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Assessment of Plant Diversity and Carbon Stock of a Sub-Tropical Forest Stand of Mizoram, India

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Abstract We assessed plant diversity and carbon stock in a sub-tropical forest stand located inside Pachhunga University College, Mizoram University during 2018. A total of 33 species of trees were found and 16 families were noted with *Moraceae* having highest number of species. *Schima wallichi, Eucalyptus citriodora* and *Aporosa octandra* were found to have the highest Importance Value Index (IVI). The density of the trees ranged from 2 to 88 with *Schima wallichi* having the highest value. The Simpson Dominance Index was found to be 0.071 and Shannon-Weiner Index (H`) was 3.056. The total carbon stock was found to be 283.02 ± 55.09 Mg C ha^{-1} which was high for a sub-tropical forest. The results may be useful for modelling the carbon stock potential and conservation of plant diversity.

Keywords Carbon stock, Plant diversity, Sub-tropical forest, Mizoram.

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Introduction

Carbon stock refers to the quantity of carbon that is accumulated in a given ecosystem in the biotic biomass as well as abiotic biomass such as soil along with deadwood and litter. Is is the quantity of carbon contained in a reservoir or pool which has the capacity to agglomerate or release carbon. The forest ecosystem has a major role in the maintenance of habitats that has important global diversity and they play a number of roles in regulating, supporting and cultural services to the livelihood of humans and other organisms (Escobedo et al. 2015). Since forests have a fundamental role in climate change mitigation as they store most of the carbon and trees absorb the carbon dioxide present in the atmosphere in the form of carbon, thus, reducing the atmospheric greenhouse gas (GHG), it is fundamental to assess the carbon stock in forests as climate change is an emerging threat to biodiversity. The increase in the levels of greenhouse gases (GHGs), especially carbon dioxide, has become a major concern and the United Nations Framework Convention on Climate Change (UNFCCC) developed the Kyoto Protocol, which is by far the largest agreement for reduction of the greenhouse gas emissions (Millar et al. 2007). The levels of atmospheric carbon dioxide that is increasing and climate changeas a global context is creating a critical need to appraise the utility of managing the ecosystem to carbon sequestration and storage of carbon. Deforestation and forest degradation has decreased the availability of goods and services that the forest provides and these issues have been addressed in developing countries since this is often related to the over-population and over-exploitation of resources for fuel and exports

(Kumar and Sharma 2015). In forests, the amount of carbon stored can differ depending on the two factors- spatial and temporal, which includes the type of forest, its size, age, vegetation associated with it and the overall ecology of the forest (Escobedo et al. 2015). Understanding all these differences along with the degree of impact caused by GHGs is vital for afforestation and forest management inprovement (Allen and Barnes 1985, Paoletti 2009).

In many parts of India, there insufficient knowledge on the carbon storage levels in tropical forests; hence, estimation of carbon stock is important for conserving forests as well its sustainable management. The evaluation of carbon stock are also critical and paramount for enhancing carbon to consider reduction of emissions from deforestation and forest degradation (REDD+). In India, the North Eastern regions have rainforests which are suitable for regional forest carbon stock program yet carbon studies as well as biomass studies are very limited in these rainforests. These studies would help in better understanding of the forest carbon storage dynamics at a regional level and it would provide valuable data which will be useful monitoring program of for carbon stock at national as global levels (Pragasan 2015). The objective of this paper was to assess the plant diversity along with the biomass and total carbon stock in a sub-tropical forest stand located in Mizoram, India.

Materials and Methods

Study site

The study was carried out in a sub-tropical forest stand located inside Pachhunga University College (PUC) Campus, which is located in Aizawl ($23^0 72'33''$ N -latitude and $92^0 72'72''$ E-longitude) (Fig. 1). The area covers *ca.* 900 ha of land and represent more or less like a reserve forest having not only a rich vegetation but also herpeto-fauna and avifauna in abundance, indicating a good balance of biodiversity. The annual average temperature is 20.6 ^{0}C in Aizawl with the summer seasons receiving more rainfall than the winter seasons. The annual rainfall received on average is 2564 mm and is evenly distributed with the occurrence of violent storms in March to April. The soil in the study area is brown, sandy and loamy.

Species composition, diversity and community indices

Five sample plots (quadrats) of 0.01 ha (31.62 m × 31.62 m) were randomly laid in the site for sampling trees. The shrubs and herbs present in the tree plots were evaluated from quadrat size 5 m × 5 m and 1 m × 1 m respectively. The deadwood available was recorded from the tree plots and litter was collected from 1 m × 1 m quadrats of each tree plot. The plant species that could not be identified were either recorded by

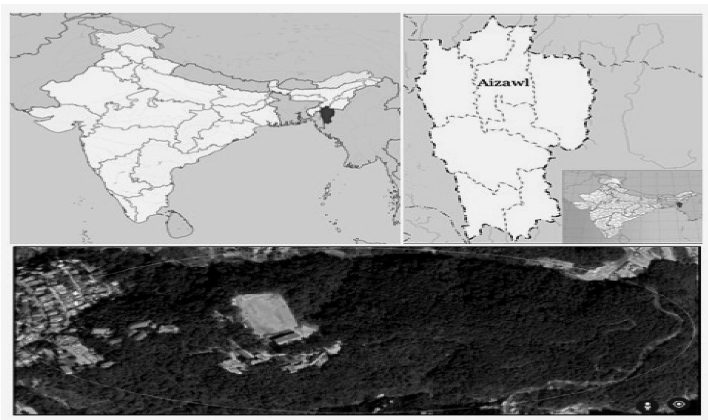

Fig. 1. Map of the study site with an aerial view of Pachhunga University College Campus, Mizoram University, Aizawl.

their local names or leaves and were later identified with the help of books published in relation to plants found in Mizoram, The density (D), frequency (F), abundance (A), dominance (Dom) and relative values of the plant species were estimated respectively (Misra 1968, Muller-Dombois and Ellenberg 1974). Importance Value Index (IVI) was calculated by the summation of relative values of density (RDen), frequency (RF) and dominance (RDom) (Curtis 1959).

Species diversity index, *H`* was calculated using Shannon-Weiner diversity index; Simpson's index was used for concentration of dominance, *Cd*; Species richness index, *SRI* and evenness index, *E* was calculated along with Sorensen's similarity index by using the formula given below:

Shannon–Weiner diversity index, *H`* (Shannon and Weaver 1949) :

$$H' = -\sum_{S=1}^{s} pilnpi$$

Where, H` is the Shannon–Weiner diversity index *pi* is the proportion of individuals in the i^{th} species i.e. (ni/N).

Simpson Index of Dominance, *D* (Simpson 1949) :

$$Cd = \sum_{i=0}^{n} pi^2$$

Where, p_i = proportion of individual in the i^{th} species

$$H' = -\sum_{S=1}^{S} pilnpi$$

Where, *H´* is the Shannon- Weiner diversity index *pi* is the proportion of individuals in the i^{th} species i.e. (ni/N).

Margalef richness index, *SRI* (Margalef 1968) :

$$SRI = \frac{S-1}{In\,(N)}$$

Where, *S* is the total number of species *N* the number of individuals

Pielou's Evenness index, E (Pielou 1966) :

$$E = \frac{H'}{In\,S}$$

Where, *H´* is the Shannon-Weiner diversity index *S* is the total number of species.

Aboveground biomass inventory

Avoveground biomass consists of tree, shrubs, saplings, lianas, herbaceous growth, deadwood and litter. All trees above 30 cm girth were measured at breast height of 1.37 m with tape and identified either by local or scientific name. Shrubs and herbaceous undergrowth were collected using destructive sampling method by laying 5 m × 5 m (2 numbers) for shrubs and for herbs 1 m × 1 m plot (5 numbers) randomly and the samples were measured. The biomass of trees was calculated by using pan-tropic equation for mixed-species according to IPCC (2006).

$$AGB=\exp\left(-2.289+2.649\times\log(DBH) - 0.021\times\{\log(DBH)\}^2\right)$$

Belowground biomass component were estimated by the models developed by Cairns et al. (1997) :.

$$BGB = \exp\left(-1.0587 + 0.8836 \times In\,(AGB)\right)$$

Where, BGB and AGB are belowground and aboveground biomass in Mg ha^{-1}.

Standing deadwoods diameter was measured using DBH while the height was estimated. Fallen deadwood were collected, then weighed and decomposition class values were estimated where sound decomposition was given 0.69, rotten coarse as 0.34 and rotten fine as 0.41.

Litter floor biomass was assessed through the litters that were collected from randomly laid 1 m × 1 m quadrat size (4 numbers) and their weight was recorded before and after oven drying.

Biomass carbon stock estimation

Biomass was calculated by the summation of both aboveground and belowground components, where, AGB consists of both the biotic and abiotic factors. AGB of trees, shrubs and deadwood were converted to carbon by assuming that 50% of the dry mass as carbon (IPCC 2006, Takimato et al. 2008). Herbs and litter components carbon content was assessed using ash content method (Negi et al. 2003). Litter was further segregated into leaves, twigs and seeds. In this method, a crucible of known weight was used. In the crucible, the oven dried samples of 3.0 g was placed and it was burnt at 550^{0}C in a muffle furnace overnight. The residue was weighed and carbon content was calculated using this equation:

$$\text{Carbon content (\%)} = \frac{100 - \textit{Ash}\ \%}{1.8}$$

Soil organic carbon stock inventory

Soil samples were collected from each of the five plots at a depth of 1-15 and 15-30 cm respectively. Five sampling plots were randomly selected and they were combined together to form one composite sample for each plot and depth. These soil samples were then oven dried overnight at around 90^{0}C– 120^{0}C, ground and sieved (Walkley and Black 1934). Soil bulk density was determined by corer method and Soil organic carbon (SOC) was estimated using the following IPCC (2003) equation:

$$SOC = \sum SOC_{horizon} = \sum^{horizon=n} \left((SOC) \times \text{Bulk density} \times \text{Depth} \times (1 - \text{frag.}) \times 10 \right)_{horizon}$$

The total carbon stock in the plot is the sum of the aboveground biomass and belowground biomass multiplied by 0.5, which represents the 50% carbon

Table 1. List of tree species with their family, basal area and importance value index in a sub-tropical forest stand of Mizoram.

Scientific name	Local name	Family	TBA ($m^2 ha^{-1}$)	Density	IVI
Acronychia pedunculata (L.) Miq.	Rah-vâr	Rutaceae	0.39	12	7.18
Albizia chinensis (Osbeck) Merr.	Vang	Fabaceae	0.19	2	2.82
Albizia procera (Roxb.) Benth	Kâng-tek	Fabaceae	0.13	4	3.19
Alseodaphane petiolaris (Meisn.) Hook. f.	Bûl	Lauraceae	0.27	14	8.09
Anthocephalus cadamba (Roxb.) Mig.	Bân-phar	Rubiaceae	2.13	4	8.91
Aporosao ctandra (Buch.-Ham. *ex* D. Don) Vickery	Chhâwn-tual	Phyllanthaceae	1.53	42	24.56
Artocarpus chaplasha Roxb.	Tât-kawng	Moraceae	0.27	2	3.05
Artocarpus heterophyllus Lam.	Lâm-khuang	Moraceae	0.81	6	5.70
Balakata baccata (Roxb.) Esser	Thing-vawk-pui	Euplhorbiaceae	1.01	12	9.65
Bombax insigne Wall.	Pâng	Malvaceae Juss.	0.29	12	7.60
Castanopsis indica (Roxb. *ex* Lindl.) A. DC.	Sehawr	Fagaceae	2.89	20	18.93
Castanopsis tribuloides (Sm.) A. DC.	Thingsia	Fagaceae	2.46	26	19.36
Elaeocarpus lanceaefolius Roxb.	Kharuan	Elaeocarpaceae	0.51	8	8.85
Eriobotrya bengalensis (Roxb.) Hook. f.	Nghal-chhun	Rosaceae	0.16	4	5.02
Eucalyptus citriodora Hook.	Thing-naw-alh	Myrtaceae	5.50	34	28.48
Euphorbia pulcherrima Willd. *ex* Klotzsch	Mas pâr	Euphorbiaceae	0.05	4	2.97
Ficus benghalensis L.	Bûng	Moraceae	2.58	2	9.62
Ficus maclellandi King	Himâwng	Moraceae	2.57	2	9.60
Ficus prostrate Buch.-Ham. *ex* Wall.	Thei-tît	Moraceae	0.26	8	6.42
Firmiana colorata (Roxb.) R. Br.	Khaw-khim	MalvaceaeJuss.	0.19	2	2.82
Gmelina arborea Roxb. *ex* Sm.	Thlan-vawng	Lamiaceae	0.00	2	2.29
Haldina cordifolia (Roxb.) Ridsdale	Lung-khûp	Rubiaceae	0.25	2	2.99
IIex godajam Colebr. *Ex* Hook. f.	Thing-ui-ha-hnî	Aquifoliaceae	0.26	6	5.87
Kydia calcyina Roxb.	Thal-teh	Malvaceae	0.54	8	5.47
Lindera pulcherrima (Nees) Benth.	Hnah-pâw-tê	Lauraceae	0.09	4	3.09
Lithocarpus obscurus C. C. Huang & Y.T. Chang	Thên	Fagaceae	0.09	2	2.55
Machilus parviflora Meisn.	Ngha-lêng-lû-târ	Lauraceae	0.08	4	4.79
Neonauclea purpurea (Roxb.) Merr.	Lung-khûp	Rubiaceae	0.09	2	2.53
Schima wallichi Choisy	Khiang	Theaceae	8.11	88	55.97
Syzygium cumini (L.) Skeels	Len-hmui	Myrtaceae	0.06	2	2.46
Syzygium grande (Wight) Walp	Thei-chhâwl	Myrtaceae	0.70	14	11.05
Terminalia crenulata (Heyne) Roth.	Tual-ram	Combretaceae	0.45	6	4.67
Wendlandia budleioides ex Wight & Arn.	Ba-tlîng	Rubiaceae	0.20	4	3.40

content assumed of the entire biomass (Takimato et al. 2008).

Total Carbon Stock, TCS = (AGB + BGB) × 0.5

Statistical analysis

Statistical analysis was performed using Microsoft EXCEL 2016 and Analysis of variance (ANOVA) and LSD (least significant difference) test were performed to test for anycritical differences within the variables.

Results and Discussion

The total number of tree species found was 33 in number, all belonging to 16 different families (Table 1) with *Moraceae* contributing the most followed by *Rubiaceae* (Fig. 2). *Schima wallichi* was found to have the highest IVI at 55.97 followed by *Eucalyptus citriodora* and *Aporosa octandra* with an IVI of 28.48 and 24.56 respectively. The overall Simpson Dominance Index was found to be 0.071 while Shannon-Weiner Index (H`) was observed to be 3.056 along with Peilou's Evenness Index (E) at 0.874 and Margalef Similarity Index (SRI) with a value of 6.149 (Table 2). Trees play an important factor in carbon stock estimation as they live for longer period and are larger in size as compared to herbs and shrubs. The herbs and shrubs tend to have lesser longevity and the carbon that they possess often goes back to the soil after their living period. Diameter of the trees was used for the estimation of tree biomass, which shows a firm liaison between the biomass of the trees and the basal area in the present study and analogous findings can be seen in other studies (Baraloto et al. 2011, Lin et al. 2015, Gogoi et al. 2017). The total basal area of the individual trees ranges from 0-8. 11 m^2 ha^{-1}, hence, the total living biomass divergence was added by the basal areas of the trees. A crucial factor of carbon stock in trees is the basal area as it shows the volume of the trees and the biomass. The density of each tree ranged from 2-8 and wood density also has a role in the variation of spatial forest biomass (Lin et al. 2015). Similar studies conducted in Eastern Himalayas (Gogoi et al. 2017) also show comparable findings regarding the relationship between the biomass of trees and basal area. In a study conducted in Mizoram University (Hrahsel and Lalramnghinglova 2011), 16 families were also noted as the current study

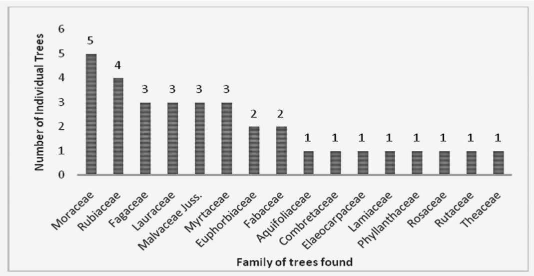

Fig. 2. Family of trees recorded under study and arranged in descending order of family with highest individual trees.

with *Castanopsis tribuloides* as the overall dominant species with *Euphorbiaceae* are the most diverse family. It can be estimated that the area was once a natural forest at its zenith succession stage and these areas have been utilized for construction and fuel purposes after human settlement, has regenerated as secondary forest. The Simpsons' Dominance Index was very small for the present study area which indicates a rich diversity.

The tree diversity as well as species richness decreased along with the increasing diameter classes (10-20 class) as shown in Fig. 3. The maximum density of trees were found to be at 20-30 DBH class with 116 individuals while the minimum was at DBH class > 60 with only 12 individuals. Whereas, the highest basal area was observed at 30-40 DBH class interval represented by 7.90 m^2 ha^{-1} followed by 40-50 and 20-30 DBH class interval with basal area of 6.25 m^2 ha^{-1} and 5.62 m^2 ha^{-1} respectively.

Table 2. Phytosociology and ecological indices of trees in sub-tropical forest of PUC Campus, Aizawl, Mizoram.

Sl. No.	Parameters	Values
1.	No. of Tree Species	33
2.	No. of Families	16
3.	Total Basal Area (m^2 ha^{-1})	16.66
4.	Tree Density (individuals ha^{-1})	364
5.	Simpson's Dominance Index (D)	0.071
6.	Shannon Weiner Diversity Index (H')	3.056
7.	Peilou's Evenness Index (E)	0.874
8.	Margalef's Species Richness Index (SRI)	6.149

Table 3. Species-wise AGB and BGB cqrbon in the tropical forest stand of Mizoram. AGB-aboveground biomass, BGB-belowground biomass.

Scientific name	AGB carbon	BGB carbon	Total carbon
Acronychia pedunculata (L.) Miq.	1.55	0.48	2.03
Albizia chinensis (Osbeck) Merr.	0.94	0.30	1.24
Albizia procera (Roxb.) Benth	0.48	0.16	0.64
Alseodaphane petiolaris (Meisn.) Hook. f.	1.11	0.35	1.47
Anthocephalus cadamba (Roxb.) Miq	4.17	1.20	5.37
Aporosao ctandra (Buch.-Ham. *ex* D. Don) Vickery	7.28	2.01	9.29
Artocarpus chaplasha Roxb.	1.45	0.45	1.91
Artocarpus heterophyllus Lam.	2.92	0.87	3.79
Balakata baccata (Roxb.) Esser	2.86	0.85	3.71
Bombax insigne Wall.	1.05	0.33	1.38
Castanopsis indica (Roxb. *ex* Lindl.) A. DC.	16.66	4.34	20.99
Cstanopsis tribuloides (Sm.) A. DC.	11.30	3.03	14.32
Elaeocarpus lanceaefolius Roxb.	1.81	0.56	2.36
Eriobotrya bengalensis (Roxb.) Hook.f.	0.63	0.21	0.84
Eucalyptus citriodora Hook.	43.65	10.58	54.23
Euphorbia pulcherrima Willd. *ex* Klotzsch	0.14	0.05	0.19
Ficus benghalensis L.	23.49	5.96	29.46
Ficus maclellandii King	23.54	5.97	29.51
Ficus prostrate Buch. -Ham. *ex* Wall.	1.34	0.42	1.76
Firmiana colorata (Roxb.) R. Br.	0.94	0.30	1.24
Gmelina arborea Roxb. *ex* Sm.	0.14	0.05	0.19
Haldina cordifolia (Roxb.) Ridsdale	1.32	0.41	1.73
IIex godajam Colebr. *Ex* Hook. f.	1.10	0.35	1.45
Kydia calcyina Roxb.	1.73	0.53	2.26
Lindera pulcherrima (Nees) Benth.	0.31	0.11	0.42
Lithocarpus obscurus C.C. Huang & Y. T. Chang	0.38	0.13	0.51
Machilus parviflora Meisn.	0.26	0.09	0.35
Neonauclea purpurea (Roxb.) Merr.	0.35	0.12	0.48
Schima wallichi Choisy	34.56	8.52	43.08
Syzygium cumini (L.) Skeels	0.23	0.08	0.31
Syzygium grande (Wight) Walp	3.55	1.04	4.59
Terminalia crenulata (Heyne) Roth.	2.14	0.65	2.78
Wendlandia budleioides ex Wight & Arn.	0.84	0.27	1.12
Total	194.20	50.80	245.00

The aboveground biomass (AGB) of the trees was seen to be highest at DBH class interval of > 60 followed by 30-40 and 40-50 with biomass of 88.7 t ha^{-1}, 78.9 t ha^{-1} and 70.3 t ha^{-1} respectively. The total biomass of the shrubs was found to be 1.61 ± 0.09 t ha^{-1} and total biomass of the herbs was 0.13 ± 0.02 t ha^{-1}. Belowground biomass (BGB) of trees was highest at 30-40 DBH class followed by >60 and 40-50 with 26.7 t ha^{-1}, 25.2 t ha^{-1} and 22.8 t ha^{-1} respectively (Fig. 4). The total biomass in the sub-tropical forest of Pachhunga University Campus (PUC), Aizawl was found to be 480.68 ± 103.39 t ha^{-1}. The total biomass of litter which composed of leaves, twigs, seeds and flowers were 0.62 ± 0.11 t ha^{-1} and the biomass of deadwood (both fallen and standing) was 17.95 ± 4.35 t ha^{-1}.

Among the tree species *Eucalyptus citriodora* contributed maximum carbon to the total carbon stock in the forest stand followed by *Schima wallichii, Ficus benghalensis, F. maciellandii* and *Castanopsis tribuloides* (Table 3). It was found that in areas where human activities are prevalent, *Eucalyptus citriodora,* was found in abundance which was not observed in areas where the forest was untouched by human activities and it is believed to have been planted since it is an exotic species. Whereas in areas where there is little to no human activities, *Schima wallichi* was in abundance. The herbs were obtained using destructive method from each of the 5 quadrats (plots) and litter

Table 4. Biomass and C stock distribution in sub-tropical forest of PUC Campus, Aizawl, Mizoram. SEm values.

Pools	Biomass (t ha^{-1})	Carbon stock (Mg C ha^{-1})
Trees	460.38 ± 101.28	230.19 ± 50.64
Shrubs	1.61 ± 0.09	0.80 ± 0.04
Herbs	0.13 ± 0.02	0.06 ± 0.01
Litter	0.62 ± 0.11	0.32 ± 0.06
Deadwood	17.95 ± 4.35	8.97 ± 2.17
Soil carbon (0-30 cm)	-	42.67 ± 7.69
LSD (0.05)	133.74	61.09
Total	480.68 ± 103.39	283.02 ± 55.09

was collected from each site and segregated into leaves, twigs and flowers and seeds. Phyto-diversity of herbaceous plants have been conducted in Pachhunga University College (Manzamawii et al. 2017) in which sampling was done for every season which gives the overall view of the density of the herbaceous plants throughout the year. The diversity of species was found to increase during the spring and summer seasons which may be attributed to the availability of water and moisture due to rain. However, the current study did not assess the diversity of the herbaceous plants as well as the shrubs as main importance was given to trees.

The total carbon stock (Table 4) in sub-tropical forest Pachhunga University Campus was observed to be 283.02 ± 55.09 Mg C ha^{-1} with LSD of 61.09. The carbon stock of shrubs, herbs and litter was 0.80 ± 0.04, 0.06 ± 0.01 and 0.32 ± 0.06 Mg C ha^{-1} respectively. The total carbon stock of deadwood was seen to be 42.67 ± 7.69 Mg C ha^{-1}. The overall soil

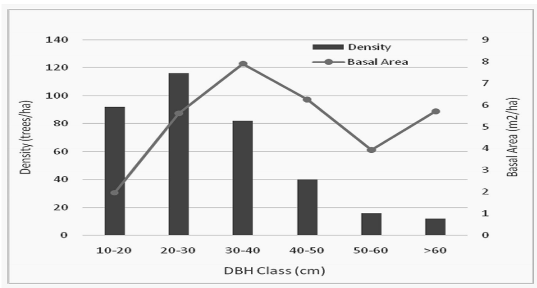

Fig. 3. Contribution of tree stand density and basal area based on the diameter (DBH) class distribution.

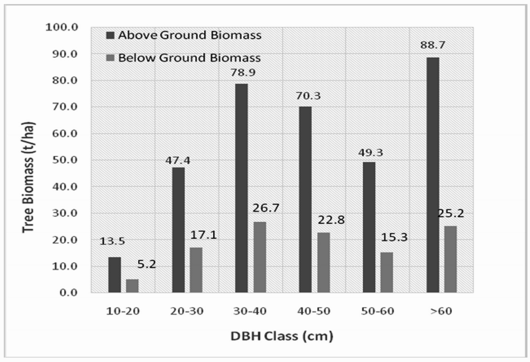

Fig. 4. Distribution of ABG and BGB based on the diameter (DBH) class distribution in the sub-tropical forest stand.

(0-30 cm) carbon stock was 61.09 Mg C ha^{-1}. The Aboveground biomass (AGB) was found to be high for *Schima wallichi* due to its dominance, although *Ficus benghalensis* also showed a relatively high amount of AGB even though its relative dominance was only 7.73 with 1 occurrence. Results from this study have shown that the basal area of trees determine the AGB as at higher diameter class intervals, the AGB is higher. This was found to be the same in a study done in Manipur (Thockchom and Yadava 2017) where the findings showed that sites with high tree density but small sizes exhibited low biomass. However, the present study does not show whether older tropical forests contain more AGB in large trees as compared to younger tropical forests with large trees (Brown and Lugo 1992, Brown et al. 1995) as a comparative study was not done between the two. A similar study conducted in Pondicherry University showed that the AGB was 14.91 Mg ha^{-1}, which was on the lower side due to sampling areas consisting of roads, gardens, landfills. The belowground biomass (BGB) is also important for carbon pool estimation and it was found to be significantly lower in trees with smaller basal area. Belowground biomass and aboveground biomass forms a substantial carbon pool for various types of vegetation and land uses, it is an indispensable facet of carbon stocks (Borah et al. 2013, Gogoi et al. 2017).

The distribution of carbon stock (Fig. 5) was found to be most significant in the living biomass

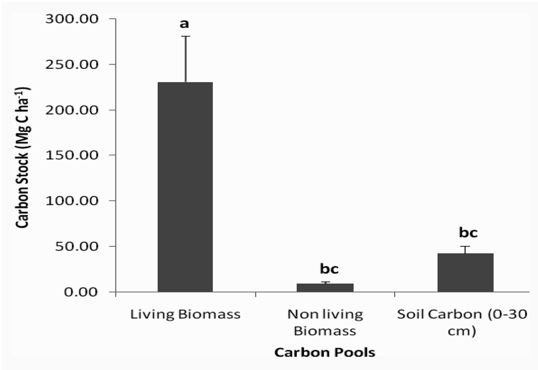

Fig. 5. Distribution of carbon stock (Mg C ha^{-1}) in different pools in a sub-tropical forest stand of PUC Campus, Aizawl, Mizoram.

while, there was bo significant difference between non-living biomass and soil carbon. The total carbon storage observed (283.02 Mg C ha^{-1}) in the study site was found to be lower than the least disturbed site of the tropical Eastern Himalayas (306.61 Mg C ha^{-1}) but higher than highly disturbed site of the Eastern Himalayas (102.43 Mg C ha^{-1}) (Gogoi et al. 2017). The total carbon stock can be considered quite high as compared to Myanmar (5.75-115.00 Mg C ha^{-1}) and Bangladesh (48.88-118.45 Mg C ha^{-1}) (Naidu and Kumar 2016). These 2 countries have been taken for comparison as they share a similar type of forest which is tropical evergreen forest. The hills in Bodamalai and Shervarayan from Tamil Nadu, India, both have low carbon storing trees (Ford-Lloyd and Pary 2014, Pragasan 2016) although Bodamalai hills have 3 different forest type viz. mixed deciduous, scrubs and semi-evergreen. Many studies (Drigo et al. 1998, Ford-Lloyd and Pary 2014, Pragasan 2015, Gogoi et al. 2017) have been conducted on the assessment of carbon stock along altitudinal gradient, where it was reported that there is significant positive correlation with increasing altitude except in Bodamalai hills and Chhitterri hills in Tamil Nadu, there was no relationship observed between the carbon stock in trees and the altitude of the forest (Pragasan 2015). Carbon stock was seen in this study to be contributed the most by living biomass such as trees, followed by soil carbon and non-living biomass such as litter and deadwood. This shows that living biomass contributes the most carbon stock in the study area.

Conclusion

Our study provides an important data set which may be utilized for carbon stock monitoring in forests especially in the North-East region, as deforestation and land degradation is occurring at a rapid rate due to shifting cultivation and improper land uses. Trees play an important role in carbon sequestration and it is therefore important to adopt proper silvicultural management for optimum productivity enhancement and for Reduction of Emissions from Deforestation and Forest Degradation (REDD+).

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