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Oxygen Generation by DBH Trees - A Study inside RV College of Engineering (RVCE), Bengaluru, India

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ABSTRACT

Urban vegetation plays an important role in reducing the air pollutant, dust, absorbing greenhouse gases, extenuation of urban heat islands, storing of carbon, aesthetically appealing and quality of urban life. The aim of this study is to approximately estimate the oxygen production by the predominant trees present inside the RVCE campus and comparing it with the statistics of oxygen consumed by the population of the area. The purpose of this study is to focus on the accountability of DBH trees present inside the campus and on the release of oxygen content of selected trees like *Mangifera indica* (Mango), *Cocos nucifera* L. (Coconut) and *Tectona grandis* L. (Teak) and much more.

Key words *: DBH trees, Oxygen demand, Carbon sequestration, RVCE.*

Introduction

Building up of greenhouse gases (GHGs) has an impact on the changes in the climate. The greenhouse effect is primarily due to carbon di-oxide (CO_2). Increasing the sinks of GHGs and by conserving the forest are the probable options of reducing the effects of global warming. In the atmosphere, if the concentrations of CO_2 is more than 400 ppm (current concentration is 389 ppm), there is a remarkable environmental damage (Ramachandra *et al.* (2014).

R V College of Engineering (RVCE) is a pioneer Institution in eco-initiatives compared to many other neighboring colleges in the surrounding region. Established in 1963 in Bengaluru-Mysore road and is recognized as one of the India's leading technical institutions. Over a period of 57-58 years importance has been given to plantation of different species inside the campus. In the beginning years, the strength of staff and students were less and even the traffic. As RVCE grew in leaps and bounds year after year, and now after its existence for over 5 decades the strength of students and faculties increased even the traffic grew. In the present study, emphasis is given on taking accountability of DBH trees, oxygen consumption, carbon sequestration and Oxygen release from the wide spectrum of RVCE ecosystem species. The entire methodology of estimating oxygen production conducted during 2018-19 in one phase.

Methodology

Study Area with Bio-physical and Socio-economic Status

RVCE is located on the banks of the Vrishabhavati river between 12°55'26.13" N and 77°29'58.78" E and has an average annual temperature of 26.5° C and average rainfall of 970 mm. It is 13 km from Bengaluru city on Mysore road. The nearest com-

muter railway station is Jnanabharathi station, and the nearest major railway station is the Bangalore city Railway Station. Area of the campus is urban 52 acres (including RV University) (2,13,570sq.m). A widespectrum of tree species is a noted feature in the landscape of RVCE.

The dominant tree species were considered for carbon estimation. Only those trees having diameter of 10 centimeter (cm) or more at breast height (1.37 m) have been considered and it is known as Diameter at Breast Height (DBH). Presently, the institution has a student strength of about approximately 5600, Technical and administrative staffs of 241, teaching faculty strength of 410, non- teaching staff of 300 and 230 research scholars are pursuing Ph.D. The total strength in RVCE campus is around 6700.

Oxygen Production by Trees

Net oxygen production by trees is the difference of amount of oxygen produced during photosynthesis and the amount of oxygen consumed during plant respiration (Nnaemeka Joe Okonkwo, 2015):

Photosynthesis

$$6CO_2 + 6H_2O + \text{light} \rightarrow C_6H_{12}O_6 + 6CO_2 \quad .. (1)$$

Carbon di oxide + water + light → Glucose + Oxygen

Respiration

$$C_6H_{12}O_6 + 6O2 \rightarrow 6CO_2 + 6H_2O + \text{Energy} \quad .. (2)$$

Glucose + Oxygen → Carbon dioxide + Water + Energy

The tree starts accumulating the carbon, when the uptake of carbon di oxide during photosynthesis exceeds carbon di oxide release by respiration during a year, which is carbon sequestration. Thus a tree that has a net accumulation of carbon during a year (tree growth) also has a net production of oxygen. Based on atomic weights, the amount of oxygen produced is estimated from carbon sequestration.

Net oxygen release (kg/year) = Net Carbon sequestration (kg/yr) × 32/12 (Perry, 2003),

Human Oxygen Consumption

Oxygen consumption rate of an average adult human is 0.84 kg/ day (Perry, 2003), and is used to estimate how much oxygen consumption would be offset by urban forest oxygen production annually. To estimate the amount of oxygen consumed by human that would be offset, can be calculated by dividing oxygen production by average annual oxygen consumption per person.

The working hour of the college is 8.30 AM to 5.30 PM and it is the peak hours where students, teaching and non- teaching faculties will be present inside the campus. The average oxygen consumption in RVCE campus is found to be 2075.9 tonnes per year. 0.9 kilograms of Carbon di oxide is released for each day per human (Peggy, 2008).

Based on the field work performed the number of DBH trees present inside the college campus is found to be 1775 with 58 wide variety of species. The oxygen release and the amount of carbon sequestered of the dominant DBH tree species has been estimated.

Suryawanshi (2014) conducted a study in North Maharashtra University campus, reported the major carbon sequestering species were Drumstick tree (15.775 tons/tree) followed by Neem tree (12.272 tons/tree, Royal Poinciana (12.247 tons/tree), Yellow flame tree (9.576 tons/tree), Babul (9.248 tons/tree), Indian rosewood (7.207 tons/tree), Flame of the forest (3.553 tons/tree), Baage tree (2.419 tons/tree). The Lemon scented eucalyptus has lowest carbon sequestrating potential (1.814 tons/tree) and second lowest carbon sequestering species was Teak having carbon content (1.915 tons/tree/anum). Table 1 presents the list of prominent tree species with their Above Ground biomass (AGB) and above ground carbon (AGC) values (Abhijit Mitra *et al.*, 2017), with their respective oxygen release along with Carbon sequestration.

Results and Discussion

According to recent data available, the RVCE has a floating population of 6700 on an average per year approximately. The amount of oxygen required to sustain this population is about 2054.22 tonnes of oxygen per year. As per the field work and calculations, the yearly production of oxygen by the seventeen (17) dominant species in RVCE campus is 2687.4 tonnes of oxygen which indicates that there is an ample supply of oxygen in RVCE campus by 0.76 times more to meet the demands of floating population. However, this computation is approximate since seedlings and grassy vegetation are not been considered in this estimation.

From this we can conclude that the oxygen requirements for the floating population of the Institution have been substantially met from the species

Table 1. List of Prominent tree species in RVCE campus with their AGB, AGC, C-sequestration and O_2 release values inside RVCE campus.

Sl. No.	Species	AGB (tonnes ha^{-1})	AGC (tonnes ha^{-1})	No. of Trees	Carbon Sequestration (tonnes ha^{-1} y^{-1})	Oxygen release (tonnes ha y^{-1})
1	*Cocos nuciera* (Coconut)	941.9	432.74	223	1.94	5.17
2	*Azardirachta indica* (Neem)	307.89	141.01	32	4.406	11.751
3	*Mangifera indica* (Mango)	2474.53	132.82	44	30.2	80.53
4	*Tamarindus indica* (Tentul)	4195.6	1929.98	34	56.76	151.37
5	Aeglemarmelos (Bel)	3202	1501.74	10	1501.74	400.46
6	*Terminalia arjuna* (Arjun)	481.24	223.3	9	24.81	66.16
7	*Tectona grandis* (Segum)	542.72	249.11	210	1.186	3.163
8	*Delonix regia* (Krishnachura)	2854.98	1350.41	44	30.69	81.84
9	*Artoxarpus heterophyllus* (Jackfruit)	228.67	111.82	20	5.591	14.91
10	*Swietenia mahagoni* (Mahogany)	455.35	219.02	24	4.76	12.7
11	*Terminalia catappa* (Kathbadam)	233.12	114.23	24	4.76	12.7
12	*Psidium guajava* (Guava)	924.92	454.14	9	50.46	134.56
13	*Eucalyptus globus* (Eucalyptus)	5853.95	2716.23	34	79.89	213.04
14	*Santalum album*	5.96	3.27	4	0.8175	2.18
15	*Peltophorum pterocarpum* (Radhachura)	604.14	275.49	2	137.745	367.32
16	*Ficus religosa* (Peepul)	2143.11	1073.7	3	357.9	954.4
17	*Ficus benghalensis* (Banyan)	1095.66	540.16	9	60.02	160.05

indicated. RVCE is abundant in trees with wide variety of species, and the oxygen production does cater to the needs of campus, also contributing excess oxygen produced to outside campus. In order to find the oxygen release only the major species have been taken into consideration. In addition to this, more comprehensive study is required considering many other species like herbs and shrubs present to achieve the picture of floral based oxygen budget in this geographical area.

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