BirEx JOURNAL
Budapest International Research in Exact Sciences
Medical, Biological, Argiculture, Engineering
Science and other related areas
e-ISSN : 2655-7827
p-ISSN : 2655-7835
http://www.bircu-journal.com/index.php/birex

# Carbon Estimation in Three-Year-Old Ex-Field Shrub Vegetation in Ujoh Bilang Village Mahakam Ulu Regency, East Kalimantan Province

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**Abstract:** *Carbon Estimation in Three-Year-Old Ex-Field Shrub Vegetation in Ujoh Bilang Village, Mahakam Ulu Regency, East Kalimantan Province. The purpose of this study was to estimate the carbon content of shrub vegetation that had been abandoned for three years in Ujoh Bilang Village, Mahakam Ulu Regency. Vegetation sample data were collected according to the growth rate, namely in plots measuring 20 x 100 m, sub plots 10 x 50 m and research plots 1 x 1 m, the samples were plant vegetation, litter, necromass and dead wood. cVegetation samples were dried in an oven. The data were processed and calculated using the biomass formula and converted to carbon content per hectare. The results obtained from this study are the carbon content of dead wood nekormas of 12 tons/hectare, understorey vegetation of 0.609 tons/hectare, litter of 0.604 tons/hectare, and the total carbon content of shrub vegetation that has been abandoned for three years is 13,213 tons. /hectare.*
**Keywords:** *carbon content; field; shrub; litter; necromas*

## I. Introduction

As we all know that forests are the lungs of the earth where various animals live, trees, forest products and various other resources that we can get from forests that are priceless for humans. Forests are also natural resources that provide great benefits for human welfare, both tangible benefits that are felt directly, and intangible benefits that are felt indirectly. Examples of direct benefits (tangible) such as the provision of wood, animals, and forest products in the form of wood, while examples of indirect benefits (intangible) are such as benefits of recreation, protection and regulation of water systems, prevention of erosion. One of the important environmental issues that are currently of concern to various parties is global warming. Global warming is caused by emission gases such as carbon dioxide, methane, carbon monoxide in the atmosphere which results in an increase in air temperature in the mountains, if this continues, this phenomenon will threaten the lives of all living things on earth.

In connection with this phenomenon, it is necessary to reduce greenhouse gas emissions. One of these efforts is by conserving forests or conserving vegetation on this earth because vegetation is able to control greenhouse gases by absorbing CO2 through photosynthesis. If managed properly, forests are able to overcome excessive amounts of carbon in the atmosphere by storing carbon in the form of biomass (Elvina, 2018).

One of the successes of forest management can be seen from the aspect of stored carbon or carbon stocks. Forests have an important role as a carbon store.

Carbon is one of the natural elements that has the symbol "C". Carbon is also one of the main elements forming organic matter, including living things. Nearly half of living organisms are carbon. Because naturally a lot of carbon is stored on earth (land and sea) than in the atmosphere. Carbon is stored in the earth's land in the form of living things (plants and animals), dead organic matter or sediments such as plant and animal fossils. Most of the amount of carbon that comes from living things comes from forests. As forest destruction occurs, the release of carbon into the atmosphere also occurs as much as the level of forest destruction that occurs. The accumulation of greenhouse gases due to changes in land cover

and forestry is estimated at 20% of the total global emissions that contribute to global warming and climate change. This confirms that climate change mitigation efforts need to involve the land cover change and forestry sectors. Considering that forests play a very important role not only as carbon stores, but naturally also function as the most efficient carbon sinks on earth as well as a source of greenhouse gas emissions when not managed properly. Forest land consists of two types, namely forest areas that grow naturally or primary and areas overgrown with shrubs, the components that make up the two vegetation are trees, litter, and undergrowth. These components have a role in providing carbon. Forested land has two significant purposes, one is sources of agricultural arable land and the other is for fixation of carbon dioxide emission and cools down of global warming. For instance, between 2000 and 2008 agricultural land is expanded by about 4 million hectares in Ethiopia. This new agricultural land came from conversion of forestlands, woodlands, and shrub lands and also the country's demand for agricultural land expected to increase from 15 million ha in 2008 to 34 million ha by 2030 (EDRI in Adinew, 2019).

The clearing of forest land as a place for farming for the community, is one of the traditions of the local community, especially the people of the Ujoh Bilang area, Long Bagun sub-district, Mahakam Ulu Regency, where the forest area that has been used as a place for farming is then left without any activity, but some are re-managing it for farming. Sustainable planting is usually done after rice harvesting. The community replanted the former fields with garden types and forest plants with rubber core plants and other plants which were allowed to grow naturally until a few years later they became forests again. So on this occasion, the researcher wants to do research on Carbon Analysis of Three-Year Shrub Vegetation of Former Fields in Ujoh Bilang, Mahakam Ulu Regency, namely to find out some of the amount of carbon stocks on ex-field land that was left for three years without any sustainable land management.

Ujoh Bilang is one of the Long Bagun sub-districts, Mahakam Ulu Regency, where the people still practice shifting cultivation which has become a community tradition since time immemorial.

### 1.1 Objective of the Research

The purpose of the study was to analyze the carbon content of the ex-field land in the form of shrubs that had been left for three years and to determine the types of shrubs vegetation on the ex-field land.

### 1.2 3 Expected Results

The expected results of this research are to provide data and information on carbon stocks stored in ex-farm forest lands that are three years old, expand knowledge about carbon analysis contained in abandoned exfield land commonly called shrubs and as basic knowledge of carbon stocks stored in scrubland ex-fields.

## II. Research Methods

### 2.1 Place and Research

In the implementation of this research, basically all the instruments used in the research are aseptic and must be used regardless of the laboratory rules, the instruments used include:

**a. Location**

The research location was carried out in Ujoh Bilang Village, Long Bagun sub District, Mahakam Ulu Regency on an area of former community-owned land that has been abandoned and is no longer managed either for agriculture or plantations or in other words without any activity

**b. Time**

The research period was carried out for four months (April 2020 to July 2020), which included: literature study, field orientation, making research plots, data collection, data management, and report preparation.

**c. Material and Tool of the Research**

**1. Materal**

The material or object of this research is shrubland, vegetation, vegetation that is three years old, necromas (dead wood), litter and soil in the former forest area.

**2. Research Tools**

The equipment used in this study consisted of:

1. Machete/sickle to create boundary stubs and to slash
2. Meter to measure the width and length of the plot/plot
3. Sticks/sticks as plot boundaries and color bands as plot boundary markers
4. The rope as a limiter for the plot that has been measured
5. Shoot cutter/scissor for plant sampling
6. Camera/cell phone as a shooting tool
7. Writing utensils
8. Oven to determine the dry weight of understorey vegetation and litter
9. Laboratory to determine soil organic C
10. Weight measuring device (grams)
11. Sample pouch/container
12. Sieve (2 mm)
13. Tally sheet
14. Lebel

**c. Research Method**

**1. Literature Study**

Literature study is an activity to study the theory relevant to the title of the research and collect primary data which is carried out directly, verbally and with input from several sources and land owners.

**2. Field Orientation**

Prior to conducting the research, a field orientation was conducted. This is intended to explore the possibility of carrying out research at that location, namely a review of the situation and field conditions and the location of the path to be made.

**3. Research Procedure**

The object of this research is the observation method, where the object of this research is understorey, litter and soil that has been in the former field for three years, especially in the bush area. Measurement of biomass using a rectangular plot measuring 20 x 100 meters (Wibowo, et al, 2013):

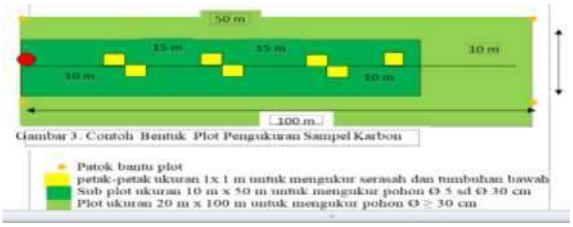


***Figure 1.*** *Research Plot for Sampling*

Sampling that will be weighed wet and dry is the collection of plant vegetation in the form of wood and non-wood, as well as litter. Each plot will be sampled and grouped between leaves and fruit, twigs and stems, and litter. The sample is put into a plastic bag and then labels each sample according to the plot point code. Measurement of understorey biomass in a 1x1 meter subplot, each sample weighed about 200 grams dry as a subsample and then dried using an oven at a temperature of 70 c to 85 c to reach a constant weight, 2x24 hours (SNI, 2011), then measurement of litter biomass. In the 1x1 meter sub plot, 5 cm thick litter was taken and then sifted. Each plot weighed about 200 grams of litter, dried in an oven at 85oC for 48 hours, and took five points on the plot to analyze the carbon content of soil samples, namely in the Laboratory.

Information on species and plants in the data as well as local names of plants in the area of ex-field are three years old based on the mention in Ujoh Bilang Village, Long Bagun sub District, Mahakam Ulu Regency. In each plot using a stake or stick, ropes to make sampling work easier, as well as observations of plant species in the sub-plots are labeled so that researchers can find out what types of plants have known local names of plants, then record the names of plant species in the data using tables tally sheets.

**d. Secondary Data**

Secondary data includes literature, reports, and writings from previous researchers related to the location of the research location, namely field conditions and vegetation, as well as interviews used to obtain data and information from local communities regarding the names of plant species.

**e. Data Analysis**

The results of data collection are processed in tabular form so that it can be seen the amount of carbon based on plots found in shrubs that are three years old, there is also a formula used to determine the amount of carbon associated with data management:

**1. Calculation of Understorey Carbon:**

a. C tb/plot = Bk tb x fraction C (0.5) Description:
   C is plant carbon/plot Bk is the dry weight of the understorey Fraction (0.5) is the percentage value of carbon content
b. The carbon content of understorey per hectare is calculated by the formula:
   C tb/ha = C tb/plot/1,000*10,000/1 m2 (plot area)
c. Litter carbon calculation
   C sr/plot = Bk sr x fraction C (0,5) Description :
   C is litter carbon/plot Bk is the dry weight of the litter Fraction (0.5) is the percentage value of carbon content
d. The calculation of litter carbon per hectare is calculated by the formula
   C sr/ha = C sr/plot/1,000*10,000/1 m2 (plot area)

**2. Measurement of Dead Tree Biomass (Woody Necromass)**

Biomass in the form of dead trees and wood on the forest floor was measured by measuring all dead trees, both standing and fallen wood in 20 x 100 meter plots. The formula for measuring the biomass of dead trees that are still standing Vpm = 1 n (dbh/100)2 x t x f

Description:

Vpm is dead tree, expressed in cubic meters (m2)

Dbh is the diameter at chest height of dead trees (cm)

T total height of dead trees, (m)

F is the dead tree correction factor

**3. Calculation of Dead Wood Biomass Felling (Hairiah et al. 2001)**

Deadwood biomass measurement formula by volume (brereton formula)

Vk = 0,25TC **x p**

**(dp+duA 2 \2xiooy**

Description:

Vkm is dead wood, expressed in cubic meters (m2)

Dp is the diameter of dead wood, expressed in centimeters (cm)

Du is the diameter of the dead wood tip, expressed in centimeters (cm)

P is the length of dead wood, expressed in meters (m) is 22/7 or 3.14

Dead wood biomass calculation Bkm = Vkm x Bj km Description:

Bkm is dead wood biomass, expressed in kilograms (kg)

Vkm is the volume of dead wood, expressed in cubic meters (m3)

Bjkm is the density of dead wood, expressed in kilograms per cubic meter (kg/m3).

## III. Discussion

### 3.1 Ex-Farm Area

The ex-field area in this study is the exfield area which is the former from crops, especially rice, corn, vegetables and other agricultural crops. At the beginning the land was cleared in the form of scrub forest or young secondary forest overgrown with relatively old shrubs, types that grew such as Macaranga gigantea, Melastoma sp, Piper sp, Mallotus sp etc., are cut and chopped by the community and dried for several months then controlled burning by the community, after cleaning, planting is carried out especially for staple crops, namely rice, although there are also planted corn, and other vegetable crops and there are also tree crops such as rubber, rambutan, mangoes and other perennials, then after several plantings and harvesting of rice finally because the yields are decreasing and they can no longer satisfy them, the land is finally abandoned or left alone and the community will look for a place to farm by opening new fields again. It is on the ex-field land where the community has abandoned it for approximately 3 (three) years. This research was conducted to determine the carbon stock of the land in the vegetation of the former field in the form of shrubs.

### 3.2 General Vegetation

The results of the observations show that the area of the former field that has been abandoned for three years has been overgrown with shrubs in the form of plants dominated by alang-alang (Imperata cylindrica), for the types of wood such as Melastoma malabatricum, Piper aduncum, Cromolaena odorata, Eugenia zeyneleca, Vitexpubescens, Ficus spp and others.

### 3.3 Carbon Stock

The results of the calculation of carbon stock consist of necromas carbon, litter carbon, upper plant vegetation carbon and soil carbon.

### 1. Litter Carbon

Litter is defined as leaves or small twigs that fall to forest slopes, decayed litter as dead organic matter which is a component of shrubland vegetation which of course also contributes to carbon stocks on ex-field land, litter sampling data collection on sub-plots research and after being processed and analyzed, converted to hectares, the data can be seen in Table

**Table 1.** Litter Weighing in 1*1 meter Sub Plot

| plot | Fresh weight (gram) | Dried weight (gram) | Biomass shrub (gram) | Carbon shrub /ha (kg/ha) |
|---|---|---|---|---|
| 1 | 1.203 | 76 | 38 | 380 |
| 2 | 853 | 105 | 52,5 | 525 |
| 3 | 948 | 116 | 58 | 580 |
| 4 | 342 | 160 | 80 | 800 |
| 5 | 1.121 | 138 | 69 | 690 |
| 6 | 287 | 113 | 56,5 | 565 |
| 7 | 342 | 137 | 68,5 | 685 |
| Tota | (kg/ha) | | | 4.225 |
| Average | | | | 0,604 ton/ha |

In general, litter consists of plant parts that have died such as fallen leaves, twigs, branches, branches, bark, flowers, and fruit from the results of data collection in this study in each sub-plot with different levels of litter thickness. Litter productivity will increase and reach a maximum in the dry season and will decrease in the rainy season (Elvina, 2018). Litter plays an important role for the soil and this is where the activity of microorganisms, so that litter decomposes again and which produces nutrients through a decomposition process (decay) so that it can be used by plants and litter is beneficial for agricultural land, especially cultivation, this is because litter becomes natural fertilizer through the process of burning on farms. The results of the calculation in the table above, the average value of carbon content in litter in scrub vegetation of ex-fields is 0.609 tons/ha consisting of leaves, twigs, stems and non-woody plants.

***Figure 2.*** *Litter Collection and Weighing on Bush Vegetation*

Litter has a very important value in restoring carbon and the carbon cycle, the nutrients produced from the decomposition process are very important for plant growth, and it is one of the indicators of land fertility for traditional cultivators.

**2. Carbon Necromas**

Next is the calculation of necromas found in former fields that have been abandoned for 3 (three) years, in general, former fields are in the form of shrubs, which are former secondary forests used by the community for cultivation or agriculture, so there are still traces of trees produced logging several years ago that has weathered and can no longer be recognized, but field owners still recognize it in the Dayak language, as shown in Table 2.

**Table 2.** Woody Necromas Found in the 10*50 Meter Sub-Plot

| Type of vegetation | Volume ($m^3$) | Biomass Carbon ($kg/m^3$) | Carbon content (kg) |
|---|---|---|---|
| Jelak Kuvung | 0,208 | 4.161 | 2.080,5 |
| Ta'ap | 0,275 | 341 | 1.705 |
| Pihing | 0,255 | 2.601 | 1.300,5 |
| Blafan | 0,879 | 5.801,4 | 2.900,7 |
| Kayo | 0,082 | 672,5 | 336,2 |
| Meranti | 1,130 | 6.780,0 | 3.390 |
| Biling | 0,108 | 594 | 297 |
| Total | | | 12.009,9 |
| Average | | | 12 ton/ha |

From the results of these calculations, it can be seen that the carbon content of the necromass material is around 12 tons/hectare.

**3. Lower Plant Vegetation Carbon**

The understorey vegetation in the exfield forest in Ujoh Bilang is donated by grasses, weeds (Imperata cilindryca), Karamunting (Melastoma malabatricum), Piper aduncum, and others. It is deliberately allowed to grow to restore land fertility, where usually after the land is overgrown with trees until it becomes secondary forest, the cultivators will open their fields again for replanting rice.

Competition between understory vegetation and other plants also occurs, such as nutrient absorption, growth space and absorption of sunlight, Figure 3 shows the competition between shrub vegetation.

***Figure 3.*** *Vegetation Land of Shrubs, Former Fields that Have Been Abandoned for Three Years*

**Table 3.** Weighing of Lower Plant Vegetation in Sub Plot 1*1 meter

| Plot | Fresh weight (gram) | Dred weight (gram) | Lowr Plant Biomass (gram) | Lower Plant Carbon/ha (kg/ha) |
|---|---|---|---|---|
| 1 | 1.116 | 194 | 97 | 970 |
| 2 | 394 | 121 | 60,5 | 605 |
| 3 | 742 | 113 | 56,5 | 565 |
| 4 | 877 | 175 | 87,5 | 875 |
| 5 | 3.771 | 235 | 117,5 | 1.175 |
| 6 | 606 | 198 | 99 | 990 |
| 7 | 6.148 | 151 | 75,5 | 75,5 |
| Total (kg/ha) | | | | 4.265,5 |
| Average | | | | 0,609 ton/ha |

The results of the calculation from the table above, the average value of lower vegetation carbon content is 0.609 tons/ha consisting of leaves, twigs, stems and nonwoody plants, it can be explained that there is quite a lot of understorey vegetation of pioneer species, such as muting coral, ferns. - ferns, weeds, Gleichenia linearis, - Rohdommyrtus tomentosa and other grasses. This vegetation is important because it is the basis for the forest succession process where this vegetation will later be replaced by the growth of trees.

**4. Carbon Content in Ex-Field Shrub Vegetation**

The results of the recapitulation of research on shrubby vegetation on the carbon content of each carbon pool are as presented in Table 4.

**Table 4.** Recapitulation of Carbon Content in Each Pool

| No. | Carbon Pool | Carbon Content (ton/Ha) |
|---|---|---|
| 1. | Nekromasa | 12 |
| 2. | Serasah | 0,604 |
| 3. | Lower Plant | 0,609 |
| | Total Carbon | 13,213 |

The high carbon necromass on the land illustrates that each of the many trees that have not been completely destroyed, the fallen wood indicates the process of felling trees when farmers make fields, where land in the form of secondary forest is cut down on the trees, then chopped and then burned with controlled burning, before the cultivators planted the staple crop, namely rice.

Meanwhile, litter carbon and understorey carbon have a smaller content of 0.6 tons/hectare, because the land formed due to a new succession process at the level of shrub vegetation is only grown with grass and some are in the form of woody shrubs that are only about 3 (three) years old year. The carbon stock in this study is also much smaller than the research conducted by Azham (2015) who conducted research on estimating carbon stocks in bushland cover in Samarinda City, which was 31.14 tons/ha for shrub cover and 19.32 tons/ha for shrub cover.

## IV. Conclusion

**4.1 Conclusion**

From the results of this study, it can be concluded that the scrub vegetation of former fields that have been abandoned for 3 years is overgrown with understorey vegetation in the form of shrubs such as Melastoma malabatricum, imperata cilindryca, other grasses, for the carbon content as follows:

1. The carbon content in litter is 0.609 tons per hectare.
2. The carbon content of necromass in the form of decayed wood is 12 tons per hectare.
3. Carbon content in understorey vegetation is 0.609 tons per hectare

**4.2 Suggestion**

In managing agricultural land, the community should be able to insert trees- or plantation-crops or fruits, so that the former abandoned fields will become more productive and in terms of carbon stocks will be larger.

## References


Adinew, M., and Gebresilasie, G. (2019). Effect of Climate Change on Agricultural Output Growth in Ethiopia: Co-Integration and Vector Error Correction Model Analysis. Budapest International Research in Exact Sciences (BirEx) Journal Vol 1 (4): 132-143.

Azham, Z. 2015. Estimasi Cadangan Karbon pada Tutupan Lahan Hutan Sekunder, Semak dan Belukar di Kota Samarinda. Jurnal AGRIFOR, 14(2),

Badan Standarisasi Nasional. 2011. Standar Nasional Indonesia (SNI) 7724:2011 Pengukuran dan Penghitungan Cadangan Karbon-Pengukuran

Lapangan untuk Penaksiran Cadangan Karbon Hutan (Ground Based Forest Carbon Accounting).

Dharmawan W.S., Rahimahyuni F.N. dkk. 2020. Cadangan Karbon Hutan Kalimantan Timur. Pusat Penelitian dan Pengembangan Sosial Ekonomi Kebijakan dan Perubahan Iklim Badan Penelitian, Pengembangan dan Inovasi Kementerian Lingkungan Hidup dan Kehutanan. IPB Press. Bogor.

Elvina C Y. Muhammad FM, dkk. 2018. Estimasi Biomassa Karbon Serasah di Kawasan Hutan Sekunder Pegunungan Deudap, Kecamatan Pulo Aceh Kabupaten Aceh Besar. Proseding Seminar Nasional Biotik 2018. Program Studi Pendidikan Biologi FTK UIN Ar- Raniry Banda Aceh

Hairiah, K., & Rahayu, S. (2007). Pengukuran karbon tersimpan di berbagai macam penggunaan lahan. World Agroforestry Centre. Bogor.

Syam'ani, Yusano N, dkk. 2012. Above Ground Carbon Stock On Various Landcover System in Amandit Sub-sub Watershed. Jurnal Hutan Tropis Volume 13 No 2 September 2012. Program Studi Kehutanan Fakultas Kehutanan Universitas Lambung Mangkurat. Banjarbaru.

Sutaryo, D. 2013. Penghitungan Biomassa Sebuah Pengantar Untuk Studi Karbon dan Perdagangan Karbon. Wetlands International Indonesia Programme. Bogor.

Wibowo, A., Samsoedin, I., Nurjahjawilasa, S., & Muttaqin, Z. 2013. Petunjuk Praktis Menghitung Cadangan Karbon Hutan. Pusat Penelitian dan Pengemabangan Perubahan Iklim dan Kebijakan. Kementerian Kehutanan, Jakarta.