

Analysis Of Carbon Emission Level on Merauke Regency Land Cover

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Abstract. This research is aimed to know level of carbon emission from land cover change in Merauke Regency. The data are historical baseline which is land cover map time series of 1990, 2000, 2005, 2010 and 2014, also zoning plan of Merauke Regency in 2010-2030. Furthermore, the data are processed with software LUMENS (land use planning for low emission development strategy). The result is presented descriptively. From the result, it can be concluded that based on analysis of carbon emission level in 1990 – 2000, it is found 1948773.523 Ton CO₂/year with emission level per unit area in amount of 0.421 Ton CO₂eq/ha.year; observation in 2000 – 2005 found emission level in amount of 6151442.314 Ton CO₂/year with emission per unit area 1.336 Ton CO₂eq/ha.year; observation in 2005 – 2010 found emission level per year in amount of 41386219.77 Ton CO₂/year and emission level per unit area in amount of 9.4 Ton CO₂eq/ha.year; meanwhile, Merauke Regency's emission level in 2010 – 2014 is 61816894.268 Ton CO₂/year with emission level per unit area in amount of 13.928 Ton CO₂eq/ha.year.

Keywords: Emission, Carbon Emission, land cover.

1 Introduction

Climate change is a global issue which caused by the increasing of gases such as Carbon dioxide (CO₂), Methane (CH₄), Nitrous oxide (N₂O), Chlorofluorocarbons (CFCs) and Volatile Organic Compounds (VOCs). The gases come from energy use activity and land function change (deforestation). Indonesia committed to decrease greenhouse gases (GRK in Indonesia) emission in amount of 26 % (0,767 GtCO₂-e) with self-effort, and 41% (1,210 GtCO₂-e) with international support. Total projection of emission decrease in Business as Usual (BAU) scale is 2.95 GtCO₂-e in 2020 (Indonesian Ministry of National Development Planning, 2011) [1]. Meanwhile, projection emission level based on BAU of all Riau province sectors in 2020 is for about 0,41 GtCO₂-e (Development Planning Agency at Sub-National Level, 2012) [2].

There are three main gases which known as greenhouse gases, they are (CO₂), (CH₄) and (N₂O). The gases considered as gas layer that traps heat wave and recently its concentrate in atmosphere are increasing twofold (IPCC, 2001). The three greenhouse gases have long lifespan such as CO₂ that is the fastest increased

gas and the longest lifespan (5-200 years), followed by N₂O (114 years) and CH₄ (12-17 years). Among three greenhouse gases, N₂O has radiation capability 200 greater than CO₂ (Myrold, 1999). Hence, N₂O is the main greenhouse gas which caused global warming (Majumdar *et al.*, 2000)

In Indonesia, most of greenhouse gases come from carbon dioxide, methane and nitrous oxide. Most of emission produces from forestry sector (especially because of deforestation) and energy. The second largest gas that causes global warming is methane which mostly comes from agricultural sector including animal farm activity. Merauke Regency is one of the pillars for capital of Papua Province since it's directly adjacent to Boven Digoel Regency. This condition makes Merauke has strategic role in succeeding emission level decrease since the region is within Merauke that consists of settlements and transmigration areas centered in Semangga District, Tanah Miring District, Kurik District, Jagebob District, Muting District, and Elikobel District. Relatively, concentration on Regency's physical development on North and East downtown has moved to West. Up until now, proportion of land use based on Merauke Spatial Plan with land area 4,6 million Ha shows land use 52,5% for protection area and 47,5% for cultivation area.

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Based on the matter above, greenhouse gas analysis on land cover in every regional planning unit is important to be conducted in Merauke Regency. Greenhouse gas emission from land cover change is suspected come from human activity or the needs and demands of area that still in development. The consequence from the development demand is the need for new land for various development activities such as food until non-food sector. This analysis of carbon emission level on land cover change in Merauke is expected to give information about greenhouse gas emission level in Merauke Regency. Thus, it can contribute to support government policy in the obligation to decrease national emission in 2030 in amount of 29% according to Paris Agreement”.

2 Research Method

This research uses field method by portraying the condition of land cover change in Merauke due to development activity. The used data is secondary data in form of land cover map time series data in 1990, 2000, 2005, 2010 and 2014 also Merauke zoning plan in 2010-2030. Furthermore, the data are processed using software LUMENS (land use planning for low emission development strategy) by using integrated approach and trade-off analysis that include: sustainable development plan, land use plan, and mitigation action plan from entire sectors.

3 Result And Discussion

3.1 Change of Land Cover Map

Based on analysis of land cover change using land cover basic map time series 1990, 2000, 2005, 2010 and 2014 which presented in Figure 1., it shows that from 1990 until 2014 land cover in Merauke has undergone significant land cover change which means carbon density level decreases.

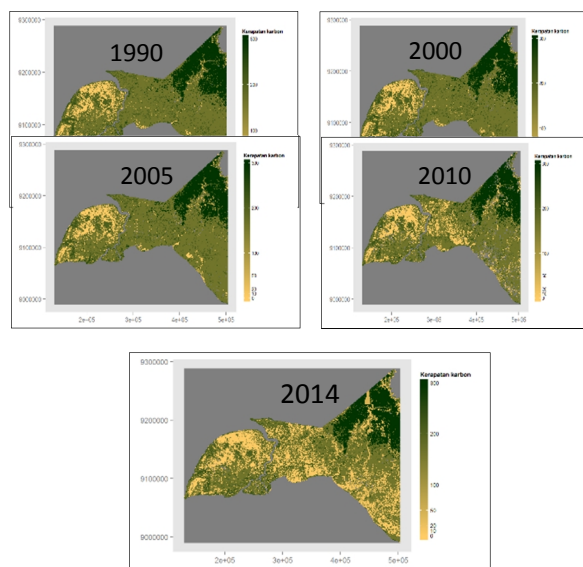


Fig. 1. Carbon density level In Merauke

3.2 CO₂ Emission Calculation in Merauke Regency

3.2.1 Observation in 1990-2000

Observation in 1990-2000 shows that emission level per hectare shows 0.421 ton CO₂-eq/ha.year.

Table 1. Emission Calculation Periods of 1990-2000

Category	Amount
Total of Emission (Ton CO ₂ eq)	115138606.124
Total of Sequestration (Ton CO ₂ eq)	95650870.892
Net Emission (Ton CO ₂ eq)	19487735.232
Emission Level (Ton CO ₂ /year)	1948773.523
Emission Level per-unit area (Ton CO ₂ eq/ha.year)	0.421

Merauke emission level observation in 1990-2000 took place on planning unit of settlement, urban area, mangrove forest area and river border. In this period, emission in Merauke tends to show in a region where there is human activity such as planning unit of settlement and urban area. Kurniawati, *et al.*, 2012 in his study on housing development influence to carbon dioxide emission in Surabaya concludes that emission in Surabaya produces by ratio of household number per area of settlement (household/Km²) and energy consumption from cooking fuel (TJ) also electric consumption (KWh). These variables are directly proportional with production of CO₂ emission. Factors in housing area that contribute to production of CO₂ emission is intensity of housing land use and energy consumption whether it is primary or secondary. Intensity of housing land use factor consists of household variables number per settlement area. Meanwhile, primary energy consumption factor consists of cooking fuel use such as LPG, firewood and kerosene. Also, secondary energy consumption variable is household electric consumption.

Table 1., emission level per unit area in Merauke is 0.421 ton CO₂eq/ha.year. Emission in settlement and urban area of Merauke is produced by the effort to expand settlement area so it is requiring land expansion. Yuliana, (2016) states that specific emission factor of settlement sector from cooking fuel use is classified to know carbon footprint condition. Thus, it makes emission estimation easier in a region. Besides fuel uses, emission in settlement or urban area can be caused by the needs of land in order to build new settlement. From DNPI data, 2010, show that national council of climate change mentions around 85% emission in Indonesia in 2005 is caused by land use activities.

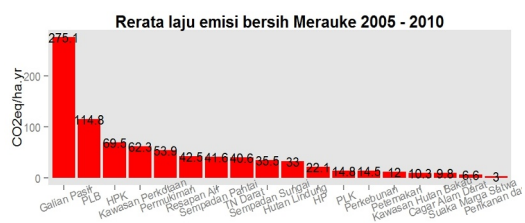


Fig. 4. Mean of Merauke Net Emission Level in 2005-2010 per plan unit.

3.2.4 Observation in 2010-2014

Table 4. Emission Calculation in 2010-2014

Category	Amount
Total of Emission (Ton CO ₂ eq)	269926215.792
Total of Sequestration (Ton CO ₂ eq)	22658638.72
Net Emission (Ton CO ₂ eq)	247267577.072
Emission level (Ton CO ₂ /year)	61816894.268
Emission level per-unit area (Ton CO ₂ eq/ha.year)	13.928

Observation in 2010-2014, Merauke emission level significantly increases to 13.93 Ton CO₂eq/ha.year. Emission increases occur to almost all plan units. Emission level is dominated by plan unit of animal farm, agriculture, land national park, settlement, and river border. Emission level of animal farm plan unit reaches 130.4 co₂eq/ha.year, while agriculture sector reaches 123.4 co₂eq/ha.year. Emission activity of animal farm come from methane emission through enteric fermentation of livestock and dinitro oxide which are produced from animal manure process (Suwondo, 2014) [5]. Other than animal farm, agriculture also contributes to Merauke emission level enhancement in 2010 – 2014. It happens because of land opening from forest to new agricultural land which is oil palm plantation in Muting, Ulilin and Elikobel Districts. On global scale, land management for agriculture has contributed 15% from all greenhouse gases. Recently, it is estimated third of all carbon emissions come from land conversion (deforestation, crop change and agricultural intensification), while two-thirds of methane emission and most of nitrogen dioxide come from agricultural cultivation. The decreasing of ecosystem function also decreases plant production and environmental quality.

Intensive agriculture management, whether it is monoculture or polyculture (agroforestry) affect ecosystem change especially decreasing soil organic material (BOT in Indonesian). The more intensive a management land system, the lowest its C reserves (Hairiah, 2005) [6]. Generally, natural ecosystem conversion to agricultural land reduces C reserve and then affects biodiversity in the soil (Hairiah, 2005)[6]. Knorr *et al.* (2005) [7] state that the rises of temperature from ecosystem function change will cause soil microorganism decomposes organics faster and release carbon dioxide (CO₂). Based on the result above, it can be seen that period of 2010 – 2014 in unit of wetland

(PLB), dryland (PLK) and animal farm also plantation contribute to the increasing of CO₂ per wide area. Emission level on wetland and dryland agriculture reach 64.4 until 74,6 CO₂ eq/ha.year.

Agriculture sector which becomes source of greenhouse gases is agricultural activity start from land opening until harvesting crops. According to Djajadilaga, et. al., (2009)[8] since 2006 CH₄ total emission from rice field sharply increase from average 1,5 million ton per year become 1,8 million per year. By knowing the data of agriculture production activity on particular region and the data of used material amount in production activity on agricultural land, carbon emission estimation on each production activity of rice can be calculated.

Rice production activities which potentially produce carbon emission is classified into three activities, they are activity on land management, maintenance, and harvest.

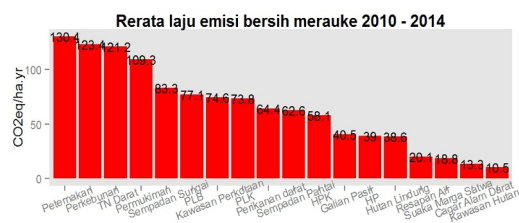


Fig. 5. Mean of Merauke Net Emission Level in 2010-2014 per plan unit.

4 Conclusion

The result of this research concludes that carbon density map in Merauke Regency has decreased from observation in 1990 – 2014. Meanwhile, Merauke emission level per unit area on 4 observation periods are, 0.42 ton CO₂ eq/ha.year in 1990 – 2000 with plan unit of settlement, urban area, and mangrove forest that dominate the carbon emission contribution; 1,34 ton CO₂ eq/ha.year in 2000 – 2005 with plan unit of urban area, beach border, and terrestrial fisheries which dominate carbon emission contribution; 9.35 ton CO₂ eq/ha.year in 2005 – 2010 with sand digging, PLB, and HPK dominate carbon emission contribution, and 13.93 ton CO₂ eq/ha.year in 2010 – 2014 with contribution of carbon emission dominated by plan unit of animal farm, plantation, and land national park (TN darat in Indonesian).

5 Suggestions

1. High level of carbon emission in land sector of Merauke Regency need to be decreased and reduces the causing factors of carbon emission level;
2. High level of emission on plan unit of settlement, agriculture, sand digging, and plantation need real action from many parties to make society realize the

importance of well land use to minimize land conversion.

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