WOODY PLANT DIVERSITY AND ABOVEGROUND CARBON STOCKS OF (*Shorea roxburghii* G. Don) DOMINANT FORESTS IN TAN PHU, DONG NAI PROVINCE

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SUMMARY

Plant diversity and carbon stocks play an important role in an increasingly complex climate change context. A total of 12 sample plots (50 m x 50 m) were established in 3 three different forest states, 4 plots/each forest state. Together with the quantitative analysis method of biodiversity indicators and the biomass equation (AGB) were used to determine the diversity of woody plants and aboveground carbon stocks of the *Shorea roxburghii* dominant forests at Tan Phu, Dong Nai. The results showed that a total of 92 woody plant species, 65 genera of 40 families were recorded. Of them, 37 threatened species were found in the IUCN list (2020), 6 species in the Vietnamese Red Data Book (2007), and 3 species in Decree No. 06 of the Government. The quantitative indicators of biodiversity were identified: Important value index (IVI) from 45.3-57.6%; Similarity index (Sc) from 66-74%; Margalef (d) from 6.7-7.1; Pielou (J') from 0.80-0.86; Shannon-Wiener (H') from 2.87-3.05; Gini-Simpson (1- λ') from 0.90-0.93; Whittaker (β) from 2.64-2.71; and Rényi index, showed that moderate diversity. A total biomass and average aboveground carbon stocks of the states ranged from 106.15 (t/ha) and 53.07 (tC/ha) to 282.63 (t/ha) and 141.32 (tC/ha). The study clarifies the biodiversity and aboveground carbon storage capacity of the *Shorea roxburghii* dominant forest in Tan Phu, making an important contribution to climate change mitigation.

Keywords: Biomass, carbon stock, *Shorea roxburghii*, Tan Phu, woody plant diversity.

1. INTRODUCTION

The study on plant diversity and carbon stocks has become an important issue in the carbon cycle and adaptation to climate change (Midgley *et al.,* 2010). Moreover, forest diversity plays an important role in supporting ecosystem processes, functions, and services that have become an issue in the environment and ecology (Loreau *et al.,* 2001). To develop environmental management plans to mitigate and adapt to climate change and protect biodiversity, research on plant diversity and carbon stocks has received special emphasis during the decades (Bosworth *et al.,* 2008). Such studies help highlight the environmental benefits and roles of ecosystems. At the same time optimize the environmental benefits of storage and conservation of plants.

The total aboveground biomass is the most important CO_2 pool which is directly affected by forest degradation. Estimating the total amount of biomass aboveground is an important step in assessing the total amount of CO_2 and its circulation in the forest ecosystem (Tran Quang Bao & Nguyen Van Thi, 2013). Therefore, studies on the CO_2 absorption capacity of each specific vegetation type were needed for quantifying the economic values brought about by the forest and establishing a payment mechanism for environmental services (Tran Quang Bao & Nguyen Van Thi, 2013).

Few studies about the quantification of forest carbon stock were carried out worldwide and still, many forest ecosystems remained unexplored (Rowena *et al.,* 2020) especially in Dong Nai province. With that, this study aims to determine the woody plant diversity and aboveground carbon stocks thereby identify the potential of *Shorea roxburghii* dominant forest in Tan Phu, Dong Nai as a valuable carbon pool.

2. RESEARCH METHODOLOGY

2.1. Study sites

This study was carried out in 2017 - 2019 at Tan Phu, Dong Nai province (from $11^0$2’32” to $11^0$10” N and $107^0$20 'to $107^0$27’30” E). The total area was identified as about 13,862.2 ha, belonging to the tropical monsoon climate (sunny and rainy season). The average air temperature was 25^0C/year. The average annual rainfall was 2,100 mm/year. The average air humidity was 80%. The terrain elevation was from 80 - 120 m above sea level (Le Hong Viet *et al.,* 2020). Tan Phu forest was characterized by a tropical moist evergreen closed forest the main composition was represented by *Shorea roxburghii*, *Dipterocarpus alatus, D. costatus, D. dyeri, D. intricatus, D. turbinatus, Anisoptera costata, Hopea odorata,* and some species of *Lagerstroemia spp., Diospyros spp., Syzygium spp., Knema spp., Vitex spp.*, etc.

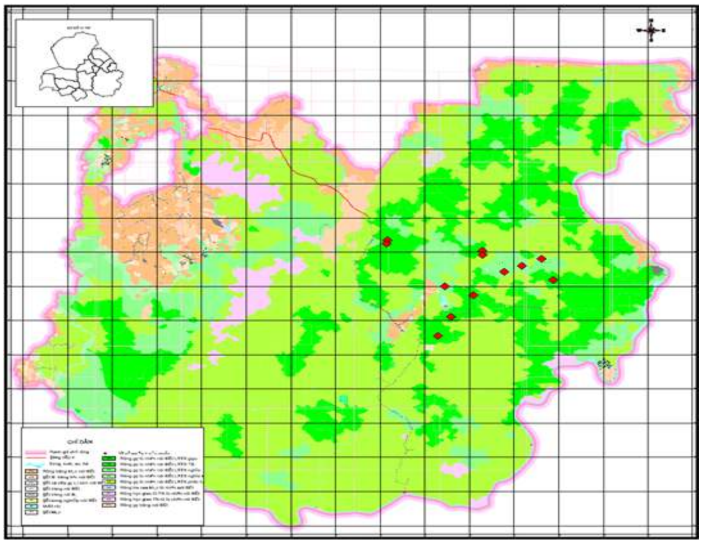

Figure 1. Location of investigation plots

2.2. Methodology

2.2.1. Field survey

A total of 12 sample plots (50m x 50m) were set up of 3 forest states (4 plots/status): rich, medium, and poor of the *Shorea roxburghii* dominant forest. In which: Rich forest: Volume > 200 (cubic meter/ha); medium forest: 100 < Volume ≤ 200 (cubic meter/ha); poor forest: 50 < Volume ≤ 100 (cubic meter/ha) (Circular No. 33/2018/TT-BNNPTNT, 2018). Information on common names, the number of individuals, diameter at breast height (DBH), and overall height (Hvn) of each tree were collected in each sample plot. Trees bigger than 6 cm in diameter were considered for DBH.

2.2.2. Data analysis

The species name was identified by the method of comparative morphology. The documents were used to identify plant species: An Illustrated Flora of Vietnam, volumes 1-3 (Pham Hoang Ho, 1999-2003), Vietnam Timber Resources (Tran Hop, 2002), Economic timber trees in Vietnam (Tran Hop & Nguyen Boi Quynh, 2003), Kew science. The scientific name of the species was identified and regulated by Kew Science, World flora online. A species list was established by the Brummitt (1992) taxonomy systems.

Threatened species were identified by the IUCN Red List (2020) (updated 10/2020), Vietnam Red Data Book (2007) and Decree 06/2019 of the Vietnamese Government.

Importance Value Index (IVI) was determined by Thai Van Trung (1999): IVI =

(N% + G% + V%)/3. Where: IVI: Importance Value Index; N%, G%, and V% are density, basal area, and trunk volume, respectively. V = G*H*F, where F = 0.45. Species with an IVI index ≥ of 4% were determined are dominant and co-dominant.

The Margalef index (d) was calculated by the formula: $d = \frac{s-1}{\log N}$

Where: d: Margalef diversity index; s: a total of species in the sample; N: a total of the individual in the sample.

The Shannon–Weiner index (H') was determined by the formula:

$$H' = -\sum_{i=l}^{s} \text{Pi} * \ln\text{Pi}$$

Where: H': Shannon-Weiner index; Pi = Ni/N; Pi: the proportion of individuals in the population; S: the number of species; Ln = Log base. The species diversity out comes was interpreted using the description by Fernando (1998): Low (H' = 1 – 2.49), Moderate (H' = 2.5 – 2.99), High (H' = 3 – 4).

Gini-Simpson's index (1 - λ') was determined by the formula of Simpson:

$D_{Simpson} = \Sigma^{S}_{i=1}(ni/N)^2 = \Sigma^{S}_{i=1}p_i^2$

Where: $D_{Simpson}$ = Gini-Simpson's index (1 - λ'); ni: Number of individuals of species i; N: Total number of individuals of all species.

Pielou index (J') was determined by the formula: J' = H'/HMax, with H'max = Ln (S).

Where: H': the Shannon-wiener index, S: the total number of trees in the sample plot.

Whittaker index (β) was calculated by the formula: β = S/s.

Where: S: the total number of species in the study area, s: the average number of species in the sample plot.

Similarity index (Cs) was determined by the formula of Sorensen (1948):

CS = 2c/(a + b)*100.

Where: a: the number of species in state i; b: the number of species in state j; c: the number of similar species in states i and j; (a + b): the total number of species in state i and j.

Entropy Rényi index (Breugel, 2007) was calculated by the formula:

$$H_\alpha = \frac{\ln(\sum_{i=1}^{s} p_i^\alpha)}{1-\alpha}$$

Where: s is the total number of species, pi is the relative abundance of species i in the sample plot, a is a variable parameter from 0 - ∞.

Tree biomass was computed using the following Allometric Equation: exp (-2.134 + 2.530 x ln(DBH), with DHB = 5-148 cm, n = 170 trees, R^2 = 0.97. Which was derived and adapted from Brown (1997) for the tropical forests with precipitation of 1500-4000 mm/yr. For the biomass density, the total biomass per plot was multiplied to 10,000 m^2 divided by the plot size in square meters which was 50 m x 50 m or 0.25 ha. On the other hand, tree carbon stock was computed by multiplying the tree biomass with the IPCC default carbon fraction value of 50% (0.50) (Houghton *et al.,* 1997). Where: DBH = diameter breast height expressed in centimeter; Tree data were converted into tree biomass per unit area (ha^{-1}); Tree Carbon stock was computed using the Carbon Stock = Biomass x 0.50.

3. RESULTS

3.1. Species component

3.1.1. Woody species composition

A total of 92 taxa of woody plant species were recorded in the *Shorea roxburghii* dominant forest, belonging to 65 genera in 40 families. In which, the rich forest was determined to be the richest (64 species), the lowest in the medium forest (61 species). The average quantity of species relatively homogeneous in three states (35 - 36 species/0.25 ha). The highest density was determined in the medium forest (200 trees/0.25 ha); the lowest was in the poor forest (131 trees/0.25 ha).

The families of species richness were represented by Dipterocarpaceae and Myrtaceae 8 species each (8.70%), Lauraceae was represented by 7 species (7.61%), while

Euphorbiaceae and Ebenaceae were represented by 5 species each (5.43%). Annonaceae, Rubiaceae, and Sapindaceae were represented by 4 species each (4.35%), main while Anacardiaceae, Elaeocarpaceae, Verbenaceae were represented by 3 species each (3.26%). Aquifoliaceae, Clusiaceae, Fabaceae, Hypericaceae, Lythraceae, Mimosaceae, Symplocaceae, Tiliaceae were represented by 2 species each (2.17%), and 21 families of single species.

Syzygium (8 species = 8.70%), *Diospyros* (5 species = 5.43%) were the most species-rich genera. Also, *Dipterocarpus*, and *Vitex* (4 species = 4.35%), *Elaeocarpus* (3 species = 3.26%); genera *Ilex*, *Aporosa, Dalbergia, Cratoxylum, Litsea, Lagerstroemia, Aidia* and *Symplocos* (2 species = 2.17%), and 52 genera single species were also identified.

3.1.2. Threatened species composition

A total of 37 species (40.22% of the total species) belonging to 31 genera (47.69%) of 23 families (57.50%) were identified as endangered, precious, and rare plant species (Table 2). Of them, 3 species were found in Decree 06/2019 of the Vietnam Government (group IIA); 6 species in the Vietnam Red Data Book (2007) (3 species at Vulnerable (VU), and 3 species at Endangered (EN)); and 37 species in the IUCN list (2020) (24 species at Least Concern (LC), 1 species at Near Threatened (NT), 7 species at Vulnerable (VU) and 5 species at Endangered (EN)). Besides, *Dalbergia cochinchinensis, Sindora siamensis, Anisoptera costata, Shorea roxburghii, Dipterocarpus dyeri*, etc., which are high economic value species, were also confirmed in the *Shorea roxburghii* dominant forest (Table 1).

Table 1. Threatened species composition

No.	Scientific name	Vietnamese name	VNRB (2007)	Decree No. 06 (2019)	IUCN (2020)
1	*Acronychia pedunculata* (L.) Miq.	Bưởi bung			LC
2	*Aglaia tomentosa* Teijsm. & Binn.	Ngâu lông			LC
3	*Aidia cochinchinensis* Lour.	Găng nam bộ			LC
4	*Aidia pycnantha* (Drake) Tirveng.	Mãi táp			LC
5	*Amesiodendron chinense* (Merr.) Hu	Trường mật			NT
6	*Anisoptera costata* Korth.	Vên vên	EN		EN
7	*Antidesma ghaesembilla* Gaertn.	Chòi mòi			LC
8	*Baccaurea ramiflora* Lour.	Dâu da			LC
9	*Chaetocarpus castanocarpus* (Roxb.) Thwaites	Dạ nâu			LC
10	*Cinnamomum iners* (Reinw. ex Nees & T.Nees) Blume	Quế rừng			LC
11	*Cratoxylum formosum* (Jacq.) Benth. & Hook.f. ex Dyer	Thành ngạnh đẹp			LC
12	*Cyrtophyllum fragrans* (Roxb.) DC.	Trai nam			LC
13	*Dalbergia cochinchinensis* Pierre	Trắc	EN	IIA	VU
14	*Dalbergia oliveri* Prain	Cẩm lai	EN	IIA	EN
15	*Diospyros maritima* Blume	Vàng nghệ			LC
16	*Dipterocarpus alatus* Roxb. ex G.Don	Dầu rái			VU
17	*Dipterocarpus costatus* C.F.Gaertn.	Dầu mít			VU
18	*Dipterocarpus dyeri* Pierre ex Laness.	Dầu song nàng	VU		EN
19	*Dipterocarpus intricatus* Dyer	Dầu lông			EN
20	*Hopea odorata* Roxb.	Sao đen			VU
21	*Ilex cymosa* Blume	Nhựa ruồi			LC

No.	Scientific name	Vietnamese name	VNRB (2007)	Decree No. 06 (2019)	IUCN (2020)
22	*Irvingia malayana* Oliv. ex A.W.Benn.	Cầy			LC
23	*Knema globularia* (Lam.) Warb.	Máu chó			LC
24	*Litsea glutinosa* (Lour.) C.B.Rob.	Bời lời nhớt			LC
25	*Lophopetalum wightianum* Arn.	Ba khía			LC
26	*Mangifera minutifolia* Evrard	Xoài rừng			EN
27	*Parinari anamensis* Hance	Cám			LC
28	*Psydrax dicoccos* Gaertn.	Xương cá	VU		VU
29	*Shorea roxburghii* G. Don	Sến mủ			VU
30	*Sindora siamensis* Teijsm. ex Miq.	Gõ mật	VU	IIA	LC
31	*Syzygium cumini* (L.) Skeels	Trâm mốc			LC
32	*Terminalia calamansanai* (Blanco) Rolfe	Chiêu liêu nước			LC
33	*Ternstroemia penangiana* Choisy	Huỳnh nương			VU
34	*Tetrameles nudiflora* R. Br.	Tung			LC
35	*Vitex pinnata* L.	Bình linh cánh			LC
36	*Vitex quinata* (Lour.) F.N.Williams	Mẫu kinh 5 lá			LC
37	*Xylia xylocarpa* (Roxb.) W.Theob.	Căm xe			LC

Note: VRDB - Vietnam Red Data Book (2007); IUCN - Global conservation status (2020); EN - Endangered; VU - Vulnerable; NT – Near threatened; LC - Least Concern.

3.2. Quantitative analysis of some woody plant diversity indices

***- Important Value Index (IVI)*:** The number of families and species in the *Shorea roxburghii* dominant forest was considered changed by forest state, ranged 32 - 33 families, and 61 - 64 species, respectively. The dominant and co-dominant species composition was determined to change according to the status. Five dominant and co-dominant species were identified in each state, and the IVI index ranged from 45.3% (poor forest) to 57.6% (rich forest). *Shorea roxburghii* was recognized as the dominant species in three states, increasing from poor forest (IVI = 21.8%) to medium forest (IVI = 26.8%) and rich forest (IVI = 29.2%). So, *Shorea roxburghii* was considered an important ecological role species in the study area (Table 2).

Table 2. Important Value Index (IVI) of three forest status

No.	Rich forest		Medium forest		Poor fores	
	Species name	IVI (%)	Species name	IVI (%)	Species name	IVI (%)
1	*Shorea roxburghii*	29.2	*Shorea roxburghii*	26.8	*Shorea roxburghii*	21.8
2	*Parinari anamensis*	10.0	*Syzygium zeylanicum*	13.8	*Syzygium zeylanicum*	9.2
3	*Syzygium zeylanicum*	8.7	*Anisoptera costata*	8.3	*Parinari anamensis*	5.4
4	*Vatica odorata*	5.7	*Parinari anamensis*	4.4	*Irvingia malayana*	4.9
5	*Irvingia malayana*	4.0	*Vatica odorata*	4.0	*Careya arborea*	4.0
	A total of 5 species	57.6	A total of 5 species	57.3	A total of 5 species	45.3
	59 other species	42.4	56 other species	42.7	58 other species	54.7
	A total of 64 species	**100**	**A total of 61 species**	**100**	**A total of 63 species**	**100**

Coefficients of similarity (Cs): The Cs of woody plants in the *Shorea roxburghii* dominant forest is of high value; The average between the two forest states was 70%, ranged from 66% to 74% (Table 3).

Table 3. Similar coefficients of woody species between three forest states

No.	Status	C_S (%) of three forest states		
		Poor	Medium	Rich
1	Poor	100		
2	Medium	74	100	
3	Rich	66	69	100

Several other biodiversity indices: Margalef (d), Pielou (J'), Shannon (H') and Gini-Simpson index (1 - λ') in poor forest were calculated: d = 7.1; J'= 0.86; H'= 3.05; 1 - λ'= 0.93 is higher than the rich forest: d = 6.7; J'= 0.82; H'= 2.90; 1 - λ'= 0.90 and the medium forest: d = 6.7; J'= 0.80; H'= 2.87; 1 - λ'= 0.91, respectively (Table 4).

Table 4. Some quantitative index of woody plant diversity

No.	Diversity index characteristic	Forest status		
		Rich	Medium	Poor
1	No. of sample plot (n)	4	4	4
2	Total species (S)	64	61	63
	CV%	24.4	6.8	14.8
3	Average species/sample plot	35	36	36
4	No. of individual (N/sample plot)	165	200	131
5	Margalef (d)	6.7	6.7	7.1
	CV%	24.7	8.6	15.7
6	Pielou (J’)	0.82	0.80	0.86
7	Shannon-Wiener (H')	2.90	2.87	3.05
	H'_{Max}	4.1	4,1	4.2
	CV%	14.6	2,2	7.8
8	Gini-Simpson (1- λ’)	0.90	0.91	0.93
9	Whittaker (β)	2.71	2.55	2.64

The β - Whittaker index of rich forest (β = 2.71) is higher than medium forest (β = 2.55) and poor forest (β = 2.64). This indicated that the species composition of rich forests ranged more widely than medium and poor forests.

Table 5. Renyi diversity index in forest states

No.	Alpha	Forest states		
		Rich	Medium	Poor
1	0	4.247	4.147	4.164
2	0.25	3.914	3.863	3.973
3	0.5	3.618	3.613	3.800
4	1	3.123	3.197	3.499
5	2	2.428	2.623	3.045
6	3	1.999	2.276	2.734
7	4	1.734	2.066	2.522
8	100	1.305	1.747	2.062

The analysis results showed that the wood plant diversity index is highest rich forests, followed by poor forests, and lowest medium forests. The species richness in the poor forests is more uniform than in medium and rich forests. In general, Shannon index (H') was determined moderate diversity. On the other hand, when *Shorea roxburghii* is highly dominant in the plant community, the woody diversity components are more ranged than that.

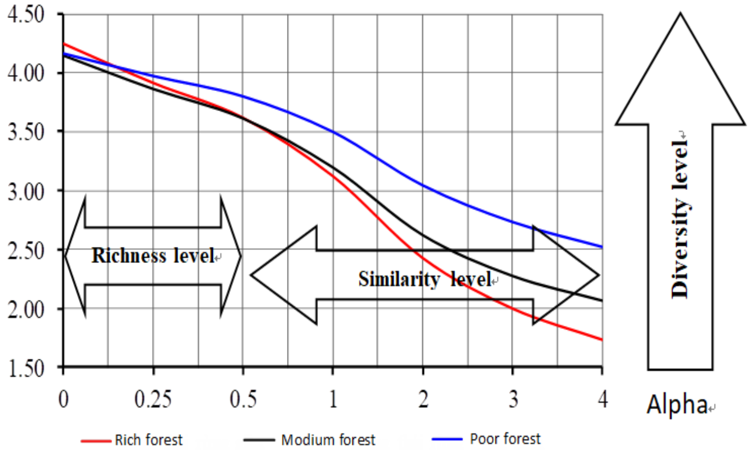

Figure 2. Histogram Rényi's woody species diversity

3.3. Total biomass and aboveground carbon stock

The total biomass and aboveground carbon stocks were determined to change according to the forest state. The highest in rich forests were 282.63 (t/ha) and 141.32 (tC/ha), followed by medium forests with 185.08 (t/ha) and 92.54 (tC/ha), the lowest was in poor forests with 106.15 (t/ha) and 53.07 (tC/ha), respectively (Table 6).

Table 6. Total biomass and aboveground carbon stock of *Shorea roxburghii* dominant forest

Forest states	Plot	AGB (t/ha)	C (AGB) (tC/ha)
Rich	1	307.88	153.94
	2	317.25	158.63
	3	253.67	126.83
	4	251.72	125.86
Average of rich forest		**282.63**	**141.32**
Medium	5	178.16	89.08
	6	178.47	89.23
	7	190.46	95.23
	8	193.22	96.61
Average of medium forest		**185.08**	**92.54**
Poor	9	96.55	48.28
	10	109.33	54.67
	11	112.17	56.09
	12	106.53	53.27
Average of poor forest		**106.15**	**53.07**

Note: AGB (t/ha): Aboveground biomass; C(AGB) (tC/ha): Carbon in AGB

A detailed analysis showed that the total biomass and aboveground carbon stocks changed by the sample plot in each state. In rich forest, estimates of biomass and aboveground carbon stocks were determined lowest in plot 4 with 251.72 (t/ha) and 125.86 (tC/ha) respectively, and the highest in plot 2 with 317.25 (t/ha) and 158.63 (tC/ha) respectively. For in the medium forest, estimates of biomass and aboveground carbon stocks were determined lowest in plot 5 with 178.16 (t/ha) and 89.08 (tC/ha) respectively, the highest in plot 8 with 193.22 (t/ha) and 96.61 (tC/ha). Meanwhile, in poor forest, estimates of biomass and aboveground carbon stocks were also determined lowest in plot 9 with 96.55 (t/ha) and 48.28 (tC/ha) respectively, and highest in plot 11 with 112.17 (t/ha) and 56.09 (tC/ha).

4. DISCUSSION

The composition of woody plant species in the *Shorea roxburghii* is quite diverse and abundant with 92 species of 40 families were recorded. However, the number of species in this study is lower than Bidoup-Nui Ba National Park (98 species) (Nguyen Van Hop, 2017) and Bu Gia Map National Park (148 species) (Vuong Duc Hoa & Vien Ngoc Nam, 2018) (Table 7).

Table 7. Comparison species diversity at Tan Phu with some regions in Southern Vietnam

Study sites	No. of species	Shannon-Wiener index (H')
Tan Phu	**92**	**2.94**
Bu Gia Map National Park	148	3.24
Bidoup-Nui Ba National Park	98	3.58

The diversity of woody plant at Tan Phu was determined in the moderate diversity by the Fernando (1998) classification scale. The Shannon (H') index was used to compare the diversity of Tan Phu with some regions of Southern Vietnam (Table 7). The result indicated that woody plant diversity in Tan Phu is lower than Bidoup-Nui Ba National Park (high diversity) (Nguyen Van Hop, 2017) and Bu Gia Map National Park (high diversity) (Vuong Duc Hoa & Vien Ngoc Nam, 2018).

Woody plants diversity in different study areas was different. This was explained by the plant diversity in general and the diversity of woody plants, in particular, was changed by environmental factors (latitude, rainfall, elevation). When environmental factors were changed, plant diversity would be changed through composition, number of species, number of individual trees, etc (Nguyen Van Hop *et al.,* 2020). Also, the plant diversity was determined depending on the type of forest vegetation (Nguyen Van Hop, 2017; Vuong Duc Hoa & Vien Ngoc Nam, 2018), climate, changes in the environment, competition among species, structure and successive stages of the plant community (Begon *et al.,* 1986).

AGB models were applied in some regions of Vietnam, but still few: Bao Huy's AGB model (2008) was applied to evergreen broad-leaved forests in Son La province by Tran Quang Bao & Nguyen Van Thi (2013); The AGB model of Brown (1997) was applied to the evergreen broad-leaved forest in the Central Highlands by Bao Huy (2012). The results of applying the AGB models showed that the permissible error was guaranteed and the AGB models could be used to determine biomass and carbon stocks in appropriate ecological regions. Besides, estimating biomass and carbon stocks using AGB models allows savings in time, money, manpower, and forest resources.

Table 8. Comparison of biomass and carbon stocks of some forest types in Southern Vietnam

Forest type	AGB (t/ha)			C(AGB) (tC/ha)		
	Rich	Medium	Poor	Rich	Medium	Poor
Shorea roxburghii	***282.63***	***185.08***	***106.2***	***141.32***	***92.54***	***53.07***
Evergreen	312.6	251.2	136.9	146.92	118.06	64.34
Semi-evergreen	246.4	170.43		108.14	91.21	
Deciduous	192.72	123.93	59.23	90.58	58.25	27.84

The biomass and aboveground carbon stocks of the *Shorea roxburghii* dominant forest are lower than that of the evergreen forest in the Central Highlands (Vo Dai Hai & Dang Thinh Trieu, 2015) (Table 8). Despite the same forest type (evergreen) and the climate regime, the biomass, and carbon stocks were different in these two regions. This result could be explained by the Tan Phu forest created by the selection harvest system in the 80-90s of the last century, the woody species of economic value and large size were the targets of harvesting. On the other hand, studies were mentioned in different ecological conditions, so estimates of biomass and carbon stocks obtained were different (Rowena *et al.,* 2020). Moreover, the differences in species composition, canopy layer structure, and soil in different regions could also create different biomass and carbon stocks. Meanwhile, the biomass and carbon stock of the *Shorea roxburghii* dominant forest is higher than that of semi-evergreen and deciduous forests. It depends on many factors such as species composition, structure, the height of the canopy layer, degree of human impact, etc (Tran Quang Bao & Nguyen Van Thi, 2013). This could be explained by the fact that semi-evergreen forest and deciduous forest were characterized by low density, simple canopy structure (2-3 layers), and simple species composition; while the evergreen forest was characterized by high density, a complex canopy structure (4-5 stories) and a diverse species composition (Ngo Tien Dung *et al.,* 2006).

Biomass and carbon stocks depend not only on the forest type but also on the forest state (Table 8). This statement is consistent with previous studies in several different ecological regions of Vietnam such as the evergreen broad-leaved forest in Son La (Tran Quang Bao & Nguyen Van Thi, 2013); evergreen broad-leaved forests, semi-evergreen and deciduous forests (Vo Dai Hai & Dang Thinh Trieu, 2015).

5. CONCLUSION

The *Shorea roxburghii* dominant forest in Tan Phu (Dong Nai) is quite diverse and abundant species. Besides, it also plays an important role in conservation and economic value. Quantitative indices of woody diversity were identified and analyzed: Important value index (IVI), Margalef (d), Shannon-Wiener (H'), Whittaker (β), Sorensen (Cs), Gini-Simpson (1 - λ'), Rényi showed that woody plant diversity index changed by the states. On the other hand, the diversity in the states in particular and the *Shorea roxburghii* dominant forest, in general, was determined moderate diversity. Total biomass and aboveground carbon stocks were recorded to depend on sample plots, and forest status. The research showed that the *Shorea roxburghii* dominant forest in the tropical moist evergreen closed forest not only plays value in biodiversity, economics but also plays an important ecological role through total biomass, and aboveground carbon stocks.

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ĐA DẠNG THỰC VẬT THÂN GỖ VÀ TRỮ LƯỢNG CARBON TRÊN MẶT ĐẤT CỦA RỪNG ƯU THẾ (*Shorea roxburghii* G. Don) Ở TÂN PHÚ, TỈNH ĐỒNG NAI

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TÓM TẮT

Đa dạng thực vật và trữ lượng carbon giữ một vai trò quan trọng trong bối cảnh biến đổi khí hậu đã và đang diễn ra ngày càng phức tạp. Tổng số 12 ô mẫu (50 m x 50 m) được thiết lập ở 3 ba trạng thái rừng khác nhau, 4 ô/mỗi trạng thái rừng. Cùng với phương pháp phân tích định lượng các chỉ số đa dạng sinh học và phương trình sinh khối (AGB) được sử dụng để xác định tính đa dạng của thực vật thân gỗ và trữ lượng carbon trên mặt đất của rừng ưu thế *Shorea roxburghii* tại Tân Phú, Đồng Nai. Kết quả đã chỉ ra rằng, tổng số 92 loài thực vật thân gỗ, 65 chi của 40 họ đã được ghi nhận. Trong đó, 37 loài bị đe dọa đã được liệt kê trong danh lục IUCN (2020), 6 loài trong Sách đỏ Việt Nam (2007) và 3 loài trong nghị định 06 của Chính Phủ. Các chỉ số định lượng đa dạng sinh học đã được xác định bao gồm: Chỉ số giá trị quan trọng (IVI) từ 45,3-57,6%; chỉ số tương đồng (Sc) từ 66-74%; Margalef (d) từ 6,7-7,1; Pielou (J’) từ 0,80-0,86; Shannon-Wiener (H’) từ 2,87-3,05, Gini-Simpson (1- λ’) từ 0,90-0,93; và Whittaker (β) từ 2,64-2,71, cho thấy tính đa dạng ở mức trung bình. Tổng sinh khối và trữ lượng carbon trên mặt đất trung bình của các trạng thái từ 106,15 (tấn/ha) và 53,07 (tấn C/ha) đến 282,63 (tấn/ha) và 141,32 (tấn C/ha). Nghiên cứu đã làm sáng tỏ tính đa dạng sinh học và khả năng lưu trữ carbon trên mặt đất của rừng ưu thế *Shorea roxburghii*, góp phần quan trọng trong việc giảm thiểu biến đổi khí hậu.

Từ khóa: Đa dạng thực vật thân gỗ, sinh khối, *Shorea roxburghii*, Tân Phú, trữ lượng carbon.

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