THE DEGREE OF STABILITY OF RUBBER STANDS (*Hevea brasiliensis*) IN THE TIMBER ESTATE AREA OF PT. SYLVADUTA DISTRICT KEMBANG JANGGUT, KUTAI KARTANEGARA DISTRICT EAST KALIMANTAN PROVINCE

ABSTRACT

The development of Timber Estate (HTI) is one of the efforts to improve the welfare of the community's interests by considering the balance of the ecosystem. The development of rubber timber estate is expected to be a solution to the problems that hinder the current performance of HTI development, especially the problem of overlapping land tenure and the realization of planting. This is to maintain the fulfillment of the balance of environmental benefits, socio-cultural benefits, and economic benefits. The study's aims were: (1) to determine the percentage of the crown, total and branch-free height; and (2) to determine the stability value of rubber stands in the area of P.T. Sylvaduta Corporation Timber Estate. This research was conducted from April to May 2023 at P.T. Sylvaduta Corporation in Kembang Janggut District, Kutai Kartanegara Regency, East Kalimantan Province. namely in block A1 plot 1 to represent block A , Block E1 tile 3 to represent block E1 and lastly Block G3 tile 5 to represent block G3. A sampling of rubber plants in the area of P.T. Sylvaduta Corporation used a purposive sampling of 150 plants. Data Collection: **(1)** primary data: Diameter at Chest Height, Tree Height, and Crown length. And (2)secondary data include the following: (1)plant spacing; (2) the year of planting or the age of the plant, and (3) the general condition of the planting site was obtained from direct observations in the field and company documents. The research results show that : (1) the value of the degree of stability and percentage of the rubber plant canopy, namely 51.16% and 64.54%, is in the stable category; and (2)the use of a 3 x 6 m spacing using IRR 118 and PB260 clones had an average diameter at breast height of 20.9 cm, a total height of 10.62 m, a branch-free height of 3.81 m and a crown length of 6.82 m.

Keywords: Growth, Degree Stability, Rubber Plant, Timber Estate

INTRODUCTION

According to the Law of the Republic of Indonesia Number 41 of 1999, a forest is an ecosystem unit in the form of a stretch of land containing biological resources dominated by trees in their natural environment, which cannot be separated from one another. Based on their function, forests are divided into three groups: protected, production, and conservation forests [1]. Forests as national development capital have real benefits for the life and life of the Indonesian nation, both ecological, socio-cultural, and economic benefits, in a balanced and dynamic manner.

Based on the long-term development strategy in the forestry sector, it is appropriate for forests that are no longer productive to return to their functions, one of which is the development of Timber Estate (HTI. This is attractive to entrepreneurs/investors because it has high economic value and a high prolonged period so that the government provides a way for the private sector (entrepreneurs) to manage it.

According to P.P. No. 6 of 2007, HTI is a plantation forest established to increase the potential and quality of production forest by applying intensive silviculture to meet the raw material needs of the forest product industry. The objective of HTI concessions is to support the development of the domestic forest product industry to increase added value and foreign exchange, land productivity and environmental quality, and expand employment and business fields. The existence of HTI development is expected to save natural forests from damage. In addition, the development of HTI can overcome the imbalance between supply and demand for raw wood materials for the Indonesian timber industry. [2] states that HTI development has 3 main targets that can be achieved: economic, ecological, and social goals.

In the era of regional autonomy, the development of HTI is one of the efforts to improve the welfare of the community's interests by considering the balance of the ecosystem. HTI development is often controversial as one of the land conservation efforts due to land clearing activities in the artificial regeneration clear-cutting system (THPB)[3].

However, behind the HTI development, the entrepreneurs who came to take advantage of the forest unknowingly damaged and eliminated the function of the forest. Gradually the loss of forest

functions causes floods, droughts, death of several varieties, food reserves, medicine reserves, plant and non-plant products, and others.

Disruption of forest integrity can lead to erosion and flooding hazards, so to ensure forest integrity is maintained, it is necessary to take concrete actions through a system of reforestation and afforestation of logged-over areas by selecting plants based on characteristics that are appropriate to the land.

Several things need to be considered in choosing plants, including plants resistant to natural disturbances such as wind and heavy rain. The rubber plant is one of the plants that can withstand natural disturbances such as wind and high rainfall intensity. In addition, rubber can bind the soil so that erosion does not occur. Rubber is one of the recommended plant choices in reforestation and afforestation because it is easy to adapt/adjust to the environment and does not require soil with a high level of fertility.

Based on the Decree of the Minister of Forestry No. 160 Kpts-II/1996 concerning Unit Costs for the Development of Industrial Rubber Plantation Forests, the regulation of forest areas is based on their functions and main benefits for people's welfare. Changes in the functions and benefits of forest areas must be based on optimizing the distribution of functions and benefits of forest areas in a sustainable and proportional distribution. This is to maintain the fulfillment of the balance of environmental benefits, socio-cultural benefits, and economic benefits [4].

One of the efforts that can be put forward to improve the performance of HTI development in terms of supplying raw materials for the national timber industry is to develop rubber HTI development. The development of rubber HTI is expected to solve the problems that hinder the current performance of HTI development, especially the problem of overlapping land tenure and the realization of planting. This is to maintain the fulfillment of the balance of environmental benefits, socio-cultural benefits, and economic benefits. The legal umbrella for implementing this rubber HTI is Government Regulation 6 of 2007 concerning Forest Management and Preparation of Forest Management Plans and Forest Utilization. [4]. According to [5], there are several advantages to choosing rubber as an HTI plant: Rubber plants as a producer of wood (Timber), carbon sequestration plant, and conservation plant.

P.T. Sylvaduta Corporation is a national private company engaged in Forest Utilization Business Licensing or PBPH-HT which is located in Kembang Janggut sub-district, Kutai Kartanegara district and Muara Ancalong sub-district, East Kutai district, East Kalimantan Province. At first, P.T. Sylvaduta Corporation is an IUPHHK-HA forest management permit company that has received an extension by the decision of the Minister of Forestry number 205/Menhut-IV/1997. Furthermore based on the letter of the Director General of Forestry Production Development Number S.163/VI-BRPHP/2007 dated March 6 2007 that forest areas that are technically unfit for use as Natural Forest IUPHHK areas, can be converted to IUPHHK utilization in Plantation Forests.

In this study, we will focus on the degree of stability of rubber stands in the timber estate of PT. Sylvaduta Corporation. The advantage of using observations of the degree of slenderness/stability of this tree is that it can be used as a benchmark in determining whether or not a silvicultural activity is necessary, namely trees that provide a good degree of slenderness. The value that is considered good is if the ratio between tree height and tree diameter (h/d) is less than 100, which is expected to be able to withstand stability disturbances [6].

The study's aims were: (1) to determine the percentage of the crown, total and branch-free height; and (2) to determine the stability value of rubber stands in the area timber estate of P.T. Sylvaduta Corporation.

RESEARCH METHODE

A. Time and Place

This research was conducted from April to May 2023 at P.T. Sylvaduta Corporation in Kembang Janggut District, Kutai Kartanegara Regency, East Kalimantan Province. namely in block A1 plot 1 to represent block A , Block E1 tile 3 to represent block E1 and lastly Block G3 tile 5 to represent block G3 .

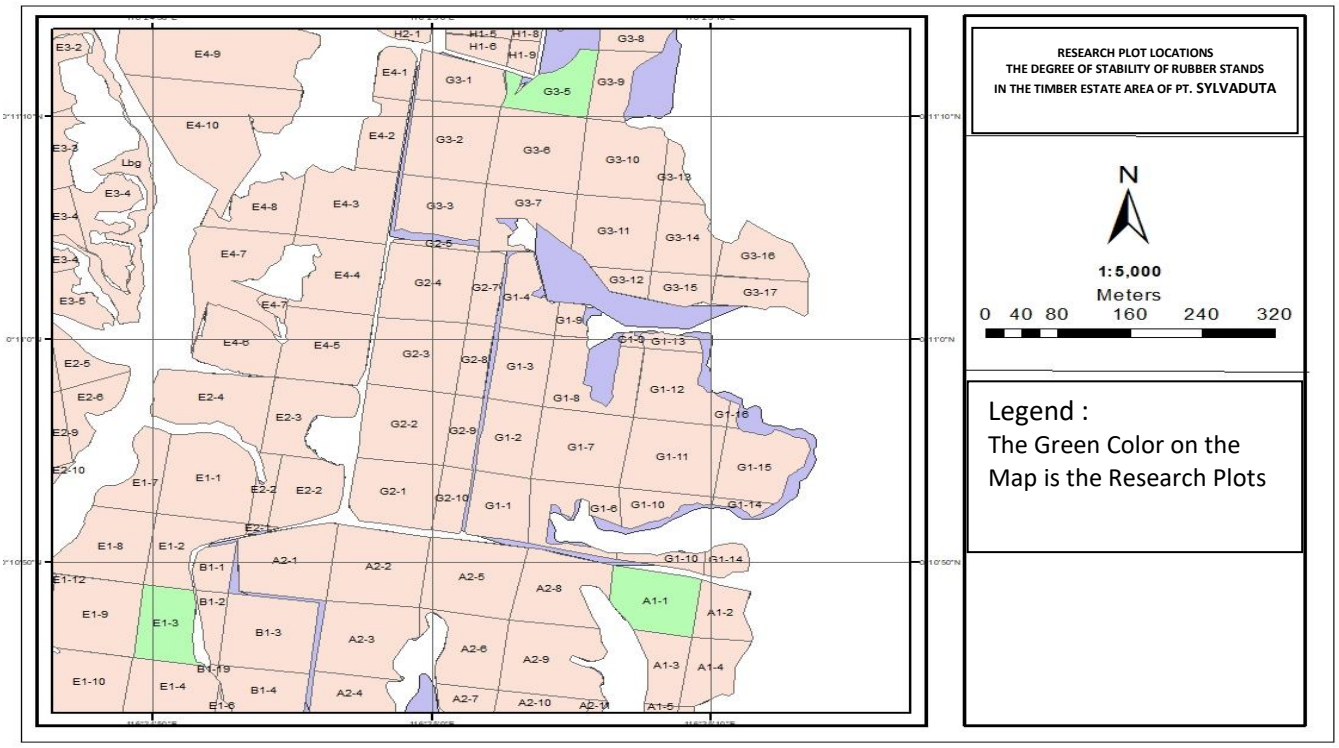

Figure 1. Research location (Source PT. Sylvaduta Corporation)

B. Materials and Tools

This research was carried out on rubber tree stands that were 11 years old, while the tools used were The equipment used is: tape measure, measuring stick, measuring tape, clinometer, compass, camera, tally sheet, and stationery

C. Sampling Technique

In each block, there are 150 plants, 50 of which were selected by purposive sampling, so from three blocks (A.E, and G) there are 150 sample plants.

D. Data Collection

1. Primary data

a. Diameter at Chest Height

The diameter at breast height of the Rubber plant is calculated based on the results of measuring the diameter at breast height divided by 3.14 cm at the time of measurement to obtain a diameter as high as the following formula [7] : $d = K/\pi$

Information: d = tree diameter (cm), K = tree circumference (cm), and $\pi = 3.14$

b. Tree Height

Measuring the height of a Rubber tree in the field: using a scientific clinometer without measuring flat distances with the help of a 2 m long measuring stick placed vertically on the tree trunk. The following formula determines the analysis of tree height data [7] :

$$h = \frac{P_3 - P_0}{P_1 - P_0} \times P_t$$

Information: h = tree height (m); P3 = Scale for treetop height (%); P2 = Scale for branch free height (%); P1 = Scale for the tip of the stick (%); Po = Scale for the base of the tree (%), and Pt = 2 m stick length

c. Crown length

Crown length can be determined by subtracting the tree height from the branch-free height. The measuring instrument used is a scientific clinometer and a 2 m stick. The following formula determines crown length data analysis [7]:

$$h = \frac{P_2 - P_0}{P_1 - P_0} \times P_t$$

Information: H = Tree height (m), P3 = Scale for treetop height (%); P2 = Scale for branch free height (%); P1 = Scale for the tip of the stick (%); P0 = Scale for the base of the tree (%), and Pt = 2 m stick length

2. Secondary data

Secondary data or supporting data collected in this study include the following: (1)plant spacing is measured directly in the field using a roller meter gauge; (2) the year of planting or the age of the plant was obtained from the information on the stem girth book of P.T. Sylvaduta Corporation, and (3) the general condition of the planting site was obtained from direct observations in the field and company documents.

E. Data analysis

Stages in analyzing/calculating data:

1. The results of measuring the average diameter of each plot are then calculated using the formula [7]:

$$\bar{d} = \frac{\sum di}{n}$$

Description: = average diameter (cm); Σdi = total diameter of the I-th (cm); di = tree diameter I; and n = the number of trees observed

2. The results of measuring the average tree height for each plot are then calculated using the formula [7]:

$$\bar{h} = \frac{\sum hi}{n}$$

Information: h = average height(cm); Σhi = total height to-i (cm), and n = number of trees observed

3. The stability figure for rubber stands is calculated using the formula [7]:

$$KT = \frac{\bar{h}}{\bar{d}}$$

Information: KT = Degree of stability; h = = average height and d = average diameter

4. The percentage of standing crowns of rubber (p) can be determined by the formula: P = (header length/total tree height) x 100

5. Stand stability data analysis

To interpret the results of the calculation of the Degree of Stand Stability, a measure of the Slenderness of Trees is used according to [7], which is as follows:

h/d < 100 → stable tree

h/d > 100 → The tree is unstable

RESULTS AND DISCUSSION

A. Overview of P.T. Sylvaduta Corporation

Based on Government Administration, P.T. Sylvaduta Corporation is included in the Government Administration area of Kutai Kartanegara Regency. Based on the Forestry Administration, the area of P.T. Sylvaduta Corporation is included in the administrative area of the Belayan DAS KPHP.

The physiography of the research location was based on direct observation at the time this research was conducted, namely: undulating topography, the land slope between 8 - 25%, and altitude + 1,200 m above sea level (asl)

B. Number of Plants and Planting Spacing

The number of trees, plant spacing, clone types, and plant ages from each plots A, E, and G are presented in Table 1.

Table 1. Data on Rubber Plantations

Plots	Number of Plants	Type of Plant	Plant Spacing (m)	Type of Clone	Age of plants
A	50	Rubber	3 x 6	IRR 118 and PB 260	11 years old (Planted in 2012)
E	50	Rubber	3 x 6	IRR 118 and PB 260	11 years old (Planted in 2012)
G	50	Rubber	3 x 6	IRR 118 and PB 260	11 years old (Planted in 2012)

Source: Processed Research Data (2023)

C. Growth and Degree of Stability of Stands and Percent of Canopy

1. Level of Stability

The relationship between the average diameter, height, and stability level of the rubber stand is presented in Table 2.

Table 2. Summary of average diameter, height, and stand stability values

Plot	Number of trees per plot	Average diameter (cm)	Average height (m)	Stand stability (%)
A	50	19.2	11.39	59.18
E	50	22.2	11.26	50.71
G	50	21.2	9.22	43.58
Average		**20.9**	**10.62**	**51.16**

Source: Processed Research Data (2023)

Based on the data in Table 2 shows that plot A has an average diameter of 19.2 cm and an average height of 11.39 m with standing stability of 59.18%; plot E has an average diameter of 22.2 cm, an average height of 11.26 m with stand stability of 50.71%; and in plot G it has an average diameter of 21.2 cm, an average height of 9.22 m with stand stability of 43.58%. Based on the slenderness of a tree, according to [7], a tree is said to be stable if h/d < 100, while it is said to be unstable if h/d > 100. Furthermore, it was stated by [8] that the slenderness coefficient (height/diameter ratio, H/D ratio) of trees is a good indicator for young stands, while the canopy shape index (relative crown length and relative crown width) are indicators in old stands of risk of damage by snow and wind

Based on these criteria, the rubber stand's stability in all plots (A, E, and G) is classified as stable. The results of another study reported by [9] that the average diameter, average height, and stability level of rubber stands at the age of 5 years in Margomulyo Village, Samboja District, Kutai Kartanegara Regency, East Kalimantan Province, namely stem diameters between 16.60 - 16.72 cm, tree height between 10.14 – 10.16 m and tree stability values between 60.86 – 61.60% and all are classified as stable. Tree stability is a condition where there is a balance between the increase in height and the development of tree diameter to withstand natural disturbances. This is supported by several factors, including the availability of nutrients in the soil, the state of groundwater, sunlight, differences in the quality of the place to grow, and the density of stands. [10] stated in the forestry manual, the growth of

standing value and increase in tree diameter or height every year varies for different tree species. Growth is influenced by factors where it grows, such as soil fertility, climate, and water availability.

The results of calculating branch-free height, total height, crown length, and crown percentage are presented in Table 3.

Table 3. Recapitulation of Total Height, TBC, Crown Length, and Percentage of Crown

Plot	Total height (m)	Branch-free height (m)	Crown length (m)	Percentage crown (%)
A	11.39	4.09	7.30	64.13
E	11.26	4.62	6.65	59.01
G	9.22	2.72	6.50	70.48
Average	**10.62**	**3.81**	**6.82**	**64.54**

Source: Processed Research Data (2023)

Based on the data in Table 3 shows that the rubber stand canopy at P.T. Sylvaduta Corporation has an average total height of 10.62 m, with a branch-free height of 3.81 m and a crown length of 6.82 m and an average crown percentage of rubber stands is 64.54 % of the total height of trees in the stand. While the results of the study reported by [9] showed that the average total height value was 10.16 m, with a branch-free height of 2.98 m and a crown length of 7.18 m, and an average crown percentage of rubber stands of 70.28% of the total height of trees in the stand. The difference between the two studies was due to differences in planting locations, the age of the plants, and the type of clones planted. As stated by [11], vegetation growth is said to be running well if there are different levels at each level of tree growth. Furthermore, [12] stated that plants have a very real correlation with the location of growth (habitat) regarding species distribution, density, and dominance.

CONCLUSIONS AND RECOMMENDATIONS

A. Conclusion

Based on the results of the research and discussion, conclusions are drawn, namely as follows:

1. The value of the degree of stability and percentage of the rubber plant canopy, namely 51.16% and 64.54%, is in the stable category.
2. The use of a 3 x 6 m spacing using IRR 118 and PB260 clones had an average diameter at breast height of 20.9 cm, a total height of 10.62 m, a branch-free height of 3.81 m, and a crown length of 6.82 m.

B. Suggestion

1. The rubber plantation company should maintain rubber commodities because it positively impacts the surrounding community's standard of living and welfare.
2. It is better to clear weeds off the rubber stands because it does not rule out the possibility that the development of rubber can be disrupted. Weed cleaning also needs to be done, considering the obstacles when collecting data in the field are disrupted due to high weeds.

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