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Biomass-based energy potential in Semujur Island, a small remote area in Indonesia

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Abstract. Electricity has not been spread equally in Indonesia, especially in remote areas. Forest biomass could potentially be utilized as bioenergy and fuel for an electricity generator, particularly in remote areas with no electricity access. The objectives of this research were to identify vegetation species composition and estimate tree biomass's potential as fuel for power plants in Semujur Island, Bangka Belitung Province, Indonesia. The method used was vegetation analysis throughout the study area. The result showed that *Terminalia catappa* dominated vegetation species at the seedling, sapling, and pole levels. At tree level was dominated by *Ficus caulocarpa* with an importance value index (IVI) of 166.81%, while non-tree species was dominated by *Cocos nucifera* (IVI of 200%) as palm species. Liana and understory that dominated the study site in order were *Imperata cylindrica* (IVI 52.50%) and *Mikania* sp. (IVI 143.59%). The total biomass on this island was 2,298.94 tons/ha, which could potentially generate electrical energy amounted to 3,371.78 MWh. This amount of energy can fulfill the electrical needs of the local community for 237 years to the future without any replanting activity. The recommended crops that can be planted on this island are vetiver and sesame to reserve biomass and prevent abrasion.

1. Introduction

The consumption of fossil energy in Indonesia is increasing in line with population growth and technological development. However, electrical energy can not fully be accessed across all areas in this country. The State Electricity Company (PLN) as the State Owned Enterprises (SOEs) explains the amount 2,500 villages that have no electricity, especially on small and remote islands. To address this problem, the Indonesian Ministry of Energy and Mineral Resources established a renewable energy iconic island program in 2010. This program aims to provide energy access for people living on small and medium islands in Indonesia. According to the Act of Indonesia Republic No. 30 in 2007, energy can be obtained from bioenergy in the form of biomass.

Biomass is all organic material in one or more living organisms in a specific habitat. Forest biomass generates heat energy, electricity, and fuel, particularly in remote areas with no electricity access. Biomass energy refers to the energy source that can be generated from organic materials such as wood waste, crops, urban trash, chaff, and animal waste. Based on the report of the Directorate General of New Renewable Energy and Energy Conservation, Indonesian Ministry of Energy and Mineral



Resources in 2017, the bioenergy utilization for new power plants is only about 1.9 GW of the total energy consumption in Indonesia. The National Energy Board (DEN) stated that Indonesia has a high potential for new and renewable energy from biomass, which is approximately 50 GW of power [1].

Forest biomass can be obtained by tree waste (branches, twigs, and leaves) for renewable energy after being converted into a solid, liquid, or gas. One of the processing techniques that can be used is the compaction technique. This technique converts biomass into wood pellets or briquettes to increase the heat value [2]. Wood pellets have a smaller form and are drier. Therefore, it is easier in the process of storage, distribution, and combustion. The objectives of this research were to identify vegetation species composition and estimate tree biomass's potential as fuel power plants in Semujur Island, Bangka Belitung Province, Indonesia.

2. Methods

2.1. Study site

This research was conducted on 15 January–30 April 2018 and is located in Semujur Island, Bangka Belitung Province, Indonesia. Soil properties were analyzed in the laboratory of the Indonesian Center for Biodiversity and Biotechnology (ICBB) Bogor and integrated Silviculture laboratory, Department of Silviculture, Faculty of Forestry and Environment, IPB University.

2.2. Tools and materials

The tools used in this study include a measuring tape, phi-band, Haga hypsometer, rope, camera, compass, ring samples of soil, plastic, knives, digital scales, oven, GPS, and a tally sheet. The objects used were vegetation and soil samples in Semujur Island, Bangka Belitung.

2.3. Research procedure

2.3.1. Plot establishment and vegetation analysis

Species composition and tree structure were assessed by conducting an inventory of the vegetation using a transect method (Figure 1). The main plot (20 x 20 m) was divided into nested subplots. The main plot was used for trees sampling, the subplot of 10 x 10 m for poles sampling, the subplot of 5 x 5 m for sapling and palm, while the subplot of 2 x 2 m for seedling and understory (Figure 1) [3].

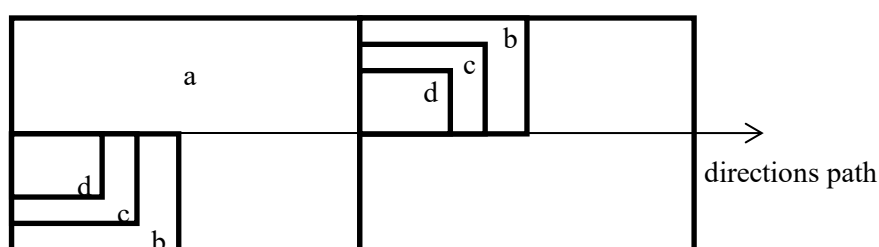


Figure 1. Design of plot samples for vegetation analysis of the tree (a), pole (b), sapling and palm (c), seedling and understory (d)

Vegetation analysis was used to determine the stand composition using an Importance Value Index (IVI), which is obtained by adding up the value of relative density (KR), relative frequency (FR), and relative dominance (DR) at the pole and tree level. For sapling, understory, palm, and liana vegetation, the IVI is obtained by adding up KR and FR. Results of IVI calculation are used to determine the species' dominance in a particular site location. [4] explained the method of calculating the IVI, as follows:

$$\text{Density (K)} = \frac{\text{Total number of individuals}}{\text{Size of plot}} \quad (1)$$

$$\text{Relative density (KR)} = \frac{\text{Number of individuals of the species}}{\text{Number of individuals of all species}} \times 100 \quad (2)$$

$$\text{Dominance (D)} = \frac{\text{Total basal area of the species}}{\text{Total size of plots}} \quad (3)$$

$$\text{Relative dominance (DR)} = \frac{\text{Total basal area of the species}}{\text{Total basal area of all species}} \times 100 \quad (4)$$

$$\text{Frequency (F)} = \frac{\text{Number of quadrats in which species occurred}}{\text{Total size of plots}} \quad (5)$$

$$\text{Relative frequency (FR)} = \frac{\text{Number of occurrence of the species}}{\text{Number of occurrence of all species}} \times 100 \quad (6)$$

2.3.2. Estimation of biomass

This island has a total area of 14.6 ha. Estimating biomass potential was conducted by census method for all trees and poles in measuring height and diameter at breast height (DBH). Tree stands biomass estimation was obtained by calculating tree volume through geometric formula [5], as follows:

$$V = 0.25\pi \times \left(\frac{\text{dbh}}{100}\right)^2 \times H \times F \quad (7)$$

Where:

V = Tree volume (m^3)

π = 3.1416

dbh = Tree diameter at breast height (m)

H = Tree height (m)

F = Correction factor

Correction factor (F) was obtained from the ratio of actual stem volume and cylinder volume at the exact size of diameter and height. If there is no correction factor for specific species, it could be used at 0.6 [6]. Tree volume estimation value was converted into tree biomass value by multiplying tree volume, wood density, and tree biomass expansion factor with the formula, as follows:

$$\text{Biomassa}_{\text{tree}} = V_{\text{tree}} \times \text{WD} \times \text{BEF}_{\text{tree}} \quad (8)$$

Where:

V_{tree} = Trees volume (m^3)

WD = Wood density (kg / m^3)

BEF_{tree} = Tree biomass expansion factor

If there is no BEF_{tree} information for certain species, it could be used BEF_{tree} according to the [7] as shown in Table 1. The following formula can estimate stand biomass:

$$\text{Biomass}_{\text{tree stand}} = (\sum V_{\text{tree}} \times \text{WD}) \times \text{BEF}_{\text{tree stand}} \quad (9)$$

Where:

V_{tree} = Trees volume (m^3)

WD = Wood density (kg/m^3)

$\text{BEF}_{\text{tree stand}}$ = Tree biomass expansion factor

Table 1. Value BEF according to the IPCC's Guide (2003)

Climate zones	Forest types	BEF (with bark)
Tropical	Conifer	1.3 (1.2 - 4.0)
	Leaf width	3.4 (2.0 - 9.0)

In estimating coconut biomass, it used allometric equations proposed by [8], as follows:

$$W = 0.11 \times \rho \times D^{2.62} \quad (10)$$

Where:

W = Biomass (kg/tree)

ρ = Wood density (kg/cm³)

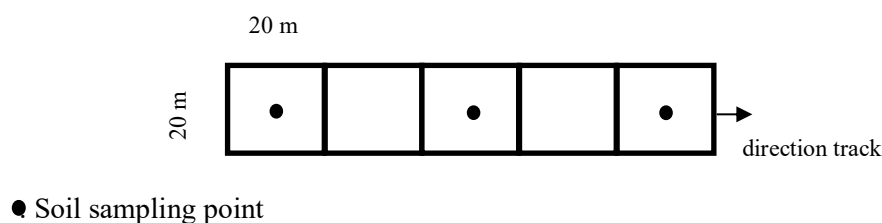
D = Diameter at breast height (cm)

2.3.3. Estimation of electrical energy potential

The potential electrical energy estimation was conducted using biomass conversion approach into wood pellets (WP). According to [9], the biomass needed to produce 1 ton of WP is about 1.5 tons of biomass. Biomass is converted into WP with heat energy of approximately 19.8 MJ/kg [10]. The heat energy of WP was used to generate electricity by converting heat energy from the WP (MJ) into electrical energy (kWh). Heat energy is converted into electrical energy with a value of 1 kWh = 3.6 MJ [11].

2.4. Soil Properties Analysis

Soil sampling was conducted in each track. Every track consisted of sampling points at the beginning, middle, and end (Figure 2). Soil samplings were categorized into two methods. Those were disturbed and undisturbed soil sampling to obtain physical and chemical soil properties.

**Figure 2.** Design of soil sampling

3. Results and Discussion

3.1. General Conditions of Semujur Island

Semujur island is located in the Kebinti village, Pangkalan Baru Sub-district, Central Bangka District, with a total area is 14.6 ha. Geographically, this island is located between 02°09'15"S-02°09'27"S and 106°17'34" E-106°18'00" E. Semujur Island is occupied by 63 family heads originating from Bangka Island and Buton Island with the main livelihoods being fishing and farming. The electricity supply has not already reached Semujur Island. There are five solar power plants (PV) that are not well maintained and has lost some of their components. Some people get the lighting at night by using this battery from PV to charge the generator illegally in the afternoon or using diesel-fueled.

3.2. Species composition

3.2.1. Total of individuals and species

The result of vegetation analysis is presented in Table 2. Based on data in Table 2, understory found was *Imperata cylindrica*, *Ageratum conyzoides*, *Crinum asiaticum*, *Physalis angulata*, *Porophyllum ruderale*, *Dendrolobium umbellatum*, *Cajanus cajan*, *Ipomoea pes-caprae*, *Morinda citrifolia*, *Premna*

serratifolia, *Scaevola taccada*, *sesuvium portulacastrum*, *didactyla Digitaria*, *Cyperus rotundus*, *Euphorbia hirta*, *Tridax procumbens*, *Lantana camara*, *Oldenlandia*, *Dioscorea hispida*, *Manihot esculenta*, *Ipomoea batatas*, *Moringa oleifera*, *Nephrolepis biserrata*. Palm found in this research was only *Cocos nucifera*. Lianas found were *Passiflora foetida* and *Mikania* sp. A species found at seedling, saplings and poles level was *Terminalia catappa*. However, four species were found at tree level: *Terminalia catappa*, *Casuarina equisetifolia*, and *Ficus Callosa*.

Table 2. Total of individuals found on Semujur Island

Class	Total of individuals
Understory	23
Seedling	1
Sapling	1
Pole	1
Tree	4
Palm	1
Liana	2

3.2.2. Importance Value Index (IVI)

The result of vegetation analysis was used for importance value index (IVI) calculation at seedling, sapling, pole and tree levels. IVI is used to determine the dominance of a species in a specific habitat. IVI calculations were obtained from any level of growth that can be seen in Table 3. Based on Table 3, *Terminalia catappa* dominated at seedling, sapling, and pole levels. *Terminalia catappa* dominated at seedling and sapling levels (IVI=200%), and pole level (IVI=300%). *T. catappa* is widely distributed in Indonesia from Sumatra to Papua.

At tree level, *T. catappa* reaches a height of 25 m and a stem diameter of up to 200 cm. This species is found in coastal forest vegetation up to 500 m above sea level. *T. catappa* sheds its leaves twice a year. Therefore, this species can survive in the dry season. In addition, this species has a shady canopy with horizontal and stratified branches like a pagoda. Thus *T. catappa* is usually used as a shading tree in the garden or on the beach [12].

Table 3. Importance value index at seedling, sapling, pole, and tree level in Semujur Island

Level	Species	Total of individuals	Total plot found	IVI (%)
Seedling	<i>T. catappa</i>	16	4	200.00
Sapling	<i>T. catappa</i>	2	2	200.00
Pole	<i>T. catappa</i>	2	2	300.00
Tree	<i>T. catappa</i>	7	7	89.42
	<i>C. equisetifolia</i>	4	3	34.51
	<i>F. Callosa</i>	1	1	9.26
	<i>F. caulocarpa</i>	4	4	166.81

Table 3 showed that at the tree level, the top four species with the highest IVI were *F. caulocarpa* (166.81%), *T. catappa* (89.42%), *C. equisetifolia* (34.51%), and *F. Callosa* (9.26%). *F. caulocarpa* found in the plot have an average diameter of more than 200 cm. Other species such as *T. indica* and *M. indica* also found on Semujur Island. The local communities believe that maintaining the big trees will produce clean water and an inexhaustible water source on Semujur island, although in the dry season. This is following [13] reported that *Ficus* is a plant that has deep roots and a dense canopy. Thus this species can be used for soil and water conservation and water surrounding the spring.

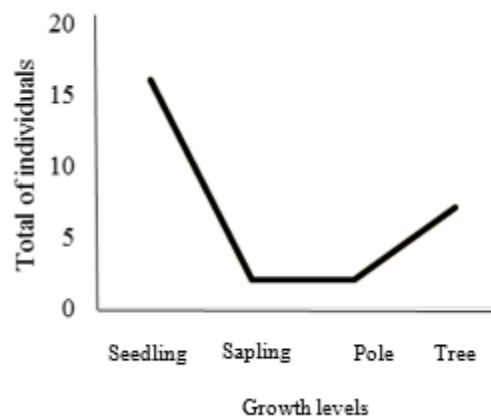


Figure 3. Total of individuals *T. catappa* at every level of growth

Figure 3 reflected in relationships between total of individuals and growth level (seedling, sapling, pole, and tree levels) in Semujur Island resulting in a reverse J-curve. Distribution of total of individuals with reverse J-curve shows the normal and balance forests, where the order of total of individuals respectively is seedling>sapling>pole>tree. Therefore the regeneration process usually grows normally [14].

C. equisetifolia, *F. callosa* and *F. caulocarpa* were not found at seedling, sapling, or pole levels. It might be caused by forest disturbances such as logging activity, and forest burning by the local community for land clearing. According to [15], forest disturbances cause damage of the forest ecosystem and result in a decrease in vegetation regeneration.

Based on Table 4, the dominant understory is *Imperata cylindrica* with IVI of 52.50%, followed by *Morinda citrifolia* (22.82%), *Ageratum conyzoides* (17.94%), *Sesuvium portulacastrum* (15.13%), *Nephrolepis biserrata* (14.30%), *Digitaria didactyla* (12.47%), *Premna serratifolia* (10.51%). Understory existence is strongly influenced by sunlight penetration of the forest floors. [16] explained that abundant sunshine will trigger the growth of intolerant species. In addition, the existence of an understory is also affected the soil conditions such as pH.

Table 4. Understory with IVI not more than 10% in Semujur Island

Species	IVI (%)
<i>I. cylindrica</i>	52.50
<i>M. citrifolia</i>	22.82
<i>A. conyzoides</i>	17.94
<i>S. portulacastrum</i>	15:13
<i>N. biserrata</i>	14:30
<i>D. didactyla</i>	12:47
<i>P. serratifolia</i>	10:51

I. cylindrica is an annual grass categorized into weed and as an indicator of land degradation. Additionally, [17] explained that when the forests with climax vegetation have been destroyed such as by logging, shifting cultivation, and land fire, it will be replaced by *I. cylindrica* soon. *I. cylindrica* will grow quickly after land burning. This species reproduces in two ways, namely seeds and rhizome reproductions. A new shoot will grow on the rhizome after land burning. Land dominated by *I. cylindrica* has low soil productivity, due to this weed is very aggressive and has become a high competitor for other vegetation in fixing nutrients and water [18].

S. portulacastrum is mostly found on the edge of the beach, which became a part of Pes-caprae formation. This species belongs to an annual herbaceous that grow crawl, and have many branches. *S. portulacastrum* leaves can be used for material consumption. It grows up in sandy and muddy substrates, as well as clay soils [12]. *M. citrifolia* and *P. serratifolia* belong to shrubs that are commonly found in Baringtonia formation. [19] reported that this species found in the Baringtonia zone is salt-tolerant and adapted to the infertile and dry season. Both species are utilized by the local community as firewood utilization. *M. citrifolia* fruit can be used in traditional medicine.

Table 5. The dominant liana species in Semujur Island

Species name	IVI (%)
<i>Passiflora foetida</i>	56.41
<i>Mikania sp.</i>	143.59

The dominant liana species in Semujur Island are *P. foetida* with IVI 56.41% and *Mikania sp.* with IVI 143.59%. The existence of lianas and vine plants affected land openness and light intensity. Liana needs abundant sunlight, thus it is usually found in open and gap areas [20].

3.3. The potential of species

Biomass is biological material that can be used as a fuel source, either directly or after processing through a series of processes known as biomass conversion. Biomass resources are a product of photosynthesis that absorbs solar energy and converts carbon dioxide, with water to a mixture of carbon, hydrogen and oxygen [21]. According to [22], biomass can be divided into two categories: above-ground and below-ground biomass. Further, it is said that the aboveground biomass is an organic element material weight per unit area on the ground's surface at a time.

We measured all of the trees' diameter and height on Semujur Island and it resulted in the Semujur Island forest has been converted into a residential and agricultural field. Stand biomass and electric energy estimations are presented in Table 8. The result showed total biomass in Semujur Island was 2,298.94 tons/ha, with the highest biomass on *F. caulocarpa* (1,358.51 tons/ha) and the lowest on *M. indica* (1.53 tons/ha). *F. caulocarpa* had the highest biomass due to the size of tree's diameter of approximately 200 cm. The tree diameter is one of the important variables for biomass estimation beside tree density value and tree species [23]. Total biomass is affected by tree dimensions. A larger tree diameter, height and volume resulted in higher biomass content.

Table 6 shows that 2,298.94 tons of biomass/ha produced 1,532.63 tons of wood pellets. In the form of heat energy contained in 1,532.63 tonnes of wood pellets for 3,0346.01 GJ, equivalent to 3,371.78 MWh when converted into units used in electricity with an efficiency of the engine by 40%. If it is assumed any average home electricity use by 6.07×10^{-4} Mwh for lighting two lamps 8 watts, TV and mobile phone battery recharge, then the electricity needs of 63 households on the Semujur island approximately 1:18 or 14:22 every month MWh annually. Electrical energy from biomass that is available on the island amounted to 3,371.78 MWh Semujur can meet the needs of up to 237 years without replanting. Semujur Island's development to obtain sustainable sources of biomass is potentially due to the demand for electricity on the island at 14:22 MWh Semujur can be met sustainably if the supply of biomass is obtained by 9.70 tonnes per year.

Allegedly biomass potential will decline temporarily due to the loss of species *F. Caulocarpa* which has a large diameter. This is following [24] which states that one of the factors influencing the magnitude of the potential of biomass is the diameter of the tree that dominates. As seen in Table 5, natural regeneration provided just the kind of *Terminalia catappa* while *F. caulocarpa*. Whereas this type was not found in their natural regeneration.

Table 6. Calculation of potential biomass in Semujur Island as a source of electrical energy

Species	Biomass (ton / ha)	WP (Ton)	Heat (GJ/ton)	Electricity (MWh)
<i>F. caulocarpa</i>	1,358.51	905.67	17,932.33	1,992.48
<i>T. catappa</i>	626.06	417.37	8,263.99	918.22
<i>C. nucifera</i>	210.17	140.11	2,774.24	308.25
<i>C. equisetifolia</i>	89.42	59.61	1,180.34	131.15
<i>T. indica</i>	9.73	6.49	128.44	14.27
<i>F. Callosa</i>	3.52	2.35	46.46	5.16
<i>M. indica</i>	1.53	1.02	20.20	2.24
Total	2,298.94	1,532.63	30,346.01	3,371.78

3.4. Soil properties

3.4.1. The physical properties

The weight of contents or *bulk density* (BD) can be used to measure the soil's density. The higher the value the denser bulk density of the ground anyway. Bulk density values are very sensitive to soil tillage [25]. According to [26], the total porosity in the soil pore space is occupied by water and air. Bulk density and porosity of the soil is influenced by soil organic matter content, soil texture and soil structure. Soil porosity is higher if the high organic matter content. Ground with crumb structure has higher porosity than soils with a solid structure. Soil texture has many sand macro pores making it difficult to hold water [27].

Table 7. Results of the analysis of soil physical properties

Samples	Bulk density (g/cm ³)	Porosity (%)	Texture
1	1:16	56.19	Sand
2	1:01	61.80	Sand
3	0.96	63.88	Sand
4	1:05	60.29	Loamy sand
5	1:10	58.66	Sand
Average	1:05	60.16	-

Based on Table 7 bulk density values high of 1:16 g/cm³ contained in lane one and the lowest value contained in the track three with a value of 0.96 g/cm³ and an average bulk density in the Semujur Island of 1.05 g/cm³, otherwise porosity is highest on three lines in the amount of 63.88% and the lowest porosity value of 56.19% on a track that produces an average porosity of 60.16%. Bulk density at line three was lower than the other lines due to the presence of some large *Terminalia catappa* trees. The litter of trees causes the organic matter content in that location is higher than the other lines. Bulk density values are inversely proportional to the value of the porosity due to the influence of the organic matter contained in the soil. This is following [28] which stated that the organic material bulk density far as the organic material is much lighter than in minerals and organic matter increases soil porosity. Sand texture Semujur dominates the texture of the soil on the island. Sandy soils have coarse pores than clay so more coarse pores of the soil will be increasingly difficult to hold water and crops susceptible to drought [27].

3.4.2. Chemical properties

[28] reveals some chemical properties of soil deposits correlate with a plant's biomass. The results of the analysis of soil chemical properties on the Semujur island are presented in Table 8. The soil's degree of acidity (pH) indicates the number of H⁺ ion concentrations in the soil. The higher levels of H⁺ ions in the soil, the more acidic the soil proficiency level [27]. The lower the pH of the soil, the more difficult plants to grow because the soil contains toxic (poison), on the contrary, if the soil pH is high then the soil contains lime. Based on Table 8 the average pH of the soil on Semujur Island at 8:06 into the category of slightly alkaline with a very high base saturation.

Organic C showed high levels of organic matter in the soil. As can be seen in Table 8, the value of the content of organic C in the study site in the category of the high, high content of organic C was allegedly due to the presence of reeds that dominate research sites (Table 4). This is supported by [29] which states that the reed is kind of slow to decompose, thus contributing to increasing soil organic C content.

Table 8. Results of the analysis of soil chemical properties

The nature of the soil		Average	Category
Ph		8:06	mildly alkaline
base saturation		100.00	Very high
Exchangeable acidity (cmol (+) / kg)	Al-dd	0:00	
C-org (%)		3:24	High
N-Total (%)		0:30	moderate
P ₂ O ₅ (ppm)		436.87	Very high
K ₂ O (ppm)		30.97	moderate
C/N ratio		11.80	moderate
Water content (%)		10:39	
Cation exchange capacity (Cmol (+) / kg)		5.67	Low
Cations can be exchanged (Cmol (+) / kg)	K +	0:10	Low
	Na +	0:28	Low
	Ca ++	12.90	High
	mg ++	1:32	moderate

The average content of N-total at the study site at 0:30% were included in the middle criteria (Table 8). Nitrogen plays an important role in the growth and reproduction of plants. Shortage of N can cause stunted plant growth [30]. Besides the availability of N in the soil is determined by the total soil N is also influenced by soil organic matter content, especially the level of decomposition (C/N). The C/N ratio greater indicates that the organic material decomposes yet perfectly. The C/N compost lower indicates that the organic material is decomposed and almost into compost [30]. Based on the assessment criteria soil chemical properties [31], the average C/N ratio on Semujur Island is included in the moderate category.

In addition to the elements N, an important nutrient for plants is phosphorus (P) and potassium (K). Based on the assessment criteria soil chemical properties [31] Semujur Island contains elements of a very high P and average K elements. P element is an element which is difficult to dissolve in water, supported by the state of Semujur Island where rainfall is between 82.1 to 372.7 mm/month.

It causes a high P element in Semujur Island. The existence of an element of K is proportional to the pH of the soil, the higher the pH of the soil, the higher the K elements contained in the soil. [32] claim that if the alkali ions (Na, K, Ca, and Mg) are more entrapped in the soil so the soil pH increases. Cation exchange capacity indicates the ability of soil to adsorb and exchange cations in the soil. CEC value at relatively low Semujur Island. Adsorbed cations in the soil are generally divided into two groups, both of which have the opposite effect on the acidity and alkalinity of the soil.

The analysis showed a high content of the cations Ca, Mg being, as well as K, and Na was low (Table 8). The Ca content is high Semujur Island allegedly because the soil in these observations formed from limestone host rock material contains elements calcium. Ca is needed by plants in relatively large amounts. Ca was instrumental in the formation and development of the cell [33].

Generally, Semujur Island is divided into three parts, settlements, plantations, and scrub. The land use is dominated by palm trees plantation. Untreated land was overgrown by shrubs such as reeds. Based on the soil analysis results, good physical properties (Table 7), and the chemical properties of the soil (Table 8) land dominated by reeds, can be used for planting. Based on the criteria drawn up by the Agency for [34], species appropriate to the condition that Semujur Island is vetiver plant and sesame plant. In addition to adding value to the land and planting vetiver and sesame types can increase the income of local communities where it is grown.

Vetiver plant (*Vetiveria zizanioides*) is processed into essential oil through refining. Vetiver has roots that grow dense. Grows well in sandy soils or soils containing volcanic ash. Soil types are made easily removed without any roots left [35]. The Sesame plant (*Sesamum indicum*) is an annual herbaceous plant that is widely used as raw materials for Sesame oil. Sesame oil is used as a mixture of food. Upright crop type, jointed stems, there are highly branched, bit and some are not branching, plant height ranged at 30-200 cm, very sharp-smelling plant leaves so unwelcome pests [36].

4. Conclusion

The species composition of vegetation Semujur Island at seedlings, saplings, and poles was dominated by *Terminalia catappa*. While tree level was dominated by *Ficus caulocarpa* (IVI of 166.81%) and *Cocos nucifera* (IVI of 200%). Understory and liana in order were dominated by *Imperata cylindrica* (IVI of 52.50%) and *Mikania sp.* (IVI of 143.59%). The content of the biomass in Semujur Island of 2298.94 tons/ha. Biomass has the potential to be used as a source of fuel for power plants and can meet the needs of the surrounding community until 237 years without replanting.

Further research needs to be done about the types of plants that can be cultivated in forestry for replacing existing types after logging. The Government or private parties are expected to help in making wood pellets socialization to the surrounding communities as well as the procurement of tools, and plants (PLTU) for electric energy sources so that the island can become a self-sufficient island of Semujur energy. In addition, it is also necessary for social studies regarding the electricity needs Semujur Island in order to obtain public electricity consumption calculations more accurately.

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