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DIVERSITY AND CARBON STOCKS OF GENUS *FICUS* IN *GUNUNG TILU* KUNINGAN DISTRICT, WEST JAVA PROVINCE, INDONESIA

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A B S T R A C T

Moraceae is one of the dominant families in the forest area of *Gunung Tilu*, Kuningan Regency which is one of the lowland forests. Lowland tropical forest has the highest damage risk compared to other forest types. This study aims to determine the diversity and carbon reserves of the *Ficus* genus in the forest of *Gunung Tilu*, Kuningan District, West Java. This study was conducted in July - September 2017 by making a sample plot with an area of 9.6 ha. Measurement of tree biomass was carried out by method without logging. All trees with DBH ≥ 20 cm in diameter measured and recorded the type name. A total of 1,058 individuals consisting of 42 families and 149 species with DBH ≥ 20 cm, it has been found in the sample plot of *Gunung Tilu* forest namely *Ficus sundaica* Blume, *Ficus virens* Aiton var. *glabella*, *Ficus drupacea* Thund, *Ficus kurzii* King, and *Ficus benjamina* L are the dominant Ficus species based on the Important Value Index (IVI). While the diversity of Ficus spp is moderate. The amount of tree biomass and carbon stock in the study site are 606,75 ton ha^{-1} and 303,38 ton C ha^{-1}.

Keywords: Ficus Genus, diversity, carbon reserve, Gunung Tilu

1. Introduction

Gunung Tilu is part of the hill of inheritance including in the lowland forest in the area of Kuningan regency, from south to east. Lowland forests save most of the land's carbon. Forest vegetation absorbs carbondioxide through photosynthetic activity and it is able to store about 76-78% of the organic carbon from the total terrestrial organic carbon in the form of biomass (Kun and Dongsheng, 2008).

According to Masripatin et al (2010) carbon stocks above ground in various classes of land cover in natural forests ranged from 7.5 to 264.7 tons C / ha, including natural forests dipterocarps with carbon stocks of 204.9 - 264.7 ton C / ha, lowland natural forest 230.1 - 264.7 ton C / ha, primary forest upland 103,1 ton C / ha, lowland forest secondhand forest fire 7,5 - 55,3 ton C / ha, secondary mangrove forest 54.1 - 182.5 ton C / ha, peat forest 200 ton C / ha and lowland secondary forest 113.2 ton C / ha.

According to Berg and Corner (2005) in the Malesia *Ficus* species can be found in almost all types of terrestrial vegetation such as wet or dry soils, rocky areas (corals, limestone), primary and secondary forest, at altitudes less than 1,500 m asl (Yusuf, 2011) . Studies on the potential of stored carbon have been largely done in various types of forest ranging from mangrove forests to upland mountain ranges. Particularly on the study of the amount of carbon stored in the *Ficus* clan has not been done, therefore the authors try to examine how much carbon is stored in the *Ficus* genus compared to other species in a lowland forest area, the research plan is entitled "Diversity and Carbon Stocks of Genus Ficus in *Gunung Tilu* of Kuningan District ".

2. Methods

This research was conducted in Gunung Tilu area of Kuningan Regency for 3 Months. By using purposive sampling method. The total area of research included in the area of *Gunung Tilu* is 962 Ha with Intensity Sampling (IS) 1% so that the plot / sample plot is 9.62 Ha which consists of 12 tracks. Each path is divided from various altitudes ranging from 700 m altitude to 1000 m asl and at each altitude has a length of 100 m and a width of 20 m.

To find out the potential of flora in Gunung Tilu Forest area, observations were made on each measured plot of each growth rate of seedlings, stakes, poles and trees. For the level of seedling and stake, the data taken is the type and number of individuals while the growth rate of poles and trees, the data taken is the type, number of species, diameter and height of the tree. After the results of inventory was got through observation, then analysis is done to observe density, frequency and dominance analysis using the formula (Soerianegara, 1998) as follows:

Density/D (indv/ha)

$$D = \frac{\text{Number of a species}}{\text{Total area sampled}}$$

Relative Density/RD (%)

$$RD = \frac{\text{Density of a species}}{\text{Total density of all species}} X\ 100$$

Frequency/F

$$F = \frac{\text{Area of plot in which a species occurs}}{\text{Total area sampled}}$$

Relative Frequency/RF (%)

$$RD = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} X\ 100$$

Dominance/C

$$C = \frac{\text{Total basal area of species}}{\text{Total area sampled}}$$

Relative Dominance/RC (%)

$$RD = \frac{\text{Dominance of a species}}{\text{Total density of all species}} X\ 100$$

Tree biomass

Live tree biomass was estimated by using the Ketterings allometric equation as follows (Hairiah and Rahayu, 2007):

$(AGB)\ est = 0.11 \times r \times D^{2,62}$

Information :

(AGB) est = Live tree biomass (Kg)

D = Diameter of tree (cm)

r = Species weight (g / cm3)

The gravity of the tree refers to the website ICRAF: www.worldagroforestry.org

Carbon Estimation

The amount of carbon stock in Mt. tilu forest is estimated using equation following (Murdiyarsow et al., 2004):

$C = 0.5 \times W$

Where :

C = reserve / carbon storage (kg)

W = tree biomass (kg)

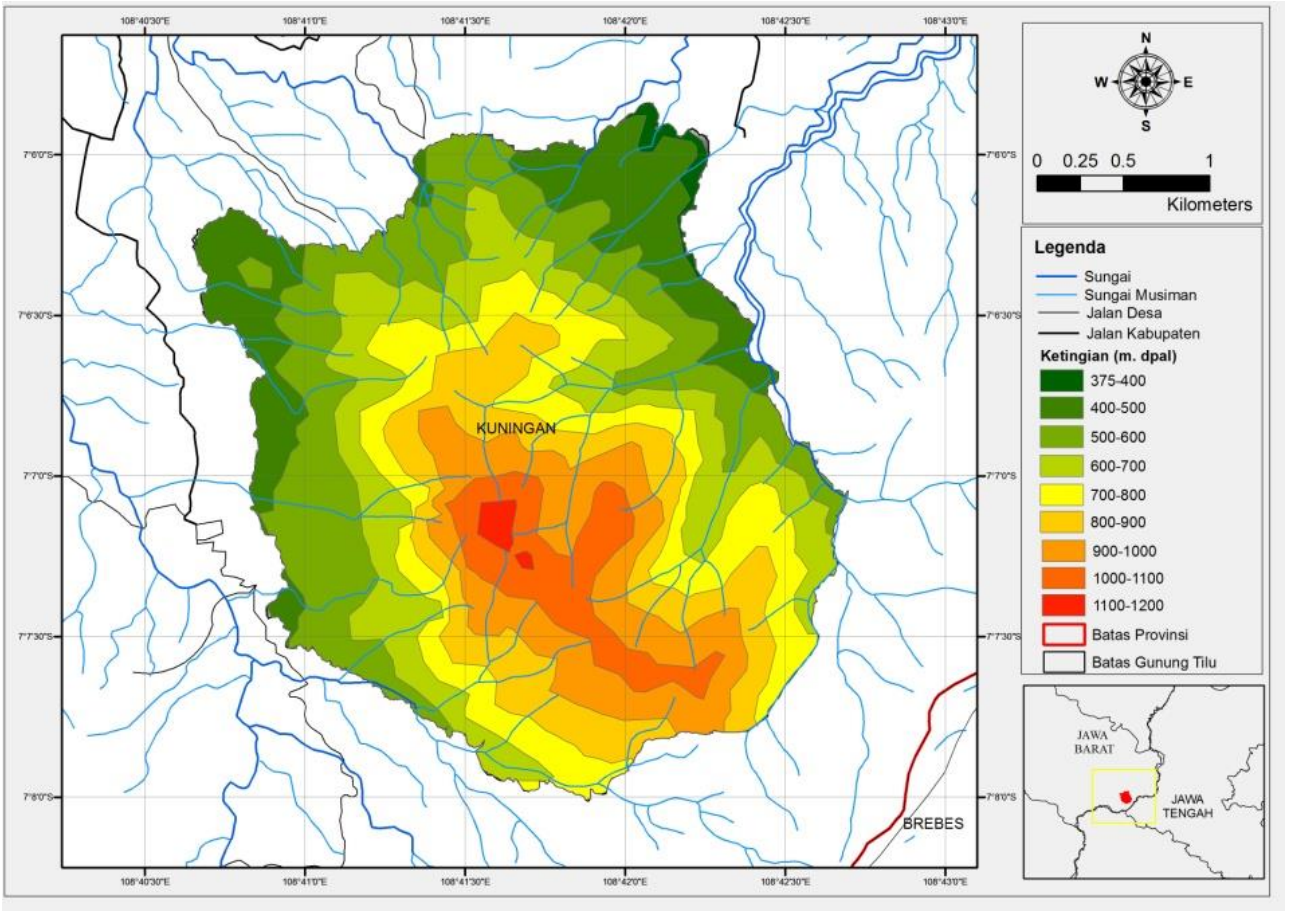


Figure1. Research Site

3. Results And Discussion

3.1. Diversity of *Ficus* spp

Based on observations on 48 sample plots, for the tree level obtained as many as 149 species of plants belonging to 42 families. The most common types are Euphorbiaceae and Moraceae family, 13 and 12 species each, 158 species of pole, 137 species of stake and 141 species of seedlings. These data show varying degrees of species diversity due to differences in the character of each plant species.

Seedling Level

Calculations indicate that the type with the highest Importance Index (IVI) for seedling level at 600 mdpl is Tundun (*Harpalia cupanoides* Roxb.) Which is equal to 12,01%, for height 700 mdpl is Ki Teja type (*Cinnamomum sintoc*) that is equal to 9,63%, for height 800 mdpl is Sawuheun *(Polyalthia lateriflora* King.) Which is equal to 6,77%, for height 900 mdpl is Tapen (*Mallotus rufidulus* (Miq.) Muell. Arg.) Is 17.31%, and for height 1000 mdpl is Gintung (*Bischofia javanica* Blume) which is 15.33%.

Sapling Level

Calculations show that the type that has the highest Importance Value Index (IVI) for the level of stake at an altitude of 600 mdpl is the type of Tundun (*Harpalia cupanoides* Roxb.) Of 8.85%, for 700 mdpl altitude is Ki Seueur (*Antidesma montanum* Blume) 6.83% for height of 800 mdpl is Tundun (*Harpalia cupanoides* Roxb.) which is 11.69%, for height 900 mdpl is Tundun *(Harpalia cupanoides* Roxb.) which is 12.56%, and for height 1000 mdpl is Comrang (*Pittosporum ferrugineum* Ait.) that is equal to 4.93%.

Pole Level

The calculation shows that the type that has the highest Importance Index (IVI) for the pole level at 600 mdpl is the Heucip (*Baccaurea javanica* (BI.) Muell, Arg.) Which is 7.13%, for 700 mdpl is Ki Lutung *(Diospyros truncata* Zoll, Et. Mor.) Is 7,28%, for height 800 mdpl is Ceurih (*Garcinia dioica* Blume.) That is equal to 15,49%, for height 900 mdpl is type Huru Nangka (*Litsea glutinosa* CB Rob) which is

11,63%, and for height 1000 mdpl is Comrang (*Pittosporum ferrugineum* Ait.) that is equal to 6,01%.

Tree Level

The calculation shows that the type that has the highest Importance Value Index (IVI) for the tree level at 600 mdpl is Caringin *(Ficus benjamina* L.) which is 8,50%, for 700 mdpl is Hantap (*Sterculia oblongata* R. Br.) that is equal to 15,26%, for height 800 mdpl is Bunut type (*Ficus glabella* BL) that is equal to 11,03%, for height 900 mdpl is Tundun (*Harpalia cupanoides* Roxb.) that is equal to 12,75%, and for height 1000 mdpl is the type of Hantap (*Sterculia oblongata* R. Br.) That is 11.86%.

From the calculation of vegetation analysis above it can be concluded according to IVI known, that the protection area of *Gunung Tilu* is still good on density, frequency, and vegetation dominance, it can bee seen from the number of individuals and diversity of species in each plot found in certain level. These data show the composition and structure of plants whose value varies in each species because of the differences in character in each species. The Importance Value Index is one of the parameters that can give an idea of the role of the type concerned in the community or at the research location.

Based on vegetation analysis done in secondary forest area of *Gunung Tilu* Jabranti Village with 864 Ha of observation area and sample plot of 105 plot, found 11 species there are Beunying (*Ficus fistulosa*), Bunut (*Ficus glabella* BL.), Calodas (*Ficus Callophylla* Blume.), Caringin (*Ficus benjamina* L), Ki Darangdang *(Ficus cusvidata*), Ki Hampelas (*Ficus emery* Burm.F.), Kiara Beas *(Ficus Sundaica* Blume), Kiara Karasak *(Ficus kurzii* king.), Kondang (*Ficus variagata* Bl.), Leles (*Ficus glandulifera* (wall.Exmiq) King), Renghas *(Ficus alba*)

Seedling Level

The calculation shows that the type with the highest Important Value Index (IVI) for seedling level at 600 mdpl is Ki Darangdang (*Ficus cusvidata*) of 1.46%, for 700 mdpl is Leles (*Ficus glandulifera* (Wal Ex , Miq.) King.) Ie 3.41%, for the height of 800 mdpl is the type of Beunying (*Ficus fistulosa.)* That is 3.87%, for the height of 900 mdpl is Renghas *(Ficus alba*), which is 3.47% , and for height 1000 mdpl is type Renghas (*Ficus alba*) that is equal to 4,69%. The data shows the composition and structure of plants whose value varies on each species.

Sapling Level

The calculation shows that the type with the highest Important Value (IVI) for sapling level at 600 mdpl is Renghas *(Ficus alba*) which is 2.39%, for 700 mdpl is Beunying (*Ficus fistulosa*) which is 2.86% %, for height of 800 mdpl is Kondang (*variegata Blume*.) that is equal to 2,25%, for height 900 mdpl is type Renghas (*Ficus alba)* that is equal to 4,23%, and for height 1000 mdpl is Caringin type (*Ficus benjamina* L.) that is equal to 3.07%. The data shows the composition and structure of plants whose value varies on each species

Pole Level

Calculations show that the type of ficus spp. which has the highest Importance Value (IVI) for pole level at 600 mdpl altitude is Renghas *(Ficus alba*) of 2.83%, for 700 mdpl is Leles *(Ficus glandulifera* (Wal. Ex Miq.) King.) of 4.06%, for the height of 800 mdpl is Bunut (*Ficus glabella* BL.) which is 3.24%, for height of 900 mdpl is the type of Kondang *(Ficus variagata* Bl.) that is equal to 2.74%, and for height 1000 mdpl is Kondang (*Ficus variagata* Bl.) that is equal to 3,30%.

Tree Level

Calculations show that the type of f*icus* spp. which has the highest Importance Value (IVI) for tree level at 600 mdpl height is Caringin type (*Ficus benjamina* L) which is 8,50%, for height of 700 mdpl is Calodas (*Ficus Callophylla* Blume.) which is 11,40%, for height of 800 mdpl is Bunut (*Ficus glabella* BL.) that is equal to 11,03%, for height 900 mdpl is Kondang (*Ficus variagata* Bl.) that is equal to 2,70%, and for height 1000 mdpl is Caringin type (*Ficus benjamina* L) that is equal to 5,60%

Species diversity is characteristic of the community level based on its biological organization and can be used to express community structure (Indriyanto, 2006). Species diversity can also be used to measure community stability, ie the ability of a community to keep itself stable despite disruption to its components (Sugianto, 1994). The results of field research for the level of species diversity and data analysis Shannon diversity index (H ') can be seen in Table as follows.

Table 1. Shanon Diversity Index (H')

No	Species	Quantity	Diversity Index (H')
1	*Ficus sundaica* Blume	24	0,336
2	*Ficus virens* Aiton var. *glabella*	21	0,321
3	*Ficus drupacea* Thunb	16	0,285
4	*Ficus kurzi*i King	9	0,209
5	*Ficus benjamina* L.	9	0,209
6	*Ficus globosa* Blume	7	0,179
7	*Ficus sinuata* Thunb	5	0,144
8	*Ficus variegata* Blume	5	0,144
9	*Ficus glandulifera* (Wal. Ex. Miq.) King	4	0,124
10	*Ficus copiosa* Steud.	4	0,124
11	*Ficus elastica* Roxb. ex Hornem	1	0,044
12	*Ficus ampelas* Burm F.	1	0,044
Amount		**106**	**2,163**

Based on data analysis using Shannon-Winner diversity index, it can be seen that the diversity value of Ficus spp is a type of *Ficus sundaica* Blume of H' = 0.336 *Ficus virens* Aiton var. globella of H' = 0.321 *Ficus drupacea* Thunb of H' = 0.285 *Ficus kurzii* King of H'= 0.209 *Ficus benjamina* L. for H' = 0.209 *Ficus globose* Blume H'= 0.179 *Ficus sinuata* Thunb H' = 0.144 *Ficus variegata* Blume of H '= 0.144 *Ficus glandulifera* (Wal. Ex. Miq.) King of H' = 0.124 *Ficus copiosa* Steud. of H '= 0.124 *Ficus elastica* Roxb. ex Hornem of H'= 0.044 and *Ficus emery* Burm F. equal to H' = 0.44 so the total amount of H'= 2,163 where it can show that the level of diversity of *Ficus* spp in the area of *Gunung Tilu* is included to the moderate criteria.

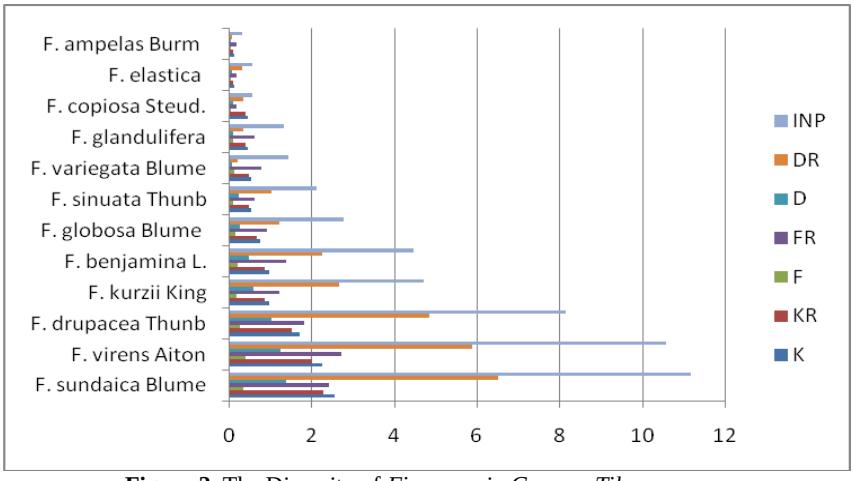
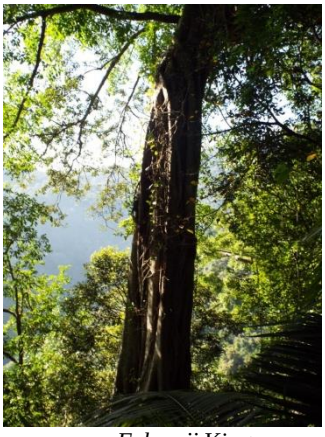


Figure 2. The Diversity of *Ficus* spp in *Gunung Tilu*

F. ampelas Burm F



F. kurzii King

F. variegata Blume

F. *sundaica* Blume

F. *glandulifera* King

F. *copiasa* Steud

Figure 3. Kinds of *Ficus* spp

3.2. Biomass and Carbon Stocks

The stored carbon value is determined by the measurement of tree biomass. The stored carbon is 50% of the measured Tree's Biomass. The tree biomass (in dry weight) was calculated using the allometric equation based on the measurement of the stem diameter at breast height (dbh). Measurements and calculations of biomass and stored carbon are based on each altitude. At an altitude of 500 m asl the amount of biomass in the *Ficus* genus is 51.69 ton / ha while the amount of carbon stored at this height is 25.85 ton / Ha. The magnitude of biomass and carbon value is stored at 600 m asl, respectively 143,46 ton / Ha and 71,73 ton / Ha. Furthermore, the biomass value at an altitude of 700 m asl is 133.10 tons / ha and the carbon value is stored at 66.55 tons / ha. The highest biomass and carbon stored values are at an altitude of 800 m above sea level of 147.95 tons / ha and stored carbon values of 73.97 tons / ha. At an altitude of 900 m asl the value of biomass of 109.30 tons / ha and the carbon value stored at 54.65 tons / Ha. The biomass and carbon values are stored at an altitude of 1000 m above sea level compared to the others at 12.15 ton / ha and the stored carbon value of 6.08 ton / Ha.

Based on the type of Biomass and the largest stored carbon in the type of *Ficus sundaica* Blume that is with the value of 154.31 tons / Ha and 77.16 tons C / Ha. While the the smallest value of biomass and carbon stored is in the type of *Ficus emery* that is equal to 0.78 tons / Ha and 0.39 tons C / Ha.

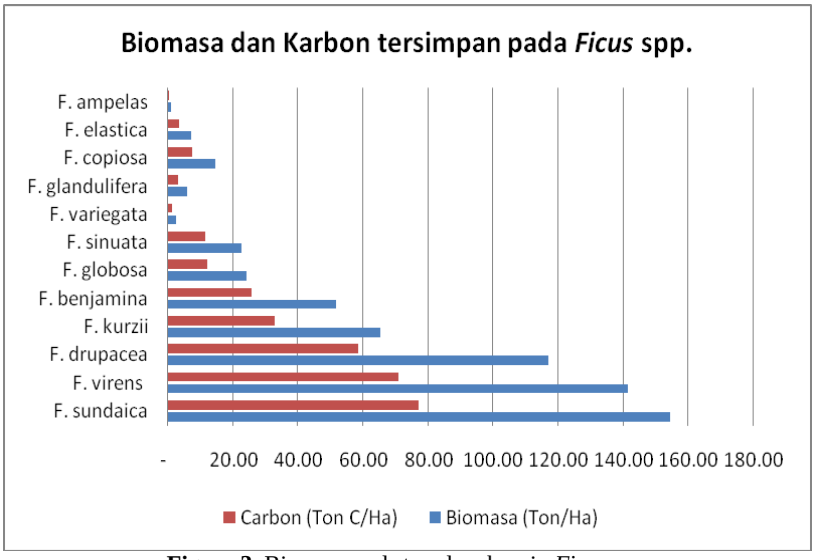


Figure 3. Biomass and stored carbon in *Ficus* spp

4. Conclusion

There are 12 types of *Ficus* spp scattered at various altitudes with the highest IV(*Important Value*) in sequence are *Ficus sundaica* Blume, *F. virens* Aiton var. glabella, *F. drupacea* Thunb, *F. kurzii* King, *F. benjamina* Linn, *F. globosa* Blume, *F. sinuata* Thunb, *F. variegata* Blume, *F. glandulifera* (Wal. Ex. Mix.) King, *F. copiosa* Steud, *F. Elastica* Roxb. ex Hornem and *F. emery* Burm F. with medium diversity values (2,163). The tree biomass and carbon stock of *Ficus* Genus in the study sites were 606,75 ton ha^{-1} and 303,38 ton C ha^{-1}.

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