SURVEY AND STUDY ON ABOVE-GROUND BIOMASS OF RUBBER PLANTATIONS IN PA YUP NAI SUB-DISTRICT, WANG CHAN DISTRICT, RAYONG PROVINCE

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Abstract

The purpose of Survey and Study on Above-ground Biomass of Rubber Plantations in Pa Yup Nai Sub-district, Wang Chan District, Rayong Province was to survey and study above-ground biomass of the rubber plantations in Pa Yup Nai Sub-district, Wang Chan District, Rayong Province. The research was divided into 2 parts: 1) a preliminary survey of the rubber tree population and 2) an above-ground biomass study. Samples were collected from 80 rubber trees/rai at a distance of 2.5 x 8 meters. According to the measurement of diameter of the rubber tree samples, the diameter at breast height (DBH) was 14.538 ± 3.218 cm with the lowest value of 7.643 cm and the highest value of 22.930 cm. The height of the rubber tree samples was 12.940 ± 2.580 m with the lowest value of 7.420 m and the highest value of 20.720 m. In terms of the total above-ground biomass yield in the trunk, the highest value was 4,442.997 (kg/rai), followed by the leaf which was to 526.995 (kg/rai) and the branch which was 4.597 (kg/rai). The total above-ground biomass yield of various components of the rubber tree was equal to 4,974.589(kg/rai).

Keywords: above-ground biomass; carbon sequestration; rubber plantation

Introduction

Global warming is an important environmental problem today as a result of climate change that increases the average global temperature. Activities that directly increase the amount of greenhouse gases in the atmosphere include burning of fuels, and those that indirectly increase in the amount of greenhouse gases include deforestation. The major greenhouse gas is carbon dioxide. Forests

play an important role in absorbing carbon dioxide from the atmosphere through photosynthesis and storing it in the form of biomass (Chansa et al., 2016).

In terms of the situation of forests in Thailand which help store carbon dioxide, according to the statistics of forest areas in Thailand from 2014-2016, forest areas decreased by 0.02% every year. In terms of the forest areas in Thailand in 2016, the satellite image from Royal Forest Department showed that the forest areas made up 31.58% of the land, or equal to 102,174,805.09 rai (163,479.69 square kilometers) which decreased by 0.02 percent from 2015, or 65,000 rai approximately (Seub Nakhasathien Foundation, 2017).

Trees and forests are the best sources of carbon storage. Most importantly, forests play a role both in storing and releasing carbon dioxide through photosynthesis. Trees use carbon dioxide to produce food and increase biomass yields. One ton of wood can absorb approximately 1.81 tons of carbon dioxide and release approximately 1.32 tons of oxygen (Somchai, 2016). Different species of trees and forests result in different carbon dioxide sequestration.

Therefore, this research focused on the survey and study on the above-ground biomass of the rubber plantations in Pa Yup Nai Sub-district, Wang Chan District. Rayong Province in order to provide preliminary information regarding carbon sequestration capacity in the biomass of the rubber plantations in Pa Yup Nai Sub-district, Wang Chan District, Rayong Province.

Research Objectives

1. To survey the preliminary data of the rubber tree population group and
2. To study the above-ground biomass of rubber plantations

Literature Review

Biomas

Biomass refers to the mass of green plants created by the process of photosynthesis. It includes the masses of other living things residing in the ecosystem. Biomass is commonly measured in dry weight or in weight per unit of plant, such as per plant or per unit of area which could refer to plant biomass usually in 1 square meter or 1 hectare, depending on the nature of the plant society (Pongsak, 1981).

Normally, biomass includes both plants and animals, but the focus in this research is on forest biomass which can be divided into above-ground and below-ground biomass.

Carbon sequestration calculations

Carbon sequestration calculations can be done in 3 different ways.

1. Carbon sequestration assessment from tree counts

This is used for an area with a sub-plot size not more than 30 rai (sub-plot means an area that has adjacent areas and is occupied by the same holder) with the total project area not exceeding 1,000 rai. The project's carbon sequestration can be calculated by determining the amount of carbon stored by trees each year to have a straightline relationship and the rate of carbon storage increase equal to 9.5 kg carbon dioxide/plant/year.

Carbon sequestration assessment from tree measurements

Carbon sequestration from tree biomass is assessed using the allometrial equation. The tree biomass consists of above-ground biomass (ABG) and below-ground biomass (BLG).

Carbon sequestration calculation from above-ground biomass (ABG)

Step 1: Place the survey sample plot as specified by the TGO and take note of the type and diameter at an altitude of 1.30 meters and the total height of trees in the sample plot area of the project.

Step 2: Calculate the above-ground biomass by selecting the allometric equation that is suitable for the project area from the equation recommended by the TGO (details in Appendix 2) or other equations that have been studied and published in academic articles which can specify whether it is suitable for the project area or develop an equation for the project area. The information used in the development of the equation must be submitted to the TGO for review and approval for use.

Step 3 Calculate above-ground carbon sequestration of trees in the project area and adjust the unit to carbon dioxide

Research Methodology

In the survey and study on above-ground biomass of rubber plantations in Pa Yup Nai Dub-district, Wang Chan District, Rayong Province, the population included rubber trees as samples.

Research Tools

1. Field equipment in the rubber plantations such as measuring tape, kinometer, record form, plant sampling device, thermometer and GPS

2. Laboratory equipment such as hot air incubator, beaker

The research area included rubber plantations in Pa Yup Nai Sub-district, Wang Chan District, Rayong Province.

The study on carbon sequestration was divided into two parts: Part 1 - a preliminary survey of rubber tree population, and Part 2 - a study on the above-ground biomass of rubber plantations.

1. Field sampling is as follows: 1.1 Field sampling 1.2 sampling plot of 40×40 m (1 rai) was set up.

2. Tree data collection

2.1 A sampling plot of 40×40 m (1 rai) was placed. The researcher collected data on rubber trees in the sampling plot of 40×40 m which

was divided into 16 plots of 10×10 m. Data of all trees with a height of more than 1.30 meters and a diameter at breast height (DBHI) greater than or equal to 4.5 centimeters were collected. The data included 1) species of plant, family name, scientific name of rubber trees, 2) the number found (plant/rai), 3) the diameter at breast height (DBH) by measuring the circumference of the trunk at the chest level (1.3 meters from the ground or diameter at breast height (DBH).

Data analysis

Biomass yield was evaluated with allometry equations by Ogawa et al. (1965); Trephattanasuwan, et al. (2008); IPCC (2006); Pongsak (1988) and Ticha (2016). The living above-ground biomass included the tree part above the ground. The calculation of the biomass of rubber plantations included allometric equations as follows:

Stem $\log W_S = 0.866 \log D^2H - 1.255$; ($r^2 = 0.991$) …….. Equation 1

Branch $\log W_B = 1.144 \log D^2H - 5.222$; ($r^2 = 0.878$)…….... Equation 2

Leaf $\log W_L = 0.572 \log D^2H - 1.152$; ($r^2 = 0.922$)…….. Equation 3

Where:

W_S is the above-ground biomass yield of rubber trees in the trunk (kg per area)

W_B is the above-ground biomass yield of rubber trees in the branch (kg per area)

W_L is the above-ground biomass yield of rubber trees in the leaf (kg per area)

D is the diameter at breast height of the rubber tree (cm).

H is the height of the rubber tree (meters).

Results

The results of the survey and study on biomass above ground of rubber plantations in Pa Yup Nai Sub-district, Wang Chan District, Rayong province are as follows.

The population in this study included rubber trees, and the sample group was the sample rubber tree. The results of carbon sequestration in biomass of rubber plantations in Pa Yup Nai Sub-district, Wang Chan District, Rayong province were divided into 2 parts: Part 1: Preliminary survey of the rubber tree population; and Part 2: Study of above-ground biomass of rubber plantations

Part 1: Preliminary survey of the rubber tree population

Figure 1 Administrative Region of Wang Chan District, Rayong Province
(Source: Wang Chan District Agriculture Office, 2021)

Wang Chan District Administrative Area was divided into 4 sub-districts and 29 villages as follows:

- Chum Saeng District consisting of 8 villages:
  - Village 1 Ban Chum Saeng
  - Village 2 Ban Santisuk
  - Village 3 Ban Klong Phai
  - Village 4 Ban Ma Ngua
  - Village 5 Ban Khao Ta In
  - Village 6 Ban Kaeng Wai
  - Village 7 Ban Wang Plong
  - Village 8 Ban Ma Ngua
- Pa Yup Nai Sub-district consisting of 8 villages:
  - Village 1 Ban Khun Intra
  - Village 2 Ban Pa Yup Nai
  - Village 3 Ban Khao Sing To
  - Village 4 Ban Yup Ta Neng
  - Village 5 Ban Klong Was Som
  - Village 6 Ban Klong Khet
  - Village 7 Ban Khao Mai Nuan
  - Village 8 Ban Ta Sao
- Plong Ta Aiem Sub-district consisting of 7 villages:

Village 1 Ban Khao Talad
Village 2 Ban Sam Nak Ta Sua
Village 3 Ban Plong Ta Aiem
Village 4 Ban Klong Bang Bo
Village 5 Ban Nong Khen
Village 6 Ban Klong Aang
Village 7 Ban Klong Song

- Wang Chan Sub-district consisting of 6 villages:

Village 1 Ban Wang Chan
Village 2 Ban Nong Prong
Village 3 Ban Yup Chong Ko
Village 4 Ban Chum Num Nai
Village 5 Ban Khao Hin Taen
Village 6 Ban Ta Kien Thong

Wang Chan District has a total area of 395.245 sq km (152.605 sq mi) with a total population (2020) of 26,063 people and a density equal to 65.94 people/square km (170.8 people/square mile). Wang Chan District is adjacent to neighboring territories:

North: connected with Nong Yai and Bo Thong Districts (Chonburi Province)

East: connected to Khao Chamao and Klaeng District

South: connected with Klaeng District and Mueang Rayong District

West: connected to Ban Khai District and Pluak Daeng District

Pa Yup Nai Sub-district is located in the north of Wang Chan District. It is about 11 kilometers from Wang Chan District and about 50 kilometers from Rayong City with an area of approximately 149.528 square kilometers or about 93,456 rai.

North: connected to Khao Sok Sub-district, Nong Yai District Chonburi

South: connected to Chum Saeng Sub-district, Wang Chan District, Rayong Province

East: connected to Chum Saeng Sub-district, Wang Chan District, Rayong Province

West: connected to Nong Bua Sub-district, Ban Khai District, Rayong Province and Nong Rai Sub-district, Pluak Daeng District, Rayong Province

Pa Yup Nai Sub-district has a flat and mountainous terrain. The soil condition is generally sandy loam. It has a total population of 6,957 people, divided into 3,493 males, 3,334 females, with an average density of 40 people/square kilometer.

Main occupations: 1. General contractor, 2. Agriculture: rubber, cassava, pineapple, 3. Trade, 4. Government service, and 5. Others

Agriculture in the area includes: 1. Rubber, 2. Cassava, and 3. Sugar cane

Rubber plantations in Wang Chan area included 96,904 rai or 13.42 percent of the rubber plantations in Rayong Province.

The field study area included the rubber plantations in the Pa Yup Nai Sub-district. A sampling plot of 40 × 40 m (1 rai) was placed. The researcher collected tree data in the sampling plot of 40 × 40 m which was divided into 10x10 sub-plots, 16 sub-plots in total. Data of all trees with a height of more than 1.30 meters and a diameter at breast height (DBHI) greater than or equal to 4.5 centimeters were collected. The findings are as follows.

1) Plant species information

Name: rubber tree

Scientific name: *Hevea brasiliensis*

Age :10 years

Species: RRIM600

2) Number found (plant/rai)

In the sampling area, it was found that 80 rubber trees were planted per rai with a distance of 25 × 8 meters. The rubber planting distance affected growth, weed control under the shade, ease of internal management and yield of latex. In general, a rubber tree requires an area of about 20 square meters in a flat area.

3) Diameter at breast height (DBH)

The diameter at breast height (DBH) was measured by the circumference of the trunk at the breast height (1.3 meters from the ground or diameter at breast height (DBH) (TGO, 2021). Eighty sample trees must have DBH greater than or equal to 4.5 centimeters. The survey results are as shown in Table 1.

Table 1Diameter at breast height of the rubber tree samples

Number	Average diameter	Elevation	Lowest	Highest
(Tree)	(Centimeter)	(Centimeter)	(Centimeter)	(Centimeter)
80	14.538	± 3.218	7.643	22.930

According to Table 1, it was found that the mean diameter at breast height (DBH) of the rubber tree samples was 14.538 ±3.218 cm, with the lowest value being 7.643 cm and the highest value being 22.930 cm.

4) Height of rubber tree

The height of the rubber tree was measured according to the method of the Green Glass Management Organization (Public Organization) by using the clinometer to measure the angle and calculate the height of the rubber tree. The survey results of the rubber tree height in the sample group are shown in Table 2.

Table 2 Height of the rubber tree samples

Number	Average diameter	Elevation	Lowest	Highest
(Tree)	(Meter)	(Meter)	(Meter)	(Meter)
80	12.940	±2.580	7.420	20.720

According to Table 4.2, it was found that the average height of the rubber tree samples was 12.940 ±2.580 m, with the lowest value being 7.420 m and the highest value being 20.720 m.

Part 2: Study on above-ground biomass of rubber plantations

The study on biomass was evaluated with allometry equations by Ogawa et al. (1965); Trephattanasuwan et al. (2008); IPCC (2006); Pongsak (1988) and Ticha (2016). The living above-ground biomass included the tree part above the ground. The calculation of the biomass of rubber plantations included allometric equations as follows:

Stem $\log W_S = 0.866 \log D^2H - 1.255$; (r^2=0.991)……..Equation 1

Branch $\log W_B = 1.144 \log D^2H - 5.222$; (r^2= 0.878)……Equation 2

Leaf $\log W_L = 0.572 \log D^2H - 1.152$; (r^2= 0.922)……..Equation 3

Where:

W_S is the above-ground biomass yield of rubber trees in the trunk (kg per area)

W_B is the above-ground biomass yield of rubber trees in the branch (kg per area)

W_L is the above-ground biomass yield of rubber trees in the leaf (kg per area)

D is the diameter at breast height of the rubber tree (cm).

H is the height of the rubber tree (meters).

The results of calculation of above-ground biomass of the rubber trees in each section using the allometric equations are shown in Table 3 as follows:

Table 4.3 Above-ground biomass yield of rubber tree

Biomass yield	Components of rubber tree			Total	Unit
	Trunk	Branch	Leaf		
Average above-ground biomass	55.537	0.057	6.587	62.181	(Kg/plant/rai)
Deviation	25.905	0.035	2.057	-	(Kg/plant/rai)
Lowest	15.103	0.010	0.189	-	(Kg/plant/rai)
Highest	6.587	2.057	12.502	-	(Kg/plant/rai)

Percent	89.315	0.092	10.593	100	
Total above-ground biomass yield	4,442.997	4.597	526.995	4,974.589	(kg/rai)
Total above-ground biomass yield	27.769	0.029	3.294	31.092	(tons/ha)

According to Table 3, the mean above-soil biomass in each component of the rubber tree was as follows: trunk 55.537(kg/plant/rai), branch 0.057(kg/plant/rai) and leaf 6.587(kg/plant/rai). Combining the components, it was equal to 62.181 (kg/plant/rai). When taking into consideration the deviation, minimum and maximum values in the trunk, branch and leaf in percentage, the results were as follows: trunk 89.315 percent, branch 0.092 percent and leaf 10.593 percent. The total above-ground biomass yield when calculated in units of (kg/rai) is as follows: trunk 4,442.97 (kg/rai), branch 4.597 (kg/rai) and leaf 526.995(kg/rai). Combining the components, it was equal to 4,974.589(kg/rai).

Discussions

According to this experiment, the samples were collected from 80 rubber trees/rai at a distance of 2.5 x 8 meters. The rubber planting distance affected growth, weed control under the shade, ease of internal management and yield of latex. According to the measurement of DBH of the rubber tree samples, it was found that the DBH was 14.538 ±3.218 centimeters with the lowest value of 7.643 centimeters and the highest value of 22.930 centimeters. In addition, it was found that the average height of the rubber tree samples was 12.940 ±2.580 m with lowest value of 7.420 m and the highest value of 20.720 m. The trunk had the highest value 4,442.997 (kg/rai), followed by the leaf which was 526.995(kg/rai) and the branch which was 4.597(kg/rai). The total above-ground biomass yield of various components of the rubber tree was 4,974.589 (kg/rai), and the total below-ground biomass yield of rubber tree was 1,343.139 (kg/rai). The experiment also found that the component of the rubber tree with the best carbon sequestration in biomass was the trunk which was equal to 2,383.116 (kg/rai), followed by the leaf which was equal to 56.284 (kg/rai) and the branch which was equal to 4.597(kg/rai).

Conclusion

Survey and Study on Above-ground Biomass of Rubber Plantations in Pa Yup Nai Sub-district, Wang Chan District, Rayong Province was to survey and study above-ground biomass of the rubber plantations in Pa Yup Nai Sub-district, Wang Chan District, Rayong Province. In terms of the total above-

ground biomass yield in the trunk (the highest value), followed by the leaf and the branch, respectively. The total above-ground biomass yield of various components of the rubber tree was equal to 4,974.589(kg/rai).

Recommendations

Recommendation for next paper publication, there should use the data of this paper to calculate carbon sequestration of Para rubber plant.

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