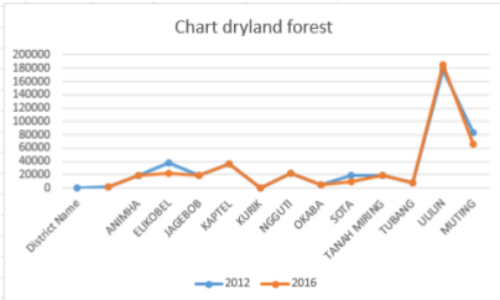

Fig 6. Chart dryland forest area primary 2012-2016

After we have classified and gained the value of forest area and primary dryland change in each district for 2012 and 2016 we further calculate the carbon savings and emission levels generated. The results can be seen in the following chart and map table.

Table 3. Table deposits of carbon and carbon dioxide dryland forest year 2012 and 2016.

Distrik Name	Total carbon		Total carbon dioxide	
	2012	**2016**	**2012**	**2016**
ANIMHA	9718,53	9713,74	35634,93	35617,36
ELIKOBEL	19253,78	11330,42	70597,85	41545,24
JAGEBOB	9415,21	9342,65	34522,75	34256,70
KAPTEL	17805,03	18251,49	65285,72	66922,72
KURIK	75,77	75,77	277,83	277,83
NGGUTI	11204,55	10947,46	41083,73	40141,06
OKABA	2452,19	2408,29	8991,45	8830,48
SOTA	9426,85	5066,78	34565,43	18578,36
TANAH M.	9589,99	9557,66	35163,63	35045,08
TUBANG	3826,37	3726,96	14030,14	13665,66
ULILIN	88913,48	92363,47	326019,05	338669,14
MUTING	42046,12	33171,24	154170,51	121629,00

Table 3. Table Change deposits of carbon and carbon dioxide year 2012 and 2016.

Distrik Name	**Change**	
	CO	**CO2**
ANIMHA	4,00	4,00
ELIKOBEL	-4,79	-17,58
JAGEBOB	-7923,37	-29052,61
KAPTEL	-72,56	-266,05
KURIK	446,45	1637,00
NGGUTI	0,00	0,00
OKABA	-257,09	-942,67
SOTA	-43,90	-160,98
TANAH	-4360,07	-15987,07
TUBANG	-32,33	-118,56
ULILIN	-99,40	-364,48
MUTING	3449,99	12650,09

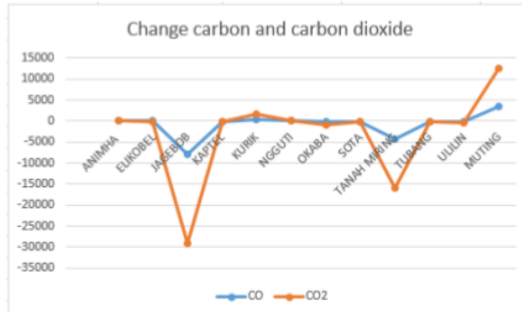

Fig 7. Chart change carbon and carbon dioxide

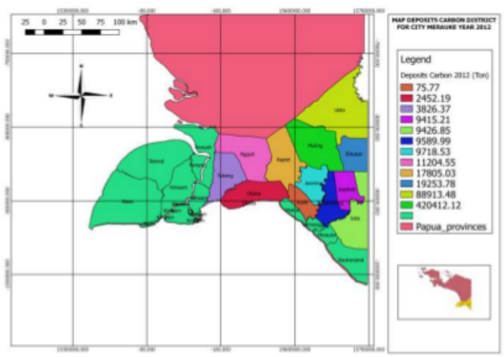

Fig 8. Map deposit carbon dryland primary year 2012

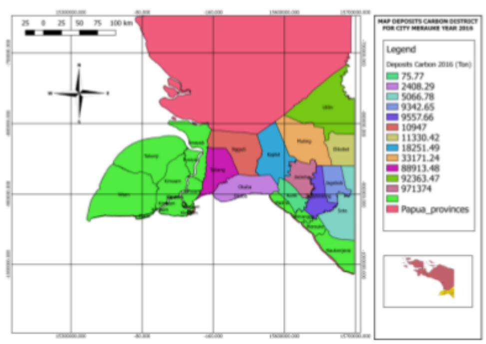

Fig 9. Map deposit carbon dryland primary Year 2016

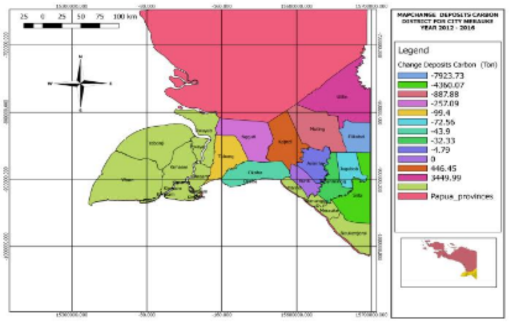

Fig 10. Map Change deposit carbon dryland Primary Year 2012- 2016

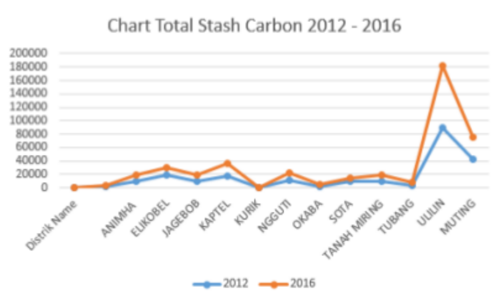

Fig 11. Chart deposit carbon dryland the primary year 2012 - 2016

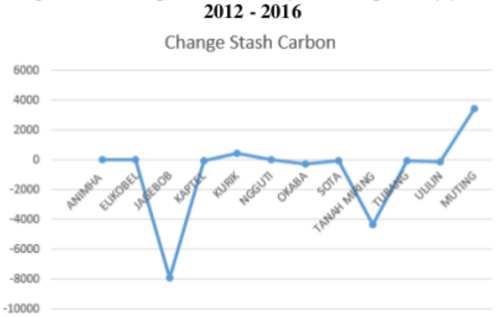

Fig 12. Chart change stash carbon dryland primer year 2012 - 2016

In Fige 12, it is clear that there is a decrease in carbon uptake so that later will affect the number of emissions that produce.

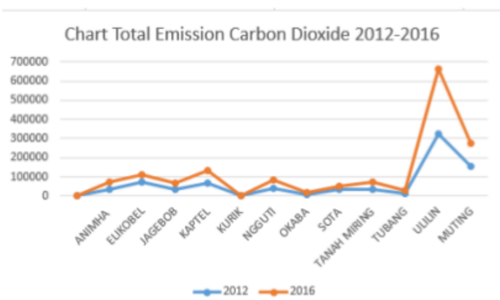

Fig 13. Chart total carbon dioxide dryland primary year 2012 – 2016.

Fige 13. explains the changes in emissions of carbon dioxide produced. It is clear that from 2012 to 2016 there is an increase in emissions this is caused by the decrease in carbon savings.

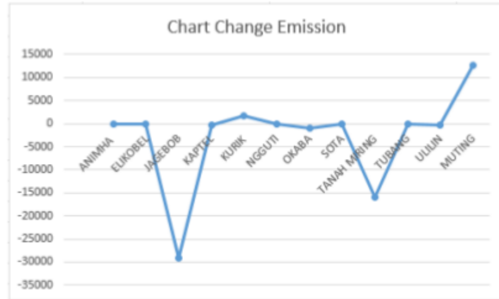

Fig 14. Chart change carbon dioxide dryland primer year 2012 - 2016

In Fige 14. It is clear that there is a decrease in carbon emissions absorption, which is due to a decrease in carbon deposits caused by reduced forest area.

5. CONCLUSION

In this study we conclude that with the limitations of available data, GIS becomes one of the most optimal solutions at this moment in finding the value of carbon savings, that is by conducting the process of classification of primary dryland forest in each region so as to obtain the results of the forest area. It is hoped that in the GIS research the calculations of future carbon and emission changes can be developed by adding the value of carbon storage and emissions conditions. So it can help in planning land clearing.

In the process of classification of these forest types can be obtained from forest area that will be used to find the value of carbon storage and the level of emission increase that occurred. then the change in forest area is very influential on changes in carbon storage and the rate of increase in emissions.

Our results conclude that in 2012 and 2016 there was a decrease in carbon savings of an average of 1,842 C tons/ha and an average rate of emission increase of 5,430.73 CO_2 tons/ha.

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