Case Study: Measuring Dalbergia species (Rosewood Trees) in Wabumari and Sololo Conservation Area, Milne Bay province

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Introduction

Trees are very useful resources used in daily lives of the people in the society. It makes up the largest terrestrial biome as rainforest of the earth which plays an important role in the ecosystem. Trees makes up the rainforest which then makes the soil moist, add minerals and nutrient to the ground which many organisms require for survival. Forests host the most diverse organisms from microorganisms to most organized organisms such birds and mammals. Forest plays many important functions in an ecosystem both biotic and non-biotic benefits such as carbon absorption, plant pollination, photosynthesis, purifying water, nitrogen cycle and more. Thus, it is very important to converse and preserve natural rainforest as it plays an important role in natural stability.

Today, due to the current trend of climate change as a result of human activities in producing greenhouse gases into the atmosphere, the forest acts as an important asset in life which can help reduce the emission of gases by absorbing the gases for their metabolic process. Just imagine when all the forests are cut or destroyed and imagine how life would be. Thus it is important to avoid illegal logging and stop people or logging companies from destroying forest for logs.

Healthy forests absorb tremendous amounts of carbon dioxide. When trees fall, usually due to illegal logging or converting land for agricultural use, the forests become sources of harmful greenhouse gases instead of serving as important carbon “sinks.” Most biodiversity of Papua New Guinea is undiscovered and undocumented and there is a huge gap in the knowledge of biodiversity. Therefore, it is very important to carry out biodiversity surveys to have possible knowledge and understand on flora and fauna.

Thus, this survey was done to measure the height, diameter and most importantly the carbon content on how much the forest can absorb the carbon dioxide in the atmosphere. This also helps to educate and train the locals on how to measure tree and calculating measurements. Both Wabumari and Sololo villages have the rainforest which host the most diverse flora and fauna in Papua New Guinea. Wabumari is located at coastal bays of Milne Bay and Sololo is located at the inlands of Milne Bay which both host the largest rainforest.

Aim

The aim of this field trip to Wabumari and Sololo was:

- To know how to measure the tree diameter
- To know how to measure tree height
- To calculate the carbon content, basal area and other measurements of a tree
- To know specific instruments used for measuring the tree.

Hypothesis

The tree plant growth and carbon absorption is lower at higher elevation then at lower elevation.

Instruments

The instruments used in this field work were a tape measure, rope and a stick. The pictures show how the Diameter at Breast Height was measured using rope and a tape measure. The picture shows how the height of the tree was measured using the stick method.

Methods

1. Measuring diameter

Diameter of a tree is measured by method of calculating DBH, which is known as the Diameter at Breast Height.

There are three (3) steps that are used to find the DBH. First step was, the specific tree was chosen, then using the girthing tape, the tree was measured above from the ground up to a 1.4 m height on the tree's trunk. And the next was, on the 1.4 m marked, the circumference of the tree was measured using the girthing tape. Then the measurement was recorded as given below. This measuring method was used for the circumference, thus using the circumference, the diameter was calculated.

Since were all agreed to calculate for the ten (10) trees for each elevations, the same techniques were used for the DBH of the other nineteen (19) trees and only five each were recorded below the result.

Community staff and a local landowner measure tree diameter

2. Measuring the height of the tree.

It is very hard to measure the height of the standing tree. But there are different methods and tools that can be used to measure the height of a tree. The height can measured using stick, ruler, clinometer pencil and etc. Thus the first step is upon choosing a tree, holding the stick up right at arm's length, carefully walked back till the stick covered the tree from base to top. Thus from that distance to the tree, the measurement was record by estimated steps waked. Using the same technique, the heights of the other nineteen (19) trees were measured and recorded as given in the result but on five were given below.

Clifford Yaee teaching community staff how to measure tree height

Results

Volume = Basal Area x Height 3
Data Analysis

Diameter Calculations

Since there was no Caliper to measure the DBH, thus using the formula for circumference, the diameters were calculated.

Circumference = $2\pi r$

Basal Area

Basal Area is simply the cross-sectional area of a tree stem measured at breast height (1.4m). DBH is expressed in centimeters and basal area is in meters.

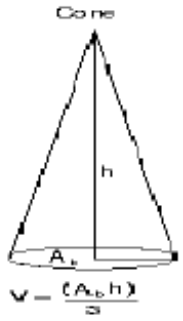
Thus, 1000cm per square meter.

$$\text{Basal area} = \text{pi} * (\text{DBH})^2 / (4*10000)$$

$$\text{Basal area} = \text{pi} * \text{DBH}^2 / 40000$$

Tree Volumes

The volumes can be estimated in a number of ways. Tree volume is simply the cross-sectional area of a tree stem measured at breast height (1.4m).



$$\text{Volume} = \frac{\text{Basal Area} \times \text{Height}}{3}$$

Biomass

The green weight of a tree is an estimate of the weight of the tree when it is alive.

For trees with diameter <28cm:
$GW = 0.0577 * d^2 * h$

For trees with diameter >28cm:
$GW = 0.0346 * d^2 * h$

Calculating Dry Weight (DW)

Estimates of dry weight to green weight show a 50:50 ratio and so, to find the dry weight, multiply green weight (GW) by 50%.

$DW = GW * 0.5$

That is; DW is about 50% of GW

Carbon Calculation

Carbon storage is the amount of carbon that is within the wood of the tree, negating other minerals and elements. To find carbon storage, multiply dry weight (DW) by 50%.

- $C = DW * 0.5$

That is; C is about 50% of DW

- Total CO2 sequestered by the tree = 31.98 * Y + total weight of carbon

- A rough estimate of the age of the tree:

$$\text{Tree age} = \frac{\text{Tree girth}}{2.5}$$

Results

The table 1, shows the different measurements of ten (10) *Dalbergia sp* (Rosewood) at two different elevations of Wabumari.

Tree	Height (m)	Girth (m)	DBH (cm)	Basal Area (m^2)	Volume (m^3)	Biomass GW (kg)	Biomass DW (kg)	Carbon content (kg)	Total CO2 sequestered	Tree age(yrs)	Total CO2 sequestered/year
Dalbergia sp. at high elevation											
1	36	3.93	120	1.13	13.6	7937	3969	1985	7278	157.2	46.30
2	20	2.3	80	0.50	3.33	4429	2215	1108	4063	92	44.2
3	34	1.5	48	0.18	2.04	2710	1355	678	2486	60	41.43
4	22	1.85	60	0.28	2.05	2740	1370	685	2512	72	34.90
5	23	2.43	80	0.50	3.83	5093	2547	1274	4671	97.2	48.06
Mean	27	2.40	77.6	0.52	4.87	4582	2291	1146	4202	95.7	42.98
Dalbergia sp. at lower elevation											
1	27	2.8	89	0.62	5.58	7400	3700	1850	6783	10.8	628.1
2	30	2.6	83	0.54	5.40	7151	3576	1788	6556	12	546.3
3	28	2.7	86	0.58	5.41	7165	3583	1792	6571	11.2	586.7
4	24	2.8	89	0.62	4.96	6578	3289	1645	6032	9.6	628.3
5	26	2.6	83	0.54	4.68	6197	3099	1550	5683	10.4	546.4
Mean	27	2.7	86	0.58	5.00	6898	3449	1725	6325	10.8	587.1

The table 2, shows the different measurements of ten (10) *Dalbergia sp* (Rosewood) at two different elevations of Sololo.

Dalbergia sp. at high elevation											
Tree	Height (m)	Girth (m)	DBH (cm)	Basal Area (m^2)	Volume (m^3)	Biomass GW (kg)	Biomass DW (kg)	Carbon content (kg)	Total CO2 sequestered	Tree age (yrs)	Total CO2 sequestered/year
1	14	2.18	69	0.37	1.73	2306	1153	576.5	2113.8	87.2	42.2
2	50	1.92	61	0.29	4.33	6437	3219	1609.5	5901.5	76.8	76.8
3	45	4.05	129	1.31	19.7	25910	12955	6477.5	23751	162	146.6
4	45	2.45	78	0.48	7.2	9473	4737	2368.5	8684.5	98	88.62
5	60	4.64	148	1.72	34.4	45473	22737	11368.5	41685	185.6	224.6
Mean	42.8	3.05	99.6	0.83	13.5	17920	8960	4480.1	16427	121.92	115.76
Dalbergia sp. at lower elevation											
1	20	2.2	70	0.38	2.53	3390.8	1695	847.5	3107.5	88	35.3
2	20	1.87	60	0.28	1.87	2491.2	1246	623	2284.3	74.8	30.5
3	19	1.75	50	0.20	1.27	1643.5	821.8	410.9	1506.6	70	21.5
4	33	2.75	83	0.54	5.94	7865.9	3933	1966.5	7210.5	110	65.55
5	27	2.90	92	0.66	5.94	7907.1	3954	1977	7249	116	62.49
Mean	23.8	2.29	71	0.41	3.51	4659.7	2330	1165	4271.6	91.8	43.068

Discussion

Height, Girth and DBH of Dalbergia sp

When comparing the height of the *Dalbergia sp* tree, growing at the two (2) different elevations, it showed that all the trees were growing at the same or similar ranges of height, which most of them growing between 20 meters to 40 meters. The average height of the trees growing at higher altitude for Wabumari was 27m and lower altitude was 27m. While in Sololo, higher elevation was 42.8m and lower 23.8. Thus for Sololo at lower elevation most of the large *Dalbergia sp* were cut down during the selective logging, thus leaving the smaller tree, therefore the results showed that lower elevation has lower value than higher elevation unlike Wabumari.

For the girth of *Dalbergia sp*, most of the species growing at the higher altitude, have thinner girth ranging from 1.5 meters to 3 meters for both areas, while those growing at the lower elevation have the thicker girth between 2 meters to 3 meters for Wabumari and Sololo between 1.7 meters to 3 meters. And for DBH, the result depends on the girth of the tree, which those growing at the higher elevation have the lower value of DBH which ranges from 40 centimeters to 120 centimeters while those grown at lower elevation have the highest value between 80s centimeters for Wabumari. Sololo forest is a disturbed forest, which selective logging was once done thus result is contradicts. Thus forest in Wabumari is never been disturbed results aligns with the phenomenal aspects of altitude influence as explained next line below.

This shows that few of the trees growing at higher altitude have lower height and all the trees at lower altitudes have grown higher. This is due to the fact that, at higher elevation, beyond the tree line, the trees cannot tolerate the environmental conditions (usually very cold temperature and lack moisture). Thus, most trees grown higher and well with the tree line where there is enough environmental conditioned it to grow. Few tree trees at higher elevation have lower height then compared to trees growing at the lower elevation. At higher elevation, beyond the tree line, the trees cannot tolerate the environmental conditions (usually very cold temperature and lack moisture). Thus, most trees grown higher and well with the

tree line where there is enough environmental conditioned it to grow. Many tree species have different adaptive method for survival. As we moved up the elevation, most species of organisms decrease and don't grow well due to survival factors such as low temperature, lack moist, lack nutrients and minerals which may contribute to the competition of resources.

Other Calculated Values (Basal Area, Volume & Biomass)

Other results such results such volume, basal area and biomass depends on the high, DBH and the girth. In other word this are the independent variables which depend on the conditions of the growth. Thus having that scenario in mind, the values of trees growing at the higher elevation have the low values compared to the trees growing at the lower elevation. As stated above, many plants have different adaptive method to grow in different environmental conditions. But higher elevation as limited resources thus has the great impact on the growth of the organism. While the lower elevations has rich in resources (sunlight, nutrients and etc.), thus many of the organism grows very well, therefore, as shown above in the results, the trees growing at higher elevation has values and those growing at lower elevation has higher values.

Carbon production

Carbon production of the tree depends on the rate of photosynthesis of the plants on how well the plants exchange their gases (Oxygen and Carbon dioxide). This means that, carbon production depends on the availability of carbon dioxide and oxygen gas in the atmosphere. According to J.Gale (2004), stated that not only plant leaves exchanges gas under saturated light and other optimum condition. It was further explained that during the day, at high elevation, maximum solar radiation may be well above saturation levels for photosynthesis of C3 plants. Some factors like respiration is very high at high altitude, thus competing when the photosynthesis process, mechanism of stoma have to choose to allow one of the process. Since the respiration rate is very high, creating high pressure in the plants, respiration is give priority through the stoma impeding photosynthesis, as a result not much photosynthesis processes is carried out by plants, thus produce low carbon rate. Therefore, with increase in the altitude, the rate of photosynthesis decrease and as a result, the partial production of carbon is also low. Therefor when comparing the result above confirms that, those trees growing at higher elevation has low carbon production then those trees growing at the lower elevation especially for undisturbed Wabumari be possible perfect result than for the Sololo as disturbed forest which the results are inaccurate.

Conclusion

Elevation gradient is one of the factors that contribute to the growth of the entire living organisms. Many studies have done and stated that, in every elevation as we up; there is decrease in process and growth of organisms. Thus, from the results obtain above have clearly shown that, the elevation gradient has the effect on the growth and the carbon content of the plant (Castanopsys sp.) thus, as we move up the elevation, the photosynthesis process decreases resulting low carbon production and also certain condition such as temperature, nutrients content is less at higher altitude. Therefore for completion is very high at the higher elevation resulting low growth and developments. Thus, trees are a very important resource that plays its role in everyday life of all organisms including the human being, such as social benefits, communal benefits, environmental benefits and economic Benefits.

References

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