

# Roles of Rubber Agroforestry to Support the Sustainability of Protection Forest through Community Forestry Program in Lampung Province, Indonesia

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**Abstract.** Community Forest (CF) in Way Kanan (WK) District aims to improve the welfare of the community around the forest while maintaining the preservation of forest functions. Specifically, the majority of plants in this protected forest are rubber which is main commodity of the WK so that the sustainability of this plant is important. The research carried out at CF area of Jaya Lestari, Mangga Mulyo, and Panca Tunggal, aims to analyze of social economic and ecological variables of CF in managing agroforestry rubber towards to protection forest sustainability. The analysis of the research results uses the quantitative methods and the multiple linear regression analysis as well as carbon analysis through biomass calculations. The results show that the 3 CF groups has a significant effect on the income level. In addition, the variable of the number of plant types, the CF area and private forest area, also cattle ownership are also significantly different. As for the ecological aspect, it is known that there are 5 variables that are significantly different, namely altitude, temperature, humidity, trees diameter, and canopy. The results of the carbon store analysis show that the mean carbon store is 96.45 ton/Ha.

**Key words:** rubber agroforestry, community forestry, socio economic variables, ecological variables, sustainable community forestry

## 1 Introduction

Forest resources that can be utilized optimally, fairly and sustainably in order to improve community welfare, while preserving the functions of the forests is the goal of the CF establishment [1]. In general, forests in Indonesia are agroforestry forests [2]. Land management by applying an agroforestry system is highly recommended to increase income and preserve land biodiversity [3]. In addition, the agroforestry system implemented in the CF working area is expected to be able to restore forest functions while contributing significantly to increasing farmers' income and welfare [4].

Way Kanan Regency is one of the districts in Lampung that has CF groups, located in the Bukit Punggur (BP) area FMU with rubber as the main commodity. This condition, a community forest with the majority of rubber in a protected forest, is rare and this is the specification for CF in Way Kanan. Rubber is an important commodity in Way Kanan, it is proven that rubber planted at 80% forest area in Way Kanan [5]. The diversity of products from rubber agroforestry can be a regional income [6], as well as producing superior rubber-based products with export values [7]. Apart from being the main source of natural rubber (latex) and a source of foreign exchange [8], the latex from rubber plants is the main income for farmers in the CF.

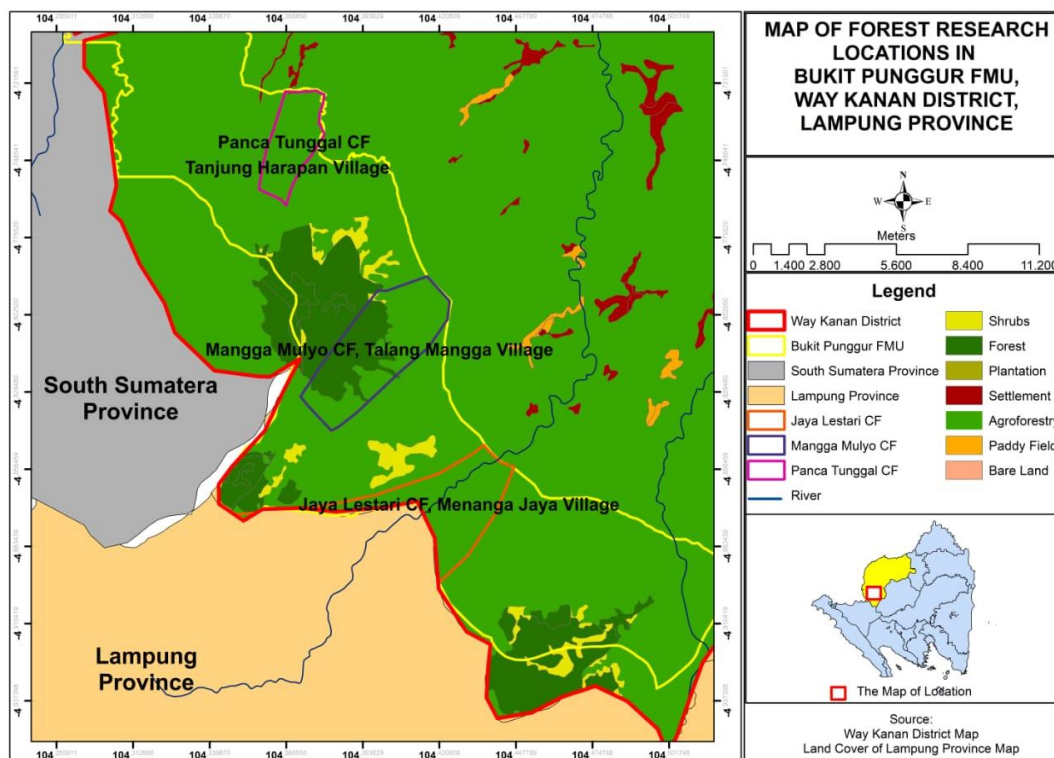
The amount of income is influenced by socio-economic factors of farmers [9] [10]. On the other hand, the production of rubber latex is also influenced by ecological conditions, namely slope, altitude, temperature, humidity, trees height, trees diameter, and crown wide. Another ecological variable analyzed is carbon produced by rubber CF as data support for the regional government of WK when implementing the Climate Change Adaptation and Mitigation program, which is the mainstreaming program of all

provinces in Indonesia. Socio-economic and ecological analyzes simultaneously carried out in a research on a protected forest with the majority of rubber and managed under the CF scheme was the first time to be done. Based on this, the research objectives are Analysis of Social Economic and Ecological Variables of Community Forestry in Managing Agroforestry Rubber towards to Protection Forest Sustainability.

## 2 Materials and methods

### 2.1. Study site

This research was conducted in September - November 2018 in forest areas managed by Mangga Mulyo CF, Panca Tunggal CF and Jaya Lestari CF. Those forest area located in Way Kanan District, Lampung Province. The tools and materials used were questionnaire sheets, cameras and Minitab 16 software for data processing and the objects as well as subjects of the study were farmers who were members of the 3 groups.



Picture 1. Mapp of research location

### 2.2. Number of samples

Data collection was carried out through field observations, interviews and literature study. The method of determining the sample was the purposive sampling method. This study used a sample of 75 respondents (25 respondents /CF group). The determination of the number of respondents was based on the Gauss Markov theorem which states that if the sample used is more than 25 people (from each group), then the data results can be stated to be normal and valid [11][12]. Thus the number of respondents was 75 people, or respondents in each group were 25 people. The determination of the sample applied the purposive sampling method. The data analysis used was the multiple linear regression analysis using Minitab version 16 software with a 90% confidence interval, meaning that the error can be tolerated by 10% [13].

### 2.3. Analysis of socio economic variables

The dependent variable (Y) in this study was the farmer's income obtained from managing the land. The independent variables (X) used 23 factors or predictor variables. This study applied multiple linear regression methods to minimize the number of squared errors, namely the development of the Ordinary Least Square (OLS) model and obtain the model (Y) as a function of the performance of the CF groups and socio-economic variables. The pattern of relationship between variables to be analyzed was based on sample data obtained

through questionnaires [13]. The regression model used for socio economic variables is the following equation .:

$$\begin{aligned}
 [Y]_i = & \alpha_0 + \alpha_1 [D1\_MGM]_i + \alpha_2 [D1\_PCT]_i + \alpha_3 [Ag]_i + \alpha_4 [Sex]_i + \alpha_5 [S\_CF]_i + \alpha_6 [S\_Vil]_i + \alpha_7 [Dep]_i + \\
 & \alpha_8 [D2\_Jun]_i \\
 & + \alpha_9 [D2\_Sen]_i + \alpha_{10} [D3\_SMD]_i + \alpha_{11} [D3\_OGAN]_i + \alpha_{12} [D\_CF]_i + \alpha_{13} [D\_VO]_i + \alpha_{14} [D\_SubDis]_i \\
 & + \alpha_{15} [N\_PSpec]_i + \alpha_{16} [Ar\_CF]_i + \alpha_{17} [Ar\_PriFor]_i + \alpha_{18} [H\_Chick]_i + \alpha_{19} [H\_Goat]_i + \alpha_{20} [H\_Cattle]_i + \\
 & \alpha_{21} [Vehicle]_i + \alpha_{22} [HP]_i + \alpha_{23} [TV]_i + \epsilon_i.
 \end{aligned}$$

Where:

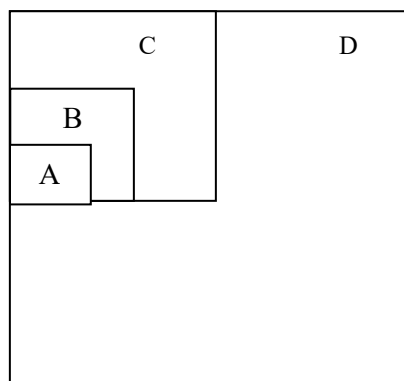
- $Y_i$  : income per HH to -i
- $\alpha_0$  : Constant model
- $\alpha_1 - \alpha_{23}$  : contribution value for each variable X,
- $Y \epsilon_i$  : error model for income increasing perform

## 2.4. Analysis of ecological variables

The important value index (IVI) and tree biomass parameter those were tree species, tree height, and tree diameter were measured. Tree height was measured by Suunto clinometer. Tree diameter was measured with a diameter-tape measure at 1.3 m above the soil surface.

### 2.4.1. Analysis of Important Value Index

The vegetation analysis can be calculated based on plots that according to [38] and the Important Vegetation Index (IVI) formula based on the Ministry of Environment Decree No. 201 year 2004 as follows:



Picture 2. Plots for IVI

Where :

- A is a plot measuring 2 m x 2 m, used for sampling of seedling, litter and understorey
- B is a plot measuring 5 m x 5 m, used for sampling of sapling with diameter of <10 cm
- C is a plot measuring 10 m x 10 m, used for sampling of poles with diameter of 10-20 cm
- D is a plot measuring 20 m x 20 m, used for sampling of trees with diameter >20 cm

$$K = \frac{\text{Individual number of a species}}{\text{Area of all sample plots}}$$

$$KR = \frac{\text{Density of a species}}{\text{Density of all species}} \times 100\%$$

$$F = \frac{\text{Number of plots a species found}}{\text{Number of all plots}}$$

$$FR = \frac{\text{Frequency of a species}}{\text{Frequency of all species}} \times 100\%$$

$$D = \frac{\text{Basal area of a species}}{\text{Area of all sample plots}}$$

$$DR = \frac{\text{Dominancy of a species}}{\text{Dominancy of all species}} \times 100\%$$

The formula to calculate the species' Important Value Index (IVI) is:  $IVI = RD + RF + RD$   
 Remarks: D = Density, RD = Relative Density, F = Frequency, RF = Relative Frequency, D= Domina ncy, RD = Relative Dominancy

#### 2.4.2. External and internal rubber trees

Multiple linear analysis is used to analyze ecological variables, namely external and internal factors for rubber trees. The external factors are altitude, slope direction, temperature, and humidity, while internal factors are tree diameter, tree height and canopy width that affect rubber production in the 3 CF areas. Furthermore, to determine the interaction effect of altitude, slope direction, temperature, and humidity, the multiple linear regression analysis is performed in a mathematical equation, as follows :

$$Y = a + b_1X_{1a} + b_2X_{1b} + b_3X_{1c} + b_4X_{1d} + b_5X_{2a} + b_6X_{2b} + b_7X_{2c} + E$$

Where :

Y : dependent variables (latex rubber product)

a: intercept in Y line

b: coefisient of regression linier

X : independent variables

X1 : External Factors

X1a = slope

X1b = altitude

X1c= temperature

X1d= humidity

X2 : Internal factors

X2a = tree height

X2b = tree diameter

X2c = canopy

#### 2.4.3. Carbon store

According to [14], the determination of the number of measuring plots obtained is based on the following equation which is use Intensity Sampling (IS) of 0.05% :

$$\text{Total number sample plots} = \frac{\text{total area of sample plots}}{\text{area of each sample plot}}$$

$$= \frac{IS \times N = 0,0005 \times 12.950.000 \text{ m}^2 = 6.475 \text{ m}^2}{20 \text{ m} \times 20 \text{ m} = 400 \text{ m}^2} = 16,2 \sim 16 \text{ plots}$$

Tree biomass data is collected using a non-destructive method (not cutting trees) and used plots as mentioned in Picture 2. According to [37], understorey and litter biomass sampling was determined i.e. used 300 grams sample if the wet weight is more than 300 grams. Used 100 grams sample if the wet weight obtained is less than 300 grams. When the wet weight obtained is less than 100 grams, the used sample is as much as that obtained. Biomass measurement by measuring the diameter at breast height and tree height then was analyzed using the general allometric equation proposed by [37], which is

$$V = 0,11 \times \rho \times D^{2,62}$$

Where:

V = biomass (kg)  $\rho$  = wood density (grams/cm<sup>3</sup>)  
 D = diameter at breast height (cm)

For the existing allometric equations to estimate tree biomass shown in Table 1.

**Table 1.** Allometric equations used in research

No	Trees	Allometric Equation	Resource
1	Mahagony	$DV = 0.902 (D^2 H)^{0.08}$	Arupa team, 2014
2	Acassia	$DV = 0.077 (D^2 H)^{0.90}$	Arupa team, 2014
3	Branched tree	$DV = 0.11 \rho (D)^{2.62}$	Ketterings, 2001
4	Unbranched tree	$DV = \pi \rho D^2 H / 40$	Hairiah et al, 2001
5	Coffee	$DV = 0.281 (D)^{2.06}$	Nugroho, 2014
6	Ruber	$DV = 3.42 D^{1.15}$	Saragih dkk, 2016

Where:

DV = Dry volume of biomass

D = Diameter

H = Height

Wet and dry weights of litter and understorey can be used to estimate the aboveground and total biomass using the Biomass Expansion Factor formula [15]. Carbon stored in forest vegetation can be estimated using the biomass value obtained from the allometric equation, or the [16], which shows that the percentage of carbon content is 47%, so that the calculation of stored carbon can be converted into carbon (tonnes / ha). The calculation of carbon store can be done through a conversion factor of 0.47.

### 3 Results and discussions

#### 3.1. Analysis results of socio economic variables

The results of the suitability test show that the X variables have a significant effect on income by using the F test which can be seen in Table 2.

**Table 2.** Optimization result of independent variables using F test

Source	DF	SS	MS	F	P
Regression	29	10188,33	351,32	6,03	0,000
Residual Error	45	2620,96	58,24		
Total	74	12809,29			

Source: Primary Data primer, 2018

The results of the multiple linear regression analysis of the overall parameter optimization seen in Table 2 are 12,809.29 using the Simultaneous Test or Test F 6.03 with a P-value in the Analysis of Variance of 0.000 from a rounding of 0.0004. The resulting P-Value shows a value of <0.1, which means that overall, all of the X variables have a significant effect on variable Y (income) significantly.

The existence of a real effect from the test results shows that the welfare of the CF farmer community in WK can be improved by the government through the social and economic variables used in this study. The relationship between the independent variables X and the dependent variable Y (income) in linear regression produces the following equation.

$$[Y]_i = 23,8 - 15,3 [D1\_MGM] - 15,1 [D1\_PCT] - 0,148 [Ag] + 3,87 [Sex] + 2,04 [S\_CF] - 1,52 [S\_Vil] - 2,14 [Dep] + 0,61 [D2\_Jun] - 0,92 [D2\_Sen] - 4,42 [D3\_SMD] + 7,2 [D3\_OGAN] -$$

$$0,33 [D\_CF] + 0,67 [D\_VO] - 1,06 [D\_SubDis] + 5,58 [N\_PSpec] + 6,78 [Ar\_CF] + 4,30 [Ar\_PriFor] - 0,295 [H\_Chick] + 0,865 [H\_Goat] + 28,5 [H\_Cattle] - 3,21 [Vehicle] + 3,78 [HP] + 5,12 [TV].$$

Socio-economic variables can affect the respondent's income both positively and negatively. The test results of each model parameter (T test) are presented in Table 3.

**Table 3.** Analysis results of socio economic variables using T test

No	Predictor	Symbol	Coef	SE Coef	T	P
1.	Constant	-	23,84	24,55	0,97	0,337
<b>Management (0=Jaya Lestari CF)</b>						
2.	Mangga Mulyo CF	[D1_MGM]	-15,308	8,347	-1,83	0,073*
3.	Panca Tunggal CF	[D1_PCT]	-15,137	6,790	-2,23	0,031*
<b>Socio-economic Variables</b>						
4.	Age	[Ag]	-0,1477	0,1039	-1,42	0,162
5.	Sex of HH Head	[Sex]	3,875	6,615	0,59	0,561
6.	Status in CF	[S_CF]	2,038	2,854	0,71	0,479
7.	Status in Village	[S_Vil]	-1,521	4,537	-0,34	0,739
8.	Number of dependents	[Dep]	-2,137	1,866	-1,15	0,258
9.	Dummy HH of Junior High School	[D2_Jun]	0,608	3,188	0,19	0,849
10.	Dummy HH of Senior High School (0 = Elementary School)	[D2_Sen]	-0,921	4,047	-0,23	0,821
11.	Dummy Semendo ethnic	[D3_SMD]	-4,422	9,801	-0,45	0,654
12.	Dummy Ogan ethnic (0 = Javanese Ethnic)	[D3_OGAN]	7,22	11,61	0,62	0,537
13.	Distance of house to CF area	[D_CF]	-0,333	1,854	-0,18	0,858
14.	Distance of house to village office "Kelurahan"	[D_VO]	0,666	1,721	0,39	0,701
15.	Distance of house to Sub District area	[D_SubDis]	-1,059	1,439	-0,74	0,466
16.	Number of plant species	[N_PSpec]	5,582	1,894	2,95	0,005*
17.	CF Area	[Ar_CF]	6,779	1,510	4,49	0,000*
18.	Private forest area	[Ar_PriFor]	4,303	1,791	2,40	0,020*
19.	Chicken husbandry	[H_Chick]	-0,2948	0,212	-1,39	0,171
20.	Goat husbandry	[H_Goat]	0,8646	0,5665	1,53	0,134
21.	Cattle husbandry	[H_Cattle]	28,48	16,72	1,70	0,095*
22.	Vehicle ownership	[Vehicle]	-3,213	2,319	-1,39	0,173
23.	Communication tool (HP)	[HP]	3,776	2,386	1,58	0,121
24.	Information tool (TV)	[TV]	5,116	6,816	0,75	0,457
<b>S = 7,63174</b>			<b>R-Sq = 79,5%</b>		<b>R-Sq (adj) = 66,4%</b>	

Where:

- (\*) = significant in level < 10%
- S = Standart Error Estimate (SEE)
- R-Sq = R Square
- R-Sq (Adj) = Adjusted R Square

### 3.1.1. CF Management

A farmer group functions as a teaching-learning platform for its members to increase knowledge, skills, and attitudes as well as the growth and development of self-reliance in farming with increased productivity, increased income, and a more prosperous life [17]. Its meant, the management unit of the three CF groups is important in organizing.

The CF management by the 3 CF groups has a significant effect on the income of the CF group members. However, this effect existence by negative coefficient. This means that the group income of the Mangga Mulyo CF group and the Panca Tunggal CF group can be lower than the Jaya Lestari CF group of IDR 15,308 million / year and IDR 15,137 million / year if the two management units do not try to improve their organizational performance. Besides, if other factors remain, the Jaya Lestari CF group management unit's total income is higher compared to the Mangga Mulyo CF and Panca Tunggal CF groups. Extension education is needed to strengthen farmers' knowledge and performance in cultivating land in a sustainable manner. As stated by [17], community assistance and training activities can increase farmers' human resource capacity. [18] research proves that there is adequate extension education and training in the Bina Wana CF group has high initiative and makes a positive impact on the progress of forest production.

### **3.1.2. Types of Plants**

The number of types of plants has a real effect and can increase farmers' income by IDR 5.582 million /person/year if each type of crop is added. The more types of crops planted in agroforestry patterns, the higher the income that will be received by farmers [19]. The number of plants grown by the respondents ranges from 2 to 3 plants, including rubber, coffee, cocoa, and cloves, of which rubber is the main crop.

### **3.1.3. CF Area**

The cultivated CF area variable with various types and areas has a real effect and gives a positive value which means that it can increase income by Rp. 6,779 million/person /year and the cultivated customary land area will give an increase of Rp. 4,303 million / person/year. The wider the land cultivated by farmers both on CF and customary lands, the more income will be provided [20] [21]. Furthermore, [22] stated that land management must be carried out intensively. [23] also said that the welfare of the community can be seen from the area of land ownership that is cultivated by farmers.

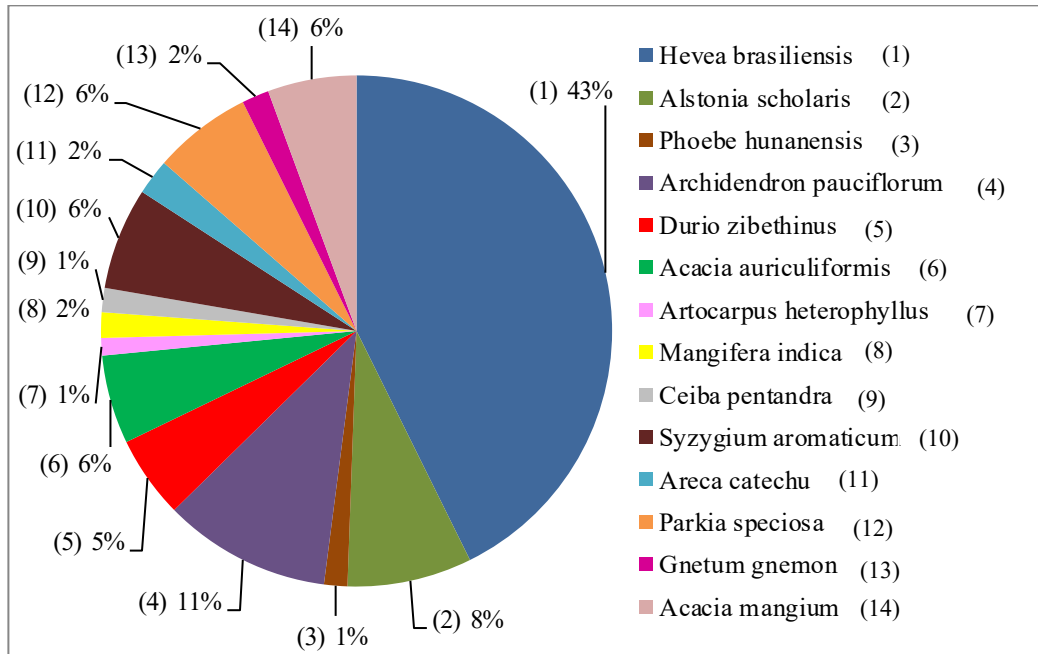
### **3.1.4. Livestock**

Not all of the variables of livestock ownership have a significant effect and not all of them provide an increase in farmers' income. Ownership of chickens and goats is not significantly different. This happens because people prefer to eat meat of cattle than chicken or goat [39] Cattles have a real effect, and can increase income by IDR 28.48 million / person / year.

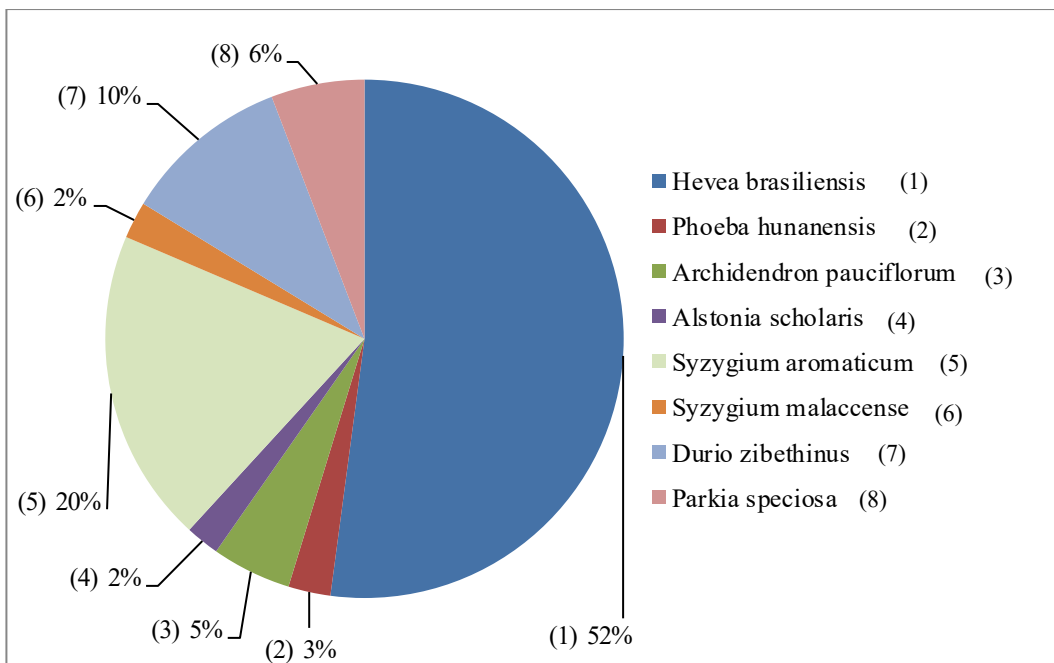
## **3.2. Ecological variables**

### **3.2.1. Results of Important Vegetation Index (IVI)**

IVI actually is calculated to determine importance of plant species. This IVI has role in the community and also as the important values on tree and vegetation seedling levels. Following analysis results of IVI as shown in Picture 3 up to Picture 6.

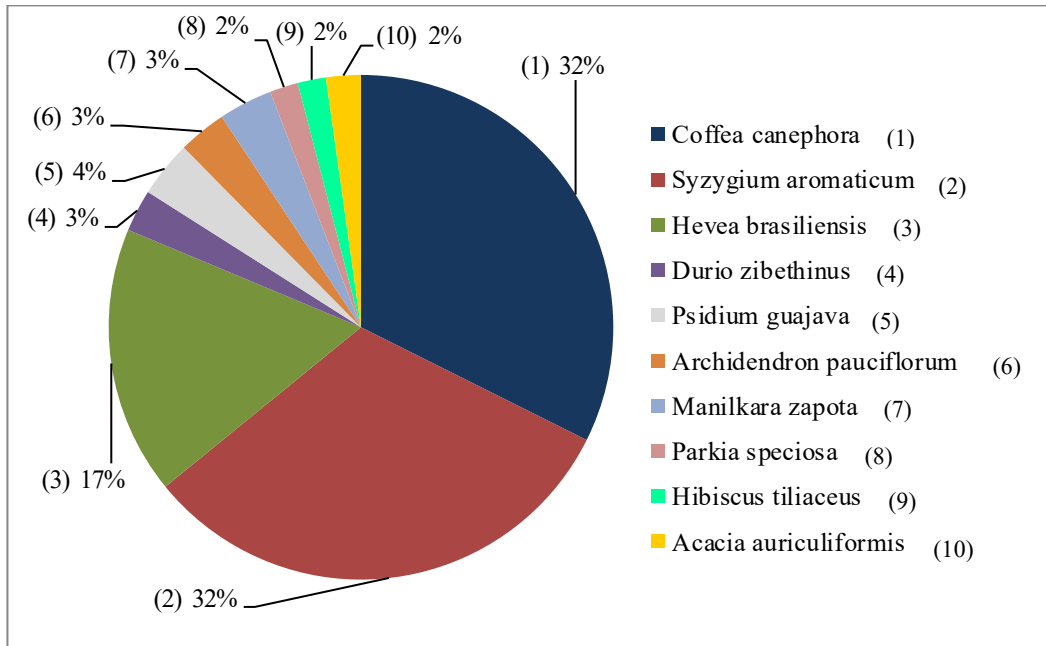


Picture 3. The IVI of trees phase

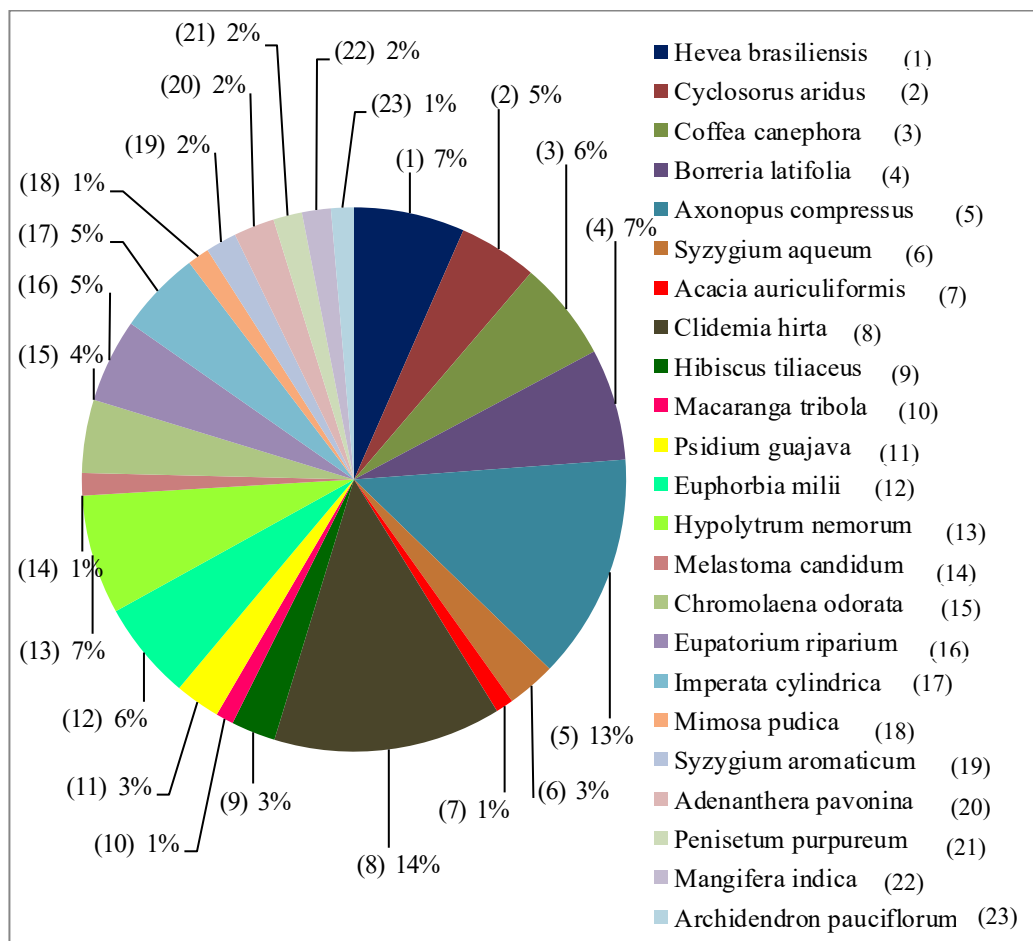


Picture 4. The IVI of poles phase





Picture 5. The IVI of sapling phase



Picture 6. The IVI of seedling and understory phases

### 3.2.2. External and internal rubber trees

To find out the significance between X and Y variables in the joint test, the multiple linear regression analysis is carried out with the F and T tests with a real level of  $\alpha = 0.05\%$  which can be seen in Table 4. From that table, the results of the optimization of the parameters can be seen in the F test of 8.24 with *P-value* in the *Analysis of Variance* of 0.000 from a rounding of 0.0004. The resulting *P-Value* shows a value of  $<0.1$ , which means that overall, all of the X variables have a significant effect on variable Y (income).

**Table 4.** Analysis result of all variables using F test

Source	DF	SS	MS	F	P
Regression	7	3,55474E+13	5,07819E+12	8,24	0,000
Residual error	67	4,12812E+13	6,16137E+11		
Total	74	7,68286E+13			

Source: Primary data, 2018

From the results of the multiple linear regression analysis above, the factors that influence the production of rubber latex can be seen in Table 5 which has been tested using the T test.

**Table 5.** Analysis results of external and internal variables of rubber trees using T test

Predictor	Symbol	coef	SE Coef	T	P
<b>constant</b>		<b>-2067592</b>	<b>2946233</b>	<b>-0,70</b>	<b>0,485</b>
Slope	SL	487,4	903,0	0,54	0,591
Altitude	AL	-1348,2	673,2	-2,00	0,049 *
Temperature	Temp	186404	84104	2,22	0,030*
Humidity	Hum	55498	27809	2,00	0,050*
Tree height	TH	-38100	49703	-0,77	0,446
Tree diameter	TD	-60798	25539	-2,38	0,020*
Canopy	Can	-162501	33270	-4,88	0,000*
S = 7,84944		R-Sq = 46,3%	R-Sq(adj) = 40,7%		

Source: Primary data, 2018.

Where:

- (\*) = significant in level  $< 10\%$
- S = *Standart Error Estimate (SEE)*
- R-Sq = *R Square*
- R-Sq (Adj) = *Adjusted R Square*

The latex production equation based on variables can be written as follows:

$$Y = - 2067592 + 487 (SL) - 1348 (AL) + 186404 (Temp) + 55498 (Hum) + 38100 (TH) - 60798 (TD) - 162501 (Can)$$

The above equation shows the positive and negative effects of each variable on the production of rubber latex. The positive effect shows that the production of rubber latex can increase, while the negative effect is that this variable can reduce the amount of rubber latex production due to certain factors. The test of the X variables together shows a significant effect on the production of rubber latex.

### 3.2.2.1. Altitude

The results of the analysis of the altitude factor shows that altitude has a significant effect on the production of rubber latex. The regression analysis model formed shows that, from the *P-Value*, the significant value of the altitude is 0.049 greater, which means that the altitude has a significant effect on rubber latex production and the significant level is  $\alpha = 0.05$ . The coefficient value for altitude has a negative sign with a value of 1348.2 and this means that if other variables are constant and the altitude increases by 100 meters above sea level, the amount of rubber latex production will decrease by 1348.2 grams per tree. The average rubber production is higher at an altitude of 525 m asl, this is because rubber plants can grow optimally at an altitude of 600> height> 200 m asl [24]. It is known that the production of the Mangga Mulyo CF, where the altitude reaches up to 1200 m asl, is not optimal [25].

### 3.2.2.2. Temperature

The results show that the temperature factor influences the rubber latex productivity process seen at the *P-Value* of 0.030 which is greater than 0.05. It means that the temperature factor has a significant effect on rubber latex production and the significant level is  $\alpha = 0.05$ . The temperature coefficient value is 186404, this means that if other variables are constant and the temperature increases by 1 ° C, the amount of rubber latex production will increase by 186.404 gr/ tree. The results of the multiple linear regression analysis on the temperature factor can be seen in Table 3. This statement is in accordance with [26], the temperature required for rubber plant growth and yield formation, that is in rubber growth, is 28 ° C. According to [27] the daily temperature preferred by rubber plants is an average of 25 -30 ° C.

### 3.2.2.3. Humidity

The results of the multiple linear regression analysis on the humidity factor can be seen in Table 3. The results obtained and processed using the multiple linear regression analysis show that the *P-Value* is 0.050 which is greater than 0.05, which means that the humidity factor has a significant effect on the production of rubber latex at a real level of  $\alpha = 0.05$ . The humidity coefficient value is 55498, this means that if other variables are constant and humidity increases, the amount of rubber latex production is 554.98 grams/tree [28] [29] stated that climate including humidity is an important limiting factor in rubber production.

### 3.2.2.4. Tree Diameter

From the data obtained, the tree diameter has an effect on the production of rubber latex, as shown in Table 3. It can be seen that the *P-value* is 0.020, which is greater than the significant value of 0.005. It means that the tree diameter has a significant effect on rubber latex production and the significant level = 0.05. The coefficient value of tree diameter has a negative sign with a value of 60798, this means that if other variables are constant and the tree diameter increases by 10 cm, the amount of rubber latex production will decrease by 6.0798 grams. [30][31] stated that tree diameter is an important factor to determine the overall volume of latex production. Bark thickness is also generally used for prediction of wood volume and correction of actual tree diameter [32]. For gummy trees such as rubber, the thickness of the tree barks also affects the production of latex [33].

### 3.2.2.5. Canopy width

The results of the analysis show that the width of tree canopy has an effect on the production of rubber latex, this can be seen in Table 3. The *P-Value* of 0.000 is greater than 0.05, so it has a significant effect on the production of rubber latex. Thus, the width of the canopy has a significant effect on the production of rubber latex and the real level is  $\alpha = 0.05$ . The coefficient value of the canopy width has a negative sign with a value of 162501, this means that if other variables are constant and the canopy width increases by 10 m, the amount of rubber latex production will decrease by 16,2502 grams. [34] argued that the tree phase plants that were very far apart would form gaps that allowed sunlight to enter and hit the ground floor of the forest. It is proven that the opening of a wide canopy will make plants with lower canopy stratification get sufficient sunlight.

### 3.2.3. Carbon Store

Biomass can be defined as the total weight or volume of an organization in a given area ? [14]. [35] defines forest biomass as the total amount of living organic matter above the soil in trees and all parts of the population or community as expressed in kiln dry weight per unit area (tonnes/ha). The [16] classifies biomass into 2 types, the first type is aboveground biomass which includes all parts of trees and understorey, and the second type is belowground biomass which includes plant roots and soil organic carbon. Carbon stored in the form of biomass and necromass in vegetation can be an indicator of the success of forest management. Carbon measurement in the 3 CF groups is carried out in sixteen sample plots (Table 6).

The stored carbon analysis data obtained in forests managed in an agroforestry manner by the 3 CF groups are 1543.16 in total and 96.45 tonnes per ha. The stored carbon data per ha is much smaller than the minimum limit agreed by the [36] stating that the good category on land is that which has a carbon store of 138 tonnes /ha. Thus, it can be said that the carbon stored in each hectare in the study location is classified as poor. This means that there needs to be an effort to enrich the types of plants at that location so that the carbon store increases [31] [29].

**Table 6.** Biomass store total and biomass store per hectare at research location (ton/ha)

Plot No	Trees Biomass	Poles Biomass	Sapling Biomass	Under-trees		Biomass Total	Carbon Store
				plant Biomass	Litter Biomass		
1	8.37	49.05	107.76	0.03	0.23	165.44	77.75
2	69.10	63.36	140.18	0.04	0.21	272.89	128.26
3	80.38	38.35	19.29	0.04	0.20	138.25	64.98
4	186.65	58.47	23.71	0.03	0.19	269.06	126.46
5	482.07	62.30	12.23	0.05	0.21	556.86	261.73
6	30.38	78.20	10.08	0.02	0.19	118.88	55.87
7	76.27	80.22	20.08	0.03	0.22	176.82	83.10
8	24.65	78.56	36.13	0.02	0.23	139.59	65.61
9	39.44	67.06	31.14	0.03	0.20	137.88	64.80
10	31.50	53.50	20.63	0.04	0.21	105.88	49.76
11	29.37	43.46	26.02	0.02	0.20	99.07	46.56
12	34.93	129.70	95.05	0.03	0.22	259.93	122.17
13	34.00	65.99	69.77	0.05	0.22	170.03	79.91
14	268.63	54.78	52.18	0.04	0.21	375.84	176.65
15	65.02	47.63	35.78	0.03	0.20	148.67	69.87
16	24.90	73.41	49.69	0.02	0.22	148.24	69.68
<b>Total (ton)</b>	1485.67	1044.04	749.72	0.53	3.36	3283.33	<b>1543.16</b>
<b>Mean</b>	92.85	65.25	46.86	0.03	0.21	112.35	<b>96.45</b>
<b>(%)</b>	45.25	31.80	22.83	0.02	0.10	100	

## 4 Conclusion

1. Simultaneously, all social economic variables of Mangga Mulyo, Panca Tunggal, and Jaya Lestari CF has significant influence to income.
2. Significant social economic variables to income: number of plant species (P=0.005), CF area (P=0.000), private forest area (P=0.020), cattle husbandry (P=0.095).

3. Significant ecological variables (rubber latex volume) to income: altitude, Temperature, Humidity, tree diameter and canopy
4. Dominance species in trees, poles and seedling phase: Rubber (*Hevea brasiliensis*), and in sapling phase is Coffee (*Coffea canephora*), and understorey dominated by Haredong (*Clidemia hirta*).
5. Mean carbon store in research location is 96.45 ton/Ha
6. Based on significant social economic and ecological variables also carbon store in research location: rubber agroforestry support the SFM of protection forest in Way Kanan District, Lampung Province

Number species (as agroforestry scheme) is significant to income of CF members for direct sell of the products, also through rubber latex volume.

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