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A COMPARATIVE STUDY ON THE CARBON STORAGE AND OXYGEN RELEASE CAPACITY OF *Swietenia macrophylla* king. and *Eucalyptus camaldulensis* Dehn. IN NORTHWEST BANGLADESH

M. M. Rahman[1], M. Rahman[1] and M. N. S. Pitol[1 2*]

[1]Bangladesh Forest Research Institute, P.O. Box: 273, Sholoshohor, Chattogram and
[2]Institute of Marine Sciences (LABOMAR), Federal University of Ceará (UFC), Fortaleza, Brazil.

Abstract

Estimating the carbon sequestration capacity of forest tree species is essential for implementing a massive plantation program in developing countries such as Bangladesh. The present study was conducted on the estimation of carbon storage and oxygen release capacity of *Swietenia macrophylla* and *Eucalyptus camaldulensis*, which were planted forest tree species in the same ecological condition. Allometric equations were applied to estimate organic carbon in two species of trees. The diameter increased with increasing height and positive correlations were found in *S. macrophylla* and *E. camaldulensis*, respectively ($p < 0.05$). The maximum carbon storage of *S. macrophylla* and *E. camaldulensis* were 17.24 kg tree^{-1} year^{-1} and 21.73 kg tree^{-1} year^{-1} at twenty-year-old trees, respectively. The lowest carbon storage of *S. macrophylla* and *E. camaldulensis* were 5.03 and 9.24 kg tree^{-1} year^{-1} at five years old, respectively. There was no significant difference (df=11; p=0.658) found between the DBH of the two species, while their DBH were significantly different among their ages (df=11; p=0.000). Besides, the height of these two species was significantly different (df=11; p=0.002) but not significant in their ages (df=11; p=0.694). The height and DBH growth became slower with the increase in the age of the plantations. The biomass, carbon stock, carbon dioxide storage, and O_2 releasing potentiality were related to each other and significantly differed with their ages (p-value varied from 0.001 to 0.023). Comparatively higher growth performances were observed in *E. camaldulensis* than *S. macrophylla* in the same environmental conditions, management and equal ages. The findings indicated that *S. macrophylla* and *E. camaldulensis* can both be selected in the massive plantation programs in this area, which will contribute to large carbon storage and play a vital role in mitigating climate change.

Keywords: Biomass, Carbon, Global warming**,** Non-destructive method, Plantation.

Introduction

Decline of biodiversity and increased CO_2 have been recognized as two major concerns nowadays (Kumar, 2011). One is the result, and the other is the cause of global warming and climate change; meanwhile, plantations are a crucial tool for mitigating

* Corresponding author: najmus.sayadat@gmail.com

their effects. We know only plants can capture atmospheric CO_2 through photosynthesis, store it as biomass, and produce a massive quantity of oxygen (Lukito and Rohmatiah, 2013; Pitol and Mian, 2023). Plantation may lead to the enhancement of forestation, although it reduces diversity (Rahman *et al.*, 2021). There are two types of plantations (such as artificial and natural plantations) (Menne, 2015), while the number of artificial plantations is increasing more rapidly than natural plantations in the tropical regions of the world. Artificial forests contribute to the declining pressure on timber extraction from natural forests and play a vital role in the conservation of forest resources (Kaul *et al*., 2010). It is not possible to increase the forest and agriculture lands, but the production will be maximized by converting the traditional lands into sustainable uses like agroforestry home gardens, tea plantations and woodlot plantations (Nair and Kumar, 2006; Pitol *et al.,* 2019). Plantation forests give us hope for the sustainable use of forest resources. Approximately, the world has 264.084 million ha of plantation forests (6.6% % of total forest area) with a new planting rate of 4.925 million ha per year (FAO, 2010). Planted forests supply 35% of total wood demand with a projected increase to 44 % by 2020 (FAO, 2010, ABARE and Jaakko Pöyry, 1999).

Homestead forests have enormously increased in different parts of Bangladesh to fulfill the wood and fuel wood demand. They are increased based on special types of timber species that are fast-growing and of high timber quality. The selection of plant species plays a vital role in mitigating global warming. In Bangladesh, the plantation forests increased from 238.81 (000 ha) to 278.11(000 ha) from 1990 to 2005 (FAO, 2010), while Jashimuddin and Inoue (2012) recorded that 48,420 ha of roadside plantations, 30,666 ha of woodlots and 8778 ha of agroforestry plantations were established during the last 30 years. However, the plantation activities are continuing without assessment of the carbon storage capacity of tree species in many regions of the world, as well as in Bangladesh. There is an urgent need to estimate biomass, carbon storage and released oxygen in different species for implementing massive plantation programs. Biomass is an important parameter to assess the assimilation of carbon by plants. Biomass and carbon storage play an important role in the global carbon cycle (Cairns *et al*., 2003; Li *et al*., 2011; Zhao *et al*., 2014) and are now considered for creating any woodlot (Ekholm, 2016; Gren and Zeleke, 2016; Riutta *et al.,* 2018; Nonini and Fiala, 2019; Rinnamang *et al.,* 2020).

Normally, homestead forests are established with a single tree species, which is known as monoplantation. Monoplantations are increasing a geometric rate in the northern parts of Bangladesh to fulfill the local wood-related demands. Numerous experts recommended that the homestead flora of Bangladesh provides about 70% of all wood consumed and 90% of all fuel wood and bamboo (Alam *et al*., 1990). Many kinds of exotic and indigenous forest tree species are planted in the homestead forests of Bangladesh, while *Swietenia macrophylla* and *Eucalyptus camaldulensis* are the best choice for their fast-growing and well adaptable potential. Private landowners plant fast-growing tree species for local consumption, such as fuel wood, poles, posts, and small wood and cottage industries (BBS, 2014). Moreover, the adaptation ability, growth performances and carbon storage capacity of planted tree species in most of the areas in

Bangladesh have been estimated, though it is too scanty. It is essential to know the role of plantation forests in carbon trade and ecosystem services (Nair, 2012). It improves the country's negotiations for REDD+ and carbon trade mechanisms (Nair, 2012; Jashimuddin and Inoue, 2012). Direct and indirect methods are mostly used for biomass calculation, while indirect methods are based on allometric equations using measurable parameters (Salazar-Iglesias *et al.*, 2010). This method is easy and suitable for the estimation of carbon storage in tropical forests (Razakamanarivo *et al.*, 2012; Rahman, *et al.*, 2019). Therefore, keeping this point in mind, an attempt was made to estimate a comparative study of the biomass, carbon storage and oxygen release between *Swietenia macrophylla* and *Eucalyptus camaldulensis* in the northern district of Bangladesh. The findings of the study will provide essential data on biomass, carbon storage and oxygen release, which will be used for carbon monitoring at the national and international levels.

Materials and Methods

The study area

The study was conducted on homestead forest areas at Natore Sadar Upazila of Natore district in Bangladesh. Geographically, the study area is situated between 24^0 07' to 24^0 43' north latitudes and between 88^0 17' to 88^0 58' east longitudes (Fig.1). This area falls under the tropical region, also known as Bangladesh's hottest district. The climatic condition is a hot-humid summer with moderate rainfall and a mild winter with foggy conditions sometimes. The summer season is considered from April to the last of June. The rainy season starts at the end of June and lasts up to September. The winter season comes from the middle of November and lasts up to the end of February. The temperature variation appears that the average annual temperature is about 26 °C to 36 °C. The minimum and maximum average temperature during winter varies from 9 °C to 14 °C. The minimum and maximum average temperatures vary from 25.50 °C to 40.70 °C during summer. The hottest month was June and the coldest month was January. The average rainfall was 1613.4 mm. The soil of the study area is rich in alluvium and clay texture with a pH of 7.22 on average. This soil is perfect for agriculture and horticulture (BBS, 2022). The study area was covered by various planted timber tree species. The following planted species were dominant, such as *Mangifera indica, Azadirachta indica, Swietenia macrophylla, Albizia richardiana, Eucalyptus camaldulensis, Samanea saman, Artocarpus heterophyllus, Delonix regia, Caesalpinia pulcherrima* and *Citrus maxima*, etc. Homestead forests are accelerating at a geometrical rate to fulfill the demand for fuel wood and timber. Massive plantations have been started in the study area with the help of some selected forest tree species. Before plantation, the area was included in cultivation land and different types of agrocultural and horticultural crops were grown such as *Oryza sativa, Corchorus capsularis, Saccharum officinarum, Litchi chinensis, Manilkara zapota, Ziziphus mauritiana, Averrhoa carambola, Psidium guajava* and *Musa sapientum*, etc.

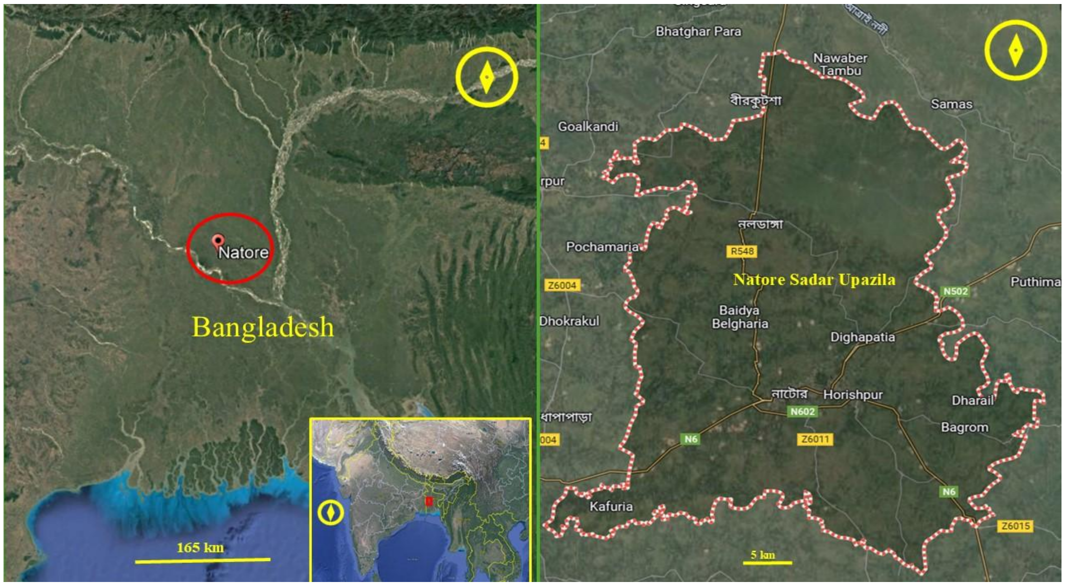

Fig. 1. Natore Sadar Upazila map, the yellow line below shows the scale, the yellow circle upper right side shows the north sign, the red circle and red shape on the left side show the study area.

Sampling and measurements

The study was carried out from January 2023 to December 2023. A multistage random sampling technique was used for the selection of plots. Firstly, a reconnaissance survey was conducted to select the potential landowners who have *Eucalyptus camaldulensis* and *Swietenia macrophylla* orchards. Landowners were interviewed to know about the age and management procedures of the orchards, while 20 hectares of area for each species were surveyed to collect data for biomass, carbon stock and oxygen release potential calculation. Most of them used mono species and bought seedlings from nearby nurseries. Thinning and pruning were done frequently at the early stage of plantations. The geographical location of each plot was recorded using a global positioning system (GPS) and the size of each plot was 10 m×10 m. Brown’s model (Brown *et al*., 1989) was used to estimate the aboveground biomass of each tree of each experiment plot. Several scientists suggested that allometric equations are one of the most suitable methods for biomass estimation in tropical forests (Alves *et al*., 1997; Schroeder *et al.*, 1997). Trees height and diameter at breast height (DBH > 5cm) from ground level (1.30 m) of all trees were measured using a clinometer and DBH tape, respectively. Trees on the border were included in a plot if 50% of their basal area fell within the plot and excluded if 50% of their basal area fell outside the plot. Trees overhanging the plots were excluded, but with their trunk inside the sampling plots, and branches out were included. Care was taken to ensure the diameter tape was put on the stem exactly at the measurement point.

Biomass, carbon stock, CO_2, and release O_2 estimation

The study was conducted in planted forest areas and all trees were measured with the help of a tape and a clinometer. It was impossible to cut all the trees to estimate the biomass and carbon of the trees. Some models were developed by Brown (1997), Luckman *et al*. (1997), Negi *et al*. (1988) and Brown *et al*. (1989). Brown's models (Brown *et al*., 1989) were used to determine above-ground biomass because this method is the most suitable for tropical forests (Alves *et al*., 1997; Brown, 1997; Schroeder *et al.*, 1997; Miah *et al.*, 2011; Ullah and Al-Amin, 2012). This is the simplest method of estimating forest tree biomass in the tropics as it requires only tree diameter at breast height, total height and wood-specific gravity. While other models or regression equations require sectional diameter, this simply deals with diameter at breast height. The model is as follows:

$$Y= \exp. \{-2.4090+0.9522 \ln (D^2HS)\}$$

Where, Y=Aboveground biomass in kg, H=Height of the trees in meters, D=Diameter at breast height (1.30 m) in cm, and S=Wood density in units of tons m^{-3} for a specific species (Brown 1997; Sattar *et al.*, 1999).

Using this model, the aboveground biomass of each tree was estimated. From aboveground biomass of each individual's tree was calculated and the biomass was converted to tons ha^{-1} and added to get the total aboveground biomass. Belowground biomass was calculated considering 15% of the aboveground biomass (MacDicken, 1997; IPCC, 2003; Miah *et al.*, 2011). Belowground biomass was calculated for each tree. Aboveground and belowground biomass of trees was added to get the total biomass of trees.

$$BGB=AGB \times (20/100).$$

The total carbon (TC) of the tree was determined by using the following formula.

$$TC= (AGB+BGB) \times 0.50$$

Where, 0.50 is the conversion factor (Schroeder, 1997).

Besides, the carbon dioxide capturing (CO_2) was calculated by multiplying the total carbon stock by 3.67 (Kauffman and Donato, 2012) and then the released oxygen was calculated by multiplying the total carbon dioxide capturing by 0.727 (Pitol and Mian, 2023; Pitol *et al.*, 2025).

Data analysis

All calculations were done using Microsoft Excel software, and figures were also produced using Microsoft Excel software. Analysis of variance (ANOVA) was performed to check the significant difference between the two species (Appendix 1) and among their ages (Appendix 2) by using the Statistical Package for the Social Sciences (SPSS-20).

Results

Diameter and height of different age plantations

Diameter, height and wood density are the most important indicators and are frequently used for estimating biomass and carbon of trees (Chave et al., 2005, 2014; Komiyama et al., 2008; Pitol et al., 2019, 2025). Biomass and carbon were calculated based on the diameter, height and wood density of planted forest tree species in the study area. The study revealed that the diameter and height were 27.78 cm and 29.65cm; and 17.44m and 9.55m were found in *Eucalyptus camaldulensis* and *Swietenia macrophylla* at 20 years old, respectively (Figure 2). There was no significant difference (df=11; p=0.658) found between the DBH of the two species (Appendix 1), while their DBH were significantly different among their ages (df=11; p=0.000) (Appendix 2). Moreover, the height of these two species was significantly different (df=11; p=0.002) but not significant in their ages (df=11; p=0.694) (Appendix 1 and Appendix 2). Comparatively higher growth performances were observed in *E. camaldulensis* than *S. macrophylla* in the same environmental conditions, management and equal ages (Fig. 1).

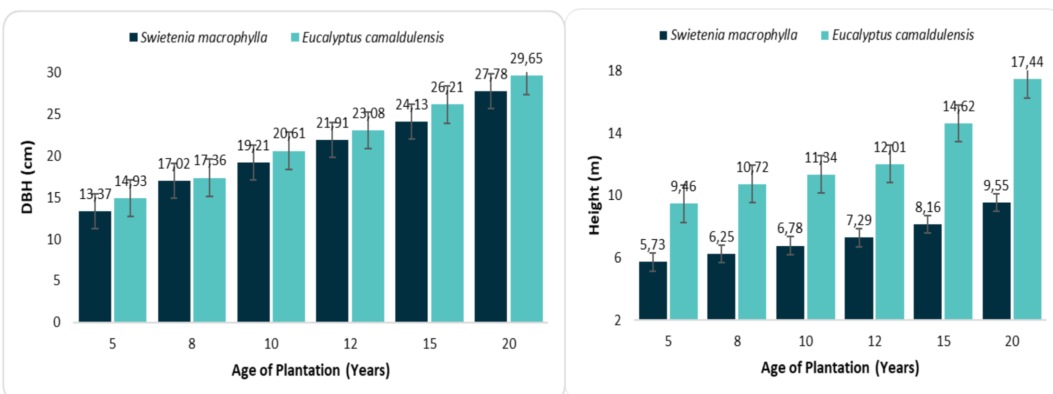

Fig. 2. Diameter at breast height and height of *Swietenia macrophylla* and *Eucalyptus camaldulensis* in different ages.

Mean Annual increment of diameter, height, biomass, carbon stock, CO_2 capturing and O_2 releasing potentiality of different ages of plantations

The mean annual increment of DBH was insignificant (df=11; p=0.629) between these two species when they significantly varied among the ages (df=11; p=0.000). Besides, the mean annual height increment was significantly varied (df=11; p=0.034) between these two species when they were not considerably diverse among the ages (df=11; p=0.321). It was found that the mean annual diameter increments and mean annual height increments were 1.93cm and 2.06 cm; and 0.78m and 1.24 m for *S. macrophylla* and *E. camaldulensis*, respectively (Figure 3). The present study revealed that the value of the mean annual diameter increments and mean yearly height increment of *E. camaldulensis* was comparatively higher than *S. macrophylla*. The height and DBH growth became slower with the increase in the age of the plantation.

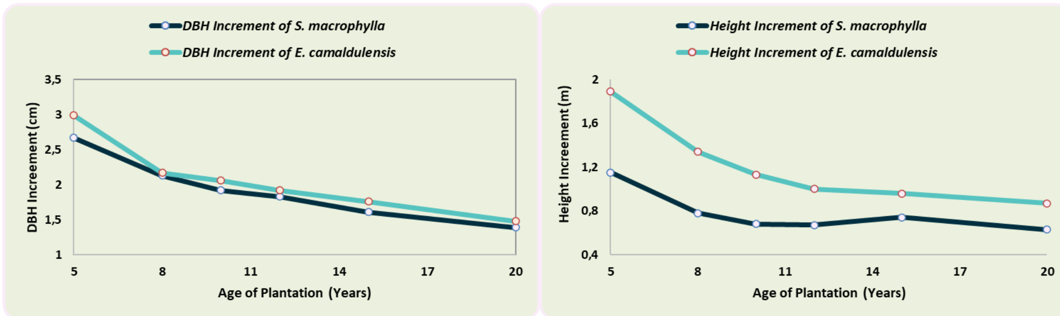

Fig. 3. Mean annual diameter increment rate and mean annual height increment rate of *Swietenia macrophylla* and *Eucalyptus camaldulensis*

The aboveground biomass, belowground biomass, total biomass, aboveground carbon, belowground carbon, total carbon, carbon dioxide storage and O_2 releasing potentiality were related to each other and significantly differed with their ages (p-value varied from 0.001 to 0.023). The value was maximum for both species in 20-year-old plantations and minimum for 5-year-old plantations (Table 1). The highest aboveground biomass, belowground biomass and total biomass were 574.55 kg tree^{-1}, 114.91 kg tree^{-1}, 689.46 kg tree^{-1} and 724.38 kg tree^{-1}, 144.88 kg tree^{-1}, 869.26 kg tree^{-1} in *S. macrophylla* and *E. camaldulensis* at twenty years old, respectively (Table 1). The lowest aboveground biomass, belowground biomass and total biomass were 41.94 kg tree^{-1}, 8.39 kg tree^{-1}, 50.33 kg tree^{-1} and 76.99 kg tree^{-1}, 15.40 kg tree^{-1}, 92.39 kg tree^{-1} in *S. macrophylla* and *E. camaldulensis* at five years old, respectively (Table 1). Moreover, the maximum aboveground carbon, belowground carbon and total carbon were 287.28 kg tree^{-1}, 57.46 kg tree^{-1}, 344.73 kg tree^{-1} and 362.19 kg tree^{-1}, 72.44 kg tree^{-1}, 434.63 kg tree^{-1} in *S. macrophylla* and *E. camaldulensis* at twenty years old. The lowest aboveground carbon, belowground carbon and total carbon were 20.97 kg tree^{-1}, 4.19 kg tree^{-1}, 25.16 kg tree^{-1} and 38.50 kg tree^{-1}, 7.70 kg tree^{-1}, 46.20 kg tree^{-1} in *S. macrophylla* and *E. camaldulensis* at five years old (Table 1). However, the carbon storage varied from 5.03 to 17.24 kg tree^{-1} year^{-1} while capturing CO_2 varied from 18.46 to 63.26 kg tree^{-1} year^{-1} and releasing O_2 varied from 13.42 to 45.99 kg tree^{-1} year^{-1} for *S. macrophylla*. In addition, the carbon storage varied from 9.24 to 21.73 kg tree^{-1} year$^{-1,}$ while capturing CO_2 varied from 33.91 to 79.75 kg tree^{-1} year^{-1} and releasing O_2 varied from 24.65 to 57.98 kg tree^{-1} year^{-1} for *E. camaldulensis* (Table 1).

Table 1. Aboveground biomass (AGB), belowground biomass (BGB), total biomass (TB), aboveground carbon (AGC), belowground carbon (BGC), total carbon (TC), carbon storage, CO_2 capturing and O_2 releasing potential of *Swietenia macrophylla* and *Eucalyptus camaldulensis* in different ages

Species Name	Age of Plantation (years)	AGB per tree (kg)	BGB per tree (kg)	TB per tree (kg)	AGC per tree (kg)	BGC per tree (kg)	TC per tree (kg)	Carbon storage kg $tree^{-1}$ $year^{-1}$	Capturing CO_2 kg $tree^{-1}$ $year^{-1}$	Releasing O_2 kg $tree^{-1}$ $year^{-1}$
Swietenia macrophylla	5	41.94	8.39	50.33	20.97	4.19	25.16	5.03	18,46	13.42
	8	72.14	14.43	86.57	36.07	7.21	43.28	5.41	19,85	14.43
	10	98.16	19.63	117.79	49.08	9.82	58.90	5.89	21,62	15.72
	12	174.13	34.83	208.96	87.06	17.41	104.48	8.71	31,95	23.23
	15	326.20	65.24	391.44	163.1	32.62	195.72	13.05	47,89	34.82
	20	574.55	114.91	689.46	287.28	57.46	344.73	17.24	63,26	45.99
Eucalyptus camaldulensis	5	76.99	15.40	92.39	38.50	7.70	46.20	9.24	33,91	24.65
	8	115.58	23.12	138.70	57.79	11.56	69.35	8.67	31,81	23.13
	10	169.07	33.81	202.88	84.53	16.91	101.44	10.14	37,23	27.07
	12	259.51	51.90	311.41	129.75	25.95	155.70	12.96	47,62	34.62
	15	418.36	83.67	502.03	209.18	41.84	251.01	16.73	61,41	44.65
	20	724.38	144.88	869.26	362.19	72.44	434.63	21.73	79,75	57.98

Discussion

The two basic functions of trees are capturing carbon dioxide and producing oxygen for curbing climate change and the survival of life on this earth, respectively. Nowadays, we are concerned about the carbon and carbon dioxide storage capacity of trees. In this study, we also observed the oxygen release potential of two widely used fast-growing species in Bangladesh. Comparatively higher growth performances were observed in *E. camaldulensis* than *S. macrophylla* in the same environmental conditions, management and equal ages. It revealed that the diameter and height were 27.78 cm and 29.65cm; and 17.44m and 9.55m in *Eucalyptus camaldulensis* and *Swietenia macrophylla* at 20-year-old plantations, respectively. The height of *S. macrophylla* increased very slowly and *E. camaldulensis* increased very fast, while both showed similar dbh growth (Fig. 2). Normally, growth parameters are mainly influenced by genetic criteria, which is known as genotype. In this regard, the following equation may be regarded as phenotype = genotype + environment. The present findings indicated that growth performances varied between the two species due to the genotypic criteria. The phenotype depends on genotype and environmental factors. Several scientists worked on the estimation of the diameter and height of forest tree species in Bangladesh. Rahman (2022a) found that the dbh and height of *Casuarina equisetifolia* at Inani and Teknaf Forest Ranges 14.10 cm and 12.70 m; 17.10 cm and 17.10 m; and 23.54 cm and 20.33 m for 5-year, 10-year and 20-year-old plantations separately. (Rahman, 2022b. Besides, the dbh and height of *Acacia auriculiformis* were 5.03 cm and 4.27 m; and 10.35 cm and 8.28 m for 5-year and 10-year plantations at Pomra, Hosnabad, Rajanagar and Parua Forest Ranges under the Chattogram North Forest Division in Bangladesh, respectively (Rahman, 2022b). Dey et al. (2022) found the dbh and height of *Eucalyptus camaldulensis* were 10.6 m and 11.9 cm for a 5-year plantation, and 30.9 m and 42.7 cm for a 21-year plantation, while Azad et al. (2021) found the dbh for 10.14 cm, 26.47 cm and 29.21cm for 5-year, 15-year, and 20-year plantations individually. It seemed that the height and dbh growth of *E. camaldulensis* was higher at every year of plantations than the *C. equisetifolia*, *A. auriculiformis* and *S. macrophylla* and very close to *Hevea brasiliensis* plantations.

In our study, the mean annual diameter increments and mean annual height increments were 1.93cm and 2.06 cm; and 0.78m and 1.24 m for *S. macrophylla* and *E. camaldulensis* respectively (Figure 3). The present study revealed that the value of the mean annual diameter increments and mean yearly height increment of *E. camaldulensis* was comparatively higher than *S. macrophylla*. Moreover, the height and DBH growth became slower with the increase of the age of the plantation. It exhibited that the tree grows faster at an early age. However, the mean annual diameter increment rate and mean annual height increment rate also varied from species to species and age to age. The mean annual diameter increment rates were 3.08 cm, 1.71 cm and 1.17 cm, while the mean annual height increment rates were 2.54 m, 1.71 m and 1.02 m found in *Casuarina equisetifolia* at 5, 10 and 20-year trees (Rahman, 2022b). In addition, the mean annual diameter increment rates were 1.01 cm and 1.04 cm found in *Acacia auriculiformis* while the mean annual height increment rates were 0.94 m and 0.91 m found in *Acacia auriculiformis* at 5 and 10-year trees. There was a positive correlation between diameter and height, but the diameter and height rates varied from species to species.

The biomass, carbon, carbon-dioxide storage and O_2-releasing potentiality were related to each other and significantly differed with ages (p-value varied from 0.001 to 0.023). There was a positive relation between age and biomass, carbon, carbon dioxide storage, and O_2-releasing potential of trees. The present study was conducted in the northern parts of Bangladesh which is situated in the hottest tropical regions of Bangladesh. Normally, biomass and carbon storage vary in different regions of the world. Scientists observed that carbon storage capacity varied from species to species due to ecological and management conditions (Rahman et al., 2019, 2020). A study was conducted in the tropical forests of Badamalai hills in India and reported that the average carbon stock of single tree species was 0.04tC/tree. It was also reported that the maximum value was 0.68 t C/tree found in *Ficus benghalensis*, followed by *Tamarindus indica*, *Spondias pinnata*, *Diospyros ebenum* and *Ficus beddomei* 0.51 t C/tree, 0 46 t C/tree, 0.30 t C/tree, and 0.22 t C/tree respectively (Pragasan *et al.*, 2015). In this case, their findings were higher than the findings of the present study. However, wide variations in the biomass potential of a tree may occur due to differences in provenances, stand density, tree age, site characteristics, management, etc. Several scientists (observed that the total aboveground biomass in the range of 9.80 to 306.01 kg $tree^{-1}$ for *Gmelina arborea* and 7.25 to 314.61 kg $tree^{-1}$ for *Swietenia Macrophylla* (Kawahara *et al*., 1981; Pitol et al. 2019; Pitol and Mian, 2023). On the other hand, Buante (1997) observed the total aboveground biomass of *Acacia auriculiformis* and *Gmelina arborea* in the ranges of only 15.71 to 49.08 kg $tree^{-1}$ and 9.18 to 68.58 kg $tree^{-1}$. The following tree species were included such as *Eucalyptus deglupta, paraserianthes falcataria, Swietenia macrophylla, Acacia auriculiformis* and *Gmelina arborea* and their values were 365.70

kg $tree^{-1}$, 90.70 kg $tree^{-1}$, 156.30 kg $tree^{-1}$, 248.20 kg $tree^{-1}$ and 114.80 kg $tree^{-1}$ respectively (Dey et al. 2022; Kawahara *et al.*, 1981; Pitol et al. 2019; Pitol and Mian, 2023). Generally, the total biomass and carbon were estimated based on aboveground and belowground biomass all over the world. Several scientists reported that total biomass and carbon varied from species to species and different ages such as 776.90 kg $tree^{-1}$ to 1574 kg $tree^{-1}$biomass was found in *Mangifera indica* at 25 years old (Ganeshamurthy *et al.*, 2016).

Carbon dioxide is the most effective greenhouse gas which traps heat and increases temperature in different levels of the atmosphere. The elevated temperature adversely affects biotic and abiotic components of all types of ecosystems which is the main obstacle to the sustainable development of the environment. In this case, plantations sequester carbon dioxide and produce oxygen from the atmosphere through photosynthesis and act as sinks which help to reduce global warming. Carbon storage capacity is the most important for the development of plantations based on species. The same species contained different amounts of carbon when grown in different regions. Scientists observed variations in carbon storage with the age of the forest, stand condition, species composition, climate condition, physiographical position and degree of disturbance (Kanime *et al.*, 2013 and Kumar *et al*., 2016). Biomass, carbon storage, CO_2 and oxygen release assimilation vary with species. Scientists reported that higher values were found in *Eucalyptus spp.* while it was the lowest value in *S. javanica* (Ganeshamurthy *et al.*, 2019). Some species such as *C. camphora, S. babylonica, P. roxburghii G. robusta* and *Diospyros* sp. also have high values of carbon storage, and carbon assimilation. Some species particularly, *M. koenigii, Mimosasp., F. auriculata, F. lacor* and *Dalbergia* sp. have low values. Myrtaceae was the family with the highest carbon storage, carbon assimilation and followed by Lauraceae Salicaceae and Pinaceae (Kaul *et al*., 2010). Maximum scientists (Chave *et al*., 2014) opined that carbon sequestration depends on single or multiple factors such as age, size, density and climatic conditions, etc. However, our study was conducted in a narrow zone of the country. A massive survey is required to assess the feasibility and potentiality of plantation forests. It is also a prerequisite for our fair share in the global carbon trade mechanism.

Conclusion

Plantation sequesters carbon dioxide and acts as a carbon sink and oxygen source in the atmosphere. Elevated carbon dioxide in the atmosphere is harmful to all living organisms of the terrestrial environment. So, plantations should be increased to continue the equilibrium balance of the environment. The present findings of the study indicated that planted forests with fast-growing tree species play a vital role in sequestering carbon and generating oxygen and their utilization demands are also high for the quality of timber and fuel wood. It is also remarkable that the planted forest tree species are well adapted to the selected study areas. The socio-economic conditions can be easily developed through applying silviculture methods in the social plantation programs. Therefore, policymakers, administrators and planters can choose *Swietenia macrophylla* an*d Eucalyptus camaldulensis* for the massive plantations based on environmental conditions.

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Conflict of interest

The authors declare that there are no competing interests.

Ethics and biosecurity

We did not use any human or animal biological data in this manuscript.

Data availability statement

Data will be made accessible on request.

Funding statement

The authors' self-funding was used for data collection.

Authors' contribution

M M Rahman: Conceptualization, Formal analysis, and Writing Original draft. M Rahman: Conceptualization, Data Collection and Review. M N S Pitol: Formal Analysis, writing draft, Review, Editing and Supervision

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APPENDIX 1 (Compare between the plantations of *Swietenia macrophylla and Eucalyptus camaldulensis*)

		Sum of Squares	df	Mean Square	F	Sig.
DBH	Between Groups	5.908	1	5.908	.208	.658[ns]
	Within Groups	283.601	10	28.360		
	Total	289.509	11			
Height	Between Groups	84.429	1	84.429	16.089	.002[**]
	Within Groups	52.475	10	5.248		
	Total	136.904	11			
DBH Increment	Between Groups	.057	1	.057	.248	.629[ns]
	Within Groups	2.314	10	.231		
	Total	2.372	11			
Height Increment	Between Groups	.538	1	.538	6.041	.034[*]
	Within Groups	.890	10	.089		
	Total	1.428	11			
Above-Ground Biomass	Between Groups	18942.469	1	18942.469	.376	.553[ns]
	Within Groups	503737.399	10	50373.740		
	Total	522679.869	11			
Below-Ground Biomass	Between Groups	757.635	1	757.635	.376	.553[ns]
	Within Groups	20149.630	10	2014.963		
	Total	20907.265	11			
Total Biomass	Between Groups	27276.775	1	27276.775	.376	.553[ns]
	Within Groups	725382.659	10	72538.266		
	Total	752659.434	11			
Above-Ground Carbon	Between Groups	4735.419	1	4735.419	.376	.553[ns]
	Within Groups	125936.064	10	12593.606		
	Total	130671.483	11			
Below-Ground Carbon	Between Groups	189.528	1	189.528	.376	.553[ns]
	Within Groups	5038.006	10	503.801		
	Total	5227.534	11			
Total Carbon	Between Groups	6819.194	1	6819.194	.376	.553[ns]
	Within Groups	181345.015	10	18134.502		
	Total	188164.209	11			
Carbon Storage Potentiality	Between Groups	48.562	1	48.562	1.918	.196[ns]
	Within Groups	253.244	10	25.324		
	Total	301.805	11			
CO_2 Capturing Potentiality	Between Groups	655.641	1	655.641	1.922	.196[ns]
	Within Groups	3410.457	10	341.046		
	Total	4066.098	11			

APPENDIX 2 (Compare among the age classes of *Swietenia macrophylla* and *Eucalyptus camaldulensis* plantations)

		Sum of Squares	df	Mean Square	F	Sig.
DBH	Between Groups	282.658	5	56.532	49.512	.000***
	Within Groups	6.851	6	1.142		
	Total	289.509	11			
Height	Between Groups	46.430	5	9.286	.616	.694ns
	Within Groups	90.475	6	15.079		
	Total	136.904	11			
DBH Increment	Between Groups	2.291	5	.458	33.874	.000***
	Within Groups	.081	6	.014		
	Total	2.372	11			
Height Increment	Between Groups	.788	5	.158	1.480	.321ns
	Within Groups	.639	6	.107		
	Total	1.428	11			
Above-Ground Biomass	Between Groups	499491.867	5	99898.373	25.849	.001***
	Within Groups	23188.002	6	3864.667		
	Total	522679.869	11			
Below-Ground Biomass	Between Groups	19979.776	5	3995.955	25.850	.001***
	Within Groups	927.490	6	154.582		
	Total	20907.265	11			
Total Biomass	Between Groups	719268.894	5	143853.779	25.849	.001***
	Within Groups	33390.540	6	5565.090		
	Total	752659.434	11			
Above-Ground Carbon	Between Groups	124874.947	5	24974.989	25.852	.001***
	Within Groups	5796.536	6	966.089		
	Total	130671.483	11			
Below-Ground Carbon	Between Groups	4995.609	5	999.122	25.848	.001***
	Within Groups	231.926	6	38.654		
	Total	5227.534	11			
Total Carbon	Between Groups	179816.979	5	35963.396	25.851	.001***
	Within Groups	8347.230	6	1391.205		
	Total	188164.209	11			
Carbon Storage Potentiality	Between Groups	252.716	5	50.543	6.178	.023**
	Within Groups	49.090	6	8.182		
	Total	301.805	11			
CO_2 Capturing Potentiality	Between Groups	3403.260	5	680.652	6.161	.023**
	Within Groups	662.838	6	110.473		
	Total	4066.098	11			