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A Geo-Environmental study of Floral Diversity and its associated Issues in the Dibrugarh University Campus, Dibrugarh, Assam

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Abstract

Species diversity is the number of different species found in a particular area. However, conservation biologist often uses the term species diversity even when they are actually referring to species richness, i.e. to number of present species (Harrison et al., 2004). Dibrugarh district located in the upper Assam is well known for its biological richness. Similarly, the study area i.e., the Dibrugarh University campus is also having a good number of species diversity. The biological diversity found in the study area is often related to its vegetation cover, which is categorized into evergreen, semi-evergreen, deciduous, semi-deciduous and coniferous/alpine/others. The Botanical garden inside the campus has been considered as one of the protected area covering an area of 4.63 hectares. It is famous for rare, valuable trees, fruits, medicinal herbs etc. Apart from that the north eastern part corner of the campus also having some forest covers including a tea garden. The present study involves identification and mapping of species diversity of prominent tree, grass and herbs in selected quadrants available in the study area. Plant communities are classified according to structure of canopy or type (tree, shrub or herbaceous) and dominance of taxa. The study is mainly based on primary data collected for the field study. For density analysis of species, 15 major species are taken for study and area is divided into 200m X 200m grids. The herbaceous plants are identified and analysis through quadrant method. The major 5 selective site are taken for study includes both grazing and non-grazing. Out of 103 herbaceous species there are 35 major species are identified which prominent inside the study area. These species are again classified into two broad i.e. Annual and Perennial. For canopy cover analysis of trees there are major 100 species are taken and average canopy area was measured.

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Key Words: Species diversity, canopy cover, quadrant method, Dibrugarh University

Introduction

Species diversity usually refers to the number of different species found in a particular area. However, conservation biologists often use the term species diversity even when they are actually referring to species richness, i.e. to number of present species (Harrison et al., 2004). Noss (1990) defines species diversity as a composition that refers to the identification of variety of element in a population includes, species lists and measures of species diversity and genetic diversity. In general floral species diversity not only satisfy human needs but it also act as index of healthy ecology. Most of the world's agricultural products and raw product for drugs comes from prime forest. Floral diversity not only helps on agriculture hybridization but it also has disease resistant capacity. It was evident in the early 1970's that the epidemic called grassy stunt virus, which destroy more than 160000 ha of rice in Asia, could be controlled from a single sample of wild rice *Oryza nivara* from central India, which was found to be only known genetic source of resistance to the grassy stunt (Pullaiah et. al 2015). The Present study aims at sustainable practices inside Dibruagrh University campus from biodiversity conservation point of view. A university is considered as an educated campus and it is necessary that the people in an around the university should know the importance of their surrounding campus environment sustainability and should be aware of other waste management practices. In order to investigate the environmental condition of the campus area, the study also examined the waste generation and management within the campus, yearly uses of paper by students and administration as well as number of vehicles run within the campus to know the level of carbon emission and try to establish a balance between the ecology and anthropogenic practices within the campus, which is helpful for the campus in investigating the balancing situation and make it sustainable for future generation.

Objective

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- To study the diversity of prominent floral species in the study area,
- To quantify per capita consumption of resources like paper, food, electricity, Automobile fuel etc. and the sustainable practices followed by the students and employees,
- To measure the carbon footprint generated by Dibrugarh university at individual scale
- To analyze the relationship between the bio diversity and carbon emission level in the university campus and to suggest measure to make all round sustainable livelihood among the student and employees of the Dibrugarh university

Study Area

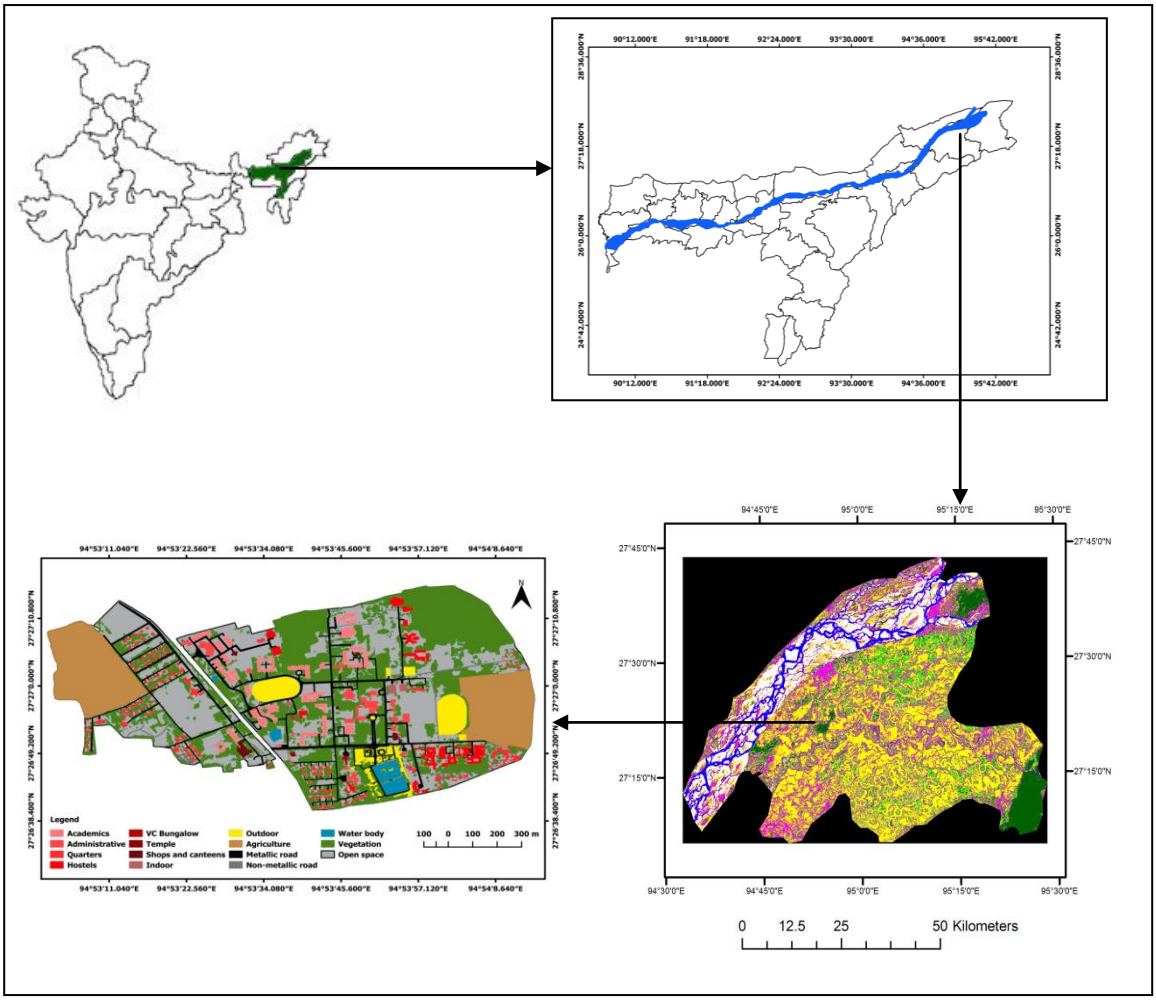

Figure 1: Location Map of the study area

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Dibrugarh University is located at 27°29′N latitude and 94°55′E longitude and is spread over an area of 2.024 sq km. The region is very rich in floral diversity wherein medicinal herbs, citrus fruits, tea etc. are found in abundance. The biological diversity found in the study area is often related to its vegetation cover, which is categorized into evergreen, semi-evergreen, deciduous, semi-deciduous and coniferous/alpine/others. Some prominent tree species are Nahor (*Mesua ferrea*), Krishnasura (*Delonix regia*), Hunaru (*Cassia fistula*), and some important herbs are *Amaranthusspinosus, Bidenstilosa, Ecliptaprostrata* etc.

Methodology

The study is mainly based on the primary data collected from the field visit. The prominent tree species have been identified by GPS so that spatial distribution of these species may be studied. Some prominent species are selected as base point to make canopy cover. Tree canopy is measured by using measurements tap and ranging rod. Quadrant method 1m x1m is used for collection the sample of micro flora species instead of taking waypoints. Blue print is georefferenced and re-projected into Datum QGS84 UTM zone 46 North in QGIS 2.16 with RMS error 0.12. This raster file is taken as base map for preparation of vector layer. In order to prepare the LU/LC map of the study area, rectified satellite images of the year 2018 have been downloaded with the help of EI-Shayal. To estimate greenhouse emission level, primary data has been collected regarding number of vehicles entered in the study area. The data has been taken between 5 A.M. to 12 A.M. for two days i.e. one in working day and one in off day and regression method is used to calculate the rest 5 hours. Vehicle data is stratified according to number of wheels i.e. two wheelers, four wheelers etc. and the type and amount of greenhouse gas emitted by the vehicles are collected from Population Control Board. Primary and secondary data have been used to collect information to estimate total waste generated in the study area. Stratified random sampling is used to collect the data of paper uses of students by dividing into schools of study i.e. Arts, Commerce, Science, Performing Arts and Physical education. Secondary data has been collected from official record of total paper use by administration and

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examination branch. Waste has been divided into two types for study i.e. degradable and non-degradable. Total degradable and non-degradable waste gathered at the interval of 1km near the roadside. The gathered wastes were weighted in electronic weighted machine.

Result and Discussion

Classification and composition of floral species

Plant communities are classified according to structure of canopy or type (tree, shrub or herbaceous) and dominance of taxa. In the present study the total number of identifies species are divided into five groups on the basis of community viz. Evergreen, Semi-evergreen, deciduous, Semi-deciduous and Coniferous/Alpine/others type of vegetation. The following table is showing classification and composition of floral species.

Table: 1 Number of species found from the major plant community

Sl no	Community	Total Number of
1	Evergreen	79
2	Semi Evergreen	7
3	Deciduous	35
4	Semi Deciduous	4
5	Coniferous/Alpine/others	5
	Total	130

Source: Field study, 2018

The detailed enumeration of the prominent plant species of present study area, it is observed that the identified species are from a spectrum of 55 families, consisting of 130 tree species and a total count of 21037 individual plants. The total number of species including trees, herbs and shrubs are reported to be 130 numbers. The 130 species are classified into 5 major groups; these are evergreen, semi-evergreen, deciduous, semi deciduous and alpine/coniferous/others. The study area is dominated by evergreen species (60.76 percent), with a total count of 79 species

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out of 130 inside the campus. The second most prominent community is deciduous trees (26.92 percent) and the total number of species of the community is 33 and followed by semi-evergreen, coniferous/alpine/others which include 7, 5 and 4 types of species respectively.

As the present study area i.e. the Dibrugarh university campus is located at tri-junction of three prominent vegetation zones viz. i) monsoon deciduous type by Indian climatic condition, ii) evergreen type (indo-Myanmar bio-diversity), and iii) evergreen and coniferous (East-Himalayan biodiversity); which made the area a rich bio-diversity area, therefore, the maximum number of prominent types of evergreen species are found in the present study area. However, due to the impact of monsoon, the area is also covered by monsoon deciduous types of species which includes *Litsea polyantha, Tactona grandis, Erythrina variegate etc.* In all 130 species some species are naturally grown but some are planted in a specific thematic manner for e.g. Nahor (*Mesua ferrea)* which belongs from the evergreen community and few other species of exotic variety were planted in the campus by making a significant presence here , this group include *Polyalthia logifolia, Thuja orientsalis and Araucaria heterophylla* belongs to deciduous, coniferous and alpine community respectively.

Density and Percentage Distribution of 15 prominent floral species

Density of an item is the quantity of that item per unit measure, especially per unit length, area, or volume. In natural resource measurements, "density" is usually used to refer to the number of items per unit area. For example, plants/m^2. For the present study density is calculated through 200m X 200m grid. Density in vegetation measurement refers to the number of individuals per unit area. The term consequently refers to the closeness of individual plants to one another.

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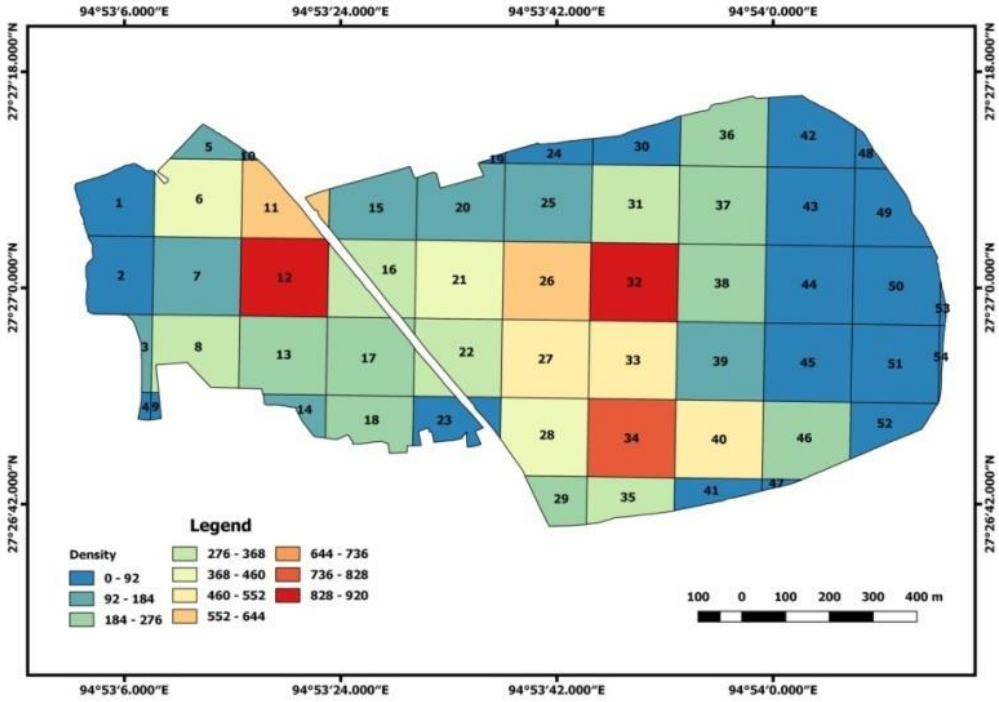

Figure 2: Grid wise density of identified plants inside Dibrugarh University campus, 2018

The primary survey estimates that 15 prominent species that have been found in the university campus are *Musa sp, Areca catechu, Delonix regia, Polythia longifolia, Aquilaria sp, Psidium guajava, Mangifera Indica, Syzygium cumini, Alogeissas latifolia, Litsea polyantha, Albizia labbeck, Mesua ferrea, Mimusops elengi, Thuja orientsalis, Alangium Chinese.* From the survey it is also found that there are many trees that have been found in the university campus are out of Indian origin, like Thuja, Arceria, Eucalyptus etc.

Table 2 : Top 15 most prominent species of Dibrugarh University

Sl. No.	Name of Tree	Total No. of trees found in DU Campus	Sl. No.	Name of Tree	Total No. of trees found in
1	*Musa sp*	1046	8	*Syzygium cumini*	292
2	*Areca Catechu*	782	9	*Alogeissas latifolia*	271

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3	*Delonix regia*	434	10	*Litsea polyantha*	239
4	*Polythia*	418	11	*Albizia labbeck*	233
5	*Aquilaria sp*	344	12	*Mesua ferrea*	229
6	*Psidium*	338	13	*Mimusops elengi*	194
7	*Mangifera*	326	14	*Thuja orientsalis*	192
			15	*Alangium Chinese*	185

Source: Field Survey, 2018

Nature and Density of few Important Species

Lebbek *(Albizia lebbeck)* is a fast growing, medium size deciduous tree with a spreading umbrella shaped crown of foliage, and smooth, finely fissured and grayish-brown bark. It is nitrogen fixing tree therefore it improves soil fertility. The extensive, shallow root system makes it a good soil binder and suitable for soil conservation and erosion control. There are 233 trees found in Dibrugarh university campus. Grid number 33 consist highest number of trees which occupied the administrative and library campus (Fig 3). Axlewood (*Anogeissus latifolia)* is a small to medium sized, deciduous tree. The tree is often harvested for its gum and tannins. It also yields a good quality wood and is planted in soil stabilization programme. The plant is used in treating snake bites and scorpion stings. There are 271 trees found in study area. Grid number 40 consist highest number trees which occupied Health Care centre campus, Mamoni roisom Goswami Chatri Nivas and some parts of Hitendranath Baruah Science and Culture Park, Aideu Handique Chatri Nivas. Agarwood (*Aquilaria sp*) is an Evergreen tree. The aromatic resin obtain from this tree is one of the most famous and most expensive on the planet. Agarwood is astringent, stimulant, tonic herb that relieves spasms, especially of the digestive and respiratory system, and lower fevers. There are 344 trees found in study area. Grid number 32 and 33 consist highest number of trees which occupied the administrative and Vice Chancellor office campus (Fig.4). Betel nut *(Areca catchu)* tree is a feathery palm which is an evergreen type of tree. The tree bears fruit all year. The nut may be used fresh, dried or cured by boiling, baking op roasting. There are 782 trees found in the study area. Grid number 32 consist highest numbers of trees followed by grid number 31 and 12.Grid number 32 occupied Ranghar campus ,VC office campus and some parts of English and sociology department campus (Fig.5). Flame *(Delonix regia)* tree is mainly valued for its seeds, leaves, shade and ornamental value. Because of its

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hardy nature and aggressive roots system, it is a good tree to control soil erosion in the arid and semi-arid areas. This tree is moderate size fast growing, deciduous tree and light feathery foliage. Flowers appear in corymbs along at the end of branches. There are 434 trees inside the campus, grid number 32 have highest number of trees which occupied from rang ghar *chariali* to josag roda side, followed by grid number 26, 38 and 34 (Fig.6).

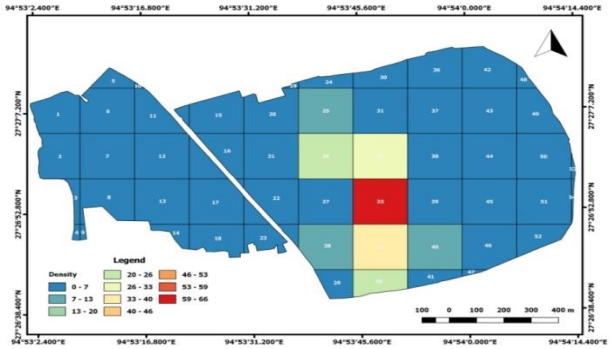

Figure 3: Density of *Albizia lebbeck*

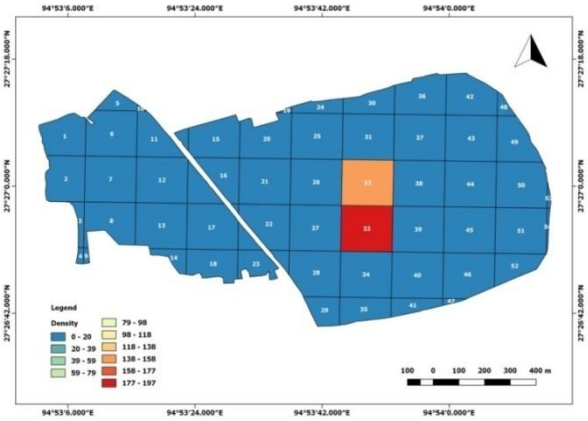

Figure 4 : Density of *Aquilaria sp*

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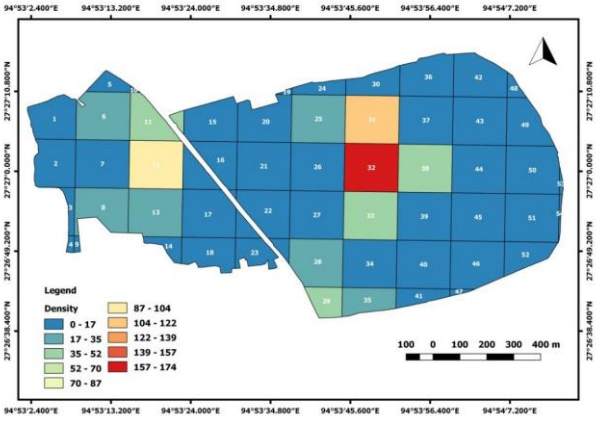

Figure 5 :Density of *Areca catchu*

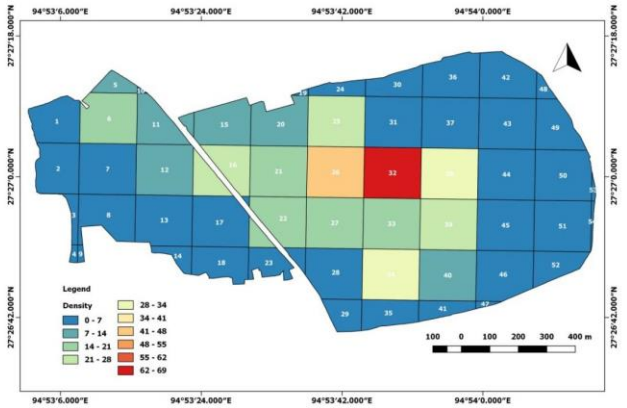

Figure 6 : Density of *Delonix regia*

From the above analysis, it is found that the density of Banana is highest in the study area, though it falls in herbaceous family. The second highest density among these species is Betal nuts followed by Flame tree, Deodaru, Agarwood, Guava, Mango, Black plum, Axlewood , Meda, Lebbeck, Rose chestnut, Spanish Cherry, White ceder and Chinese Alangium. Overall the highest number of trees are found in the grid number 32 & 12 followed by 34, 26&11.

Analysis of herbal species by quadrant method

Quadrant is the name given to the sample unit, on area of definite size, shape it may be circular, rectangular, or square. Depending upon the objective the Quadrant, can be many kind, viz list count, lip and permanent type are mainly used in the study of community structure. Since the assemblage of Herbaceous species in the natural community, Heterogeneous, a definite number of Quadrants is essential for adequate sampling of a community. As the number of quadrant increases, initially the number of species also increases. However often a certain point, an increase in number of quadrant does not show in increase in the number of species.The given study area is divided into 5 zones both grazing and non-grazing and for each zone 15 quadrant is done. Here the frequency method is applied for identifying the prominent species. The study found *Mikania micrantha* is the most prominent species and followed by *Pouzolgia indica, Sanchus sp, Ageratum conyzoides, Amphineuron opulentum, Borreria sp, Digitaria sp, Mimosa sp, Phyllanthus sp* and *Lantena camera.* Determination of minimum number of in Quadrant is

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important for the study of vegetation. The minimum number of quadrant is not fixed for all the grassland community or plant community. It may or may not vary as the plant community is heterogeneous. Various factors influence a herbaceous community such as climate and soil. In the present study area both perennial and annual herbs are found which is influenced by both soil and climate. Based on life spent species of the study area can be divided into two broad categories, this are: a) perennial and b) annual, perennials are grow back each year from roots that go dorman in the soil in the winter. New plants come from seeds of the perennial species which is found at the time of study are *kylinga sp, Auxonopus compressus, Mikania mikantha, Sida sp, Imperata cylindriea, Mimosa pudica etc, annual species which are found Ageratum conyzoides, Opplismonus composita, Leucas aspera, Hydrocotyl rotundifolia etc.* There are total 103 herbaceous species are identified inside the study area out of which 61 species are perennial and 42 species are annual.

Numbers of Automobile Vehicles

Pollution caused by the vehicle is the introduction of harmful material into the environment by motor vehicles. These materials, known as pollutants, have several bad effects on human health and the ecosystem. Examples of such pollutants include Carbon monoxide, Hydrogen, Nitrogen Oxide, particulate matter, Ammonia and Sulphur Dioxide. In order to calculate the pollutant emission level in Dibrugarh University, a survey has been conducted in the University Campus. The survey reveals a high consumption of emission caused by the pollutants from the vehicles.

Table 3 :No. of vehicles entered in DU campus on 23rdMarch (Working Day) and25th March (Holiday), 2018

No. vehicles entered in Dibrugarh University through **Jyotibatsora Gate 23 March** (Working Day)			No. vehicles entered in Dibrugarh University through **Jyotibatsora Gate 25 March**			No. vehicles entered in Dibruga University through **DUIET Gate 23 March** (Working Day)		
2W	4W	3W	2W	4W	3W	2W	4W	3W
661	253	8	610	213	17	886	343	17

Source: Field Study, 2018

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In order to calculate the total pollutant emission level in Dibrugarh University, the data of vehicle pollution is collected from Auto Pollution Testing Center which is given below.

Table 4: Vehicle pollutant emission rate

Vehicle Type	Percentage of CO	Hydrocarbon measured in PPM
2 Wheeler	3.5	6000
3 Wheeler	3.5	6000
4 Wheeler	3	1500

Source: Auto Pollution testing center, Dibrugarh, 2018

The total pollutant emission level in Dibrugarh University has been calculated as referred by the above table which reveals a very high hydrocarbon emission.

Table 5: Vehicle pollutant emission rate in DU campus (Working day)

Vehicle Type	% of CO x Total Vehic	Hydrocarbon in PPM x Total Vehicles	Total
2 Wheeler	3.5	6000 x (661 + 886)	9,282,000
3 Wheeler	3.5	6000 x (8 + 17)	150,000
4 Wheeler	3	1500 x (253 + 343)	894,000
	Total Hydrocarbon Emission in PPM		**10,326,000**

Source: Field Study, 2018 and Auto Pollution testing center, Dibrugarh, 2018

Table 6: Vehicle pollutant emission rate in DU campus (Holiday)

Vehicle Type	% of CO x Total Vehicles	Hydrocarbon in PPM x Tota Vehicles	Total
2 Wheeler	3.5	6000 x 610	3,660,000
3 Wheeler	3.5	6000 x 17	102,000
4 Wheeler	3	1500 x 213	319,500
	Total Hydrocarbon Emission in PPM		**4,081,500**

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Source: Field Study, 2018 and Auto Pollution testing center, Dibrugarh, 2018

Per Capita Paper Use

Paper has been an essential part of human life since it was first created in Ancient Egypt approximately during 3700-3200 BC. The global demand for paper products is significant, evidenced by the more than 350 million tons produced annually. According to WWF, if the current paper production and consumption practices remain the same over the coming years, the growing demand for paper will put a lot of pressure on the planet's last remaining natural forests and endangered wildlife. In order to understand the Environmental Sustainability of Dibrugarh University, it is very important to know the per capita paper use within the campus. So a survey has been conducted and it is found that per capita paper use by students in Dibrugarh University is 28.0612 kg and as the total students in Dibrugarh University is 4335. Therefore we can summarized that the total paper use in Dibrugarh University by students is (28.0612kg x 4335) 121645.302 kg and the total use paper in Dibrugarh University by both students and administration in one year is (121645.302 + 6066.144) 127711.446 kg. According to Yellow Printing, a China based printing company; it needs around 10 trees of 20-50 years old to produce 500 kgs of A4 size paper. So to produce 127711.446 kg of paper (total paper used in Dibrugarh University per year), the amount of trees that is going to be required is127711.446 kg/50 kg = 2554.22892 trees per year.

Waste Materials generated in the University Campus

Waste is created by all life forms. However, humans, due to sheer numbers and modern, industrialized lifestyles have created more waste than nature can cope with and in some cases have completely devastated the whole ecosystems. The study estimates that the total amount of greenhouse gases that the canteens and hostels of Dibrugarh University produces per day is 359 x 3.8 kgs = 1364.2kgs or 131035 x 3.8kgs = 497,933kgs per year. Bio Non-Degradable wastes are those wastes that cannot break down or degrade for many years. Since these wastes cannot break down, they get accumulated and thus contaminate the soil and water resources. Also due to the Bio non-degradable nature such wastes covers a huge amount of land that can create open space shortage in dense areas. In Dibrugarh University, the total amount of Bio non-degradable wastes that the canteens and hostels produce is 81.15 kg per day or 29,619.75 kg per year (Table.7).

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Table 7: Total waste generated by the different food joints and hotels inside DU campus

Total	Bio-Degradable (in kg/day)	Bio-degradable (in kg /year)	Non–Bio-degradable (in kg /day)	Non–Bio-degradable (in kg /year)
	359	131,035	81.15	29,619.75

Source: Field Study, 2018

Waste management in Dibrugarh University

Waste management techniques are useful to minimize or reduce the waste in environment and these will helpful to keep the environment clean. In Dibrugarh University, there are several types of wastes management techniques that are being applied for the successful wastes management in the University campus. The two busiest canteens of Dibrugarh university, Juti and Jo-Sag disposes their daily generated wastes to municipal party of Dibrugarh district that come at a regular time interval for the pickup of wastes. Apart from these two canteens, the rest canteens dispose their wastes in their respective backyards. The various department of the university dumps their generated wastes in a particular place which they later dispose with the help of fire. There are some dumping zones where all the bio-degradable wastes generated in the boys' hostel are dumped in a regular interval. The girls' hostels also do have some particular dumping zones where they dump their bio-degradable wastes at a particular time period. The non-degradable wastes generated in the hostels are disposed with the help of fire at a particular time period of interval. The administrative and different offices dispose their generated wastes in their backyard at a particular time interval. Dibrugarh University has also applied source separation dustbins that is setting up dustbins according to bio-degradability and non-degradability, which helps in selecting which wastes to recycle and which to dispose completely.

Carbon Emission Level

A carbon footprint is the amount of greenhouse gases primarily carbon dioxide released into the atmosphere by a particular human activity. In this study, it has been found that there are 21,037 trees in the university campus. With the help of an online calculator of U.S., it is found

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that on an average a single student produces 7.47 metric tons or 74700 kilograms of carbon footprints per year. By taking 3000 students as total average present students in the university, it is found that the total carbon footprints that the university produces per year is (3000 x 74700 kgs) = 224,100,000 kgs. A large tree inhales 20.3 kgs of CO2 in a year and exhales enough oxygen for a family of four for a year. As there are 21,037 trees in the university campus, so in total the trees in the campus inhale (20.3X 21037) 427,051.1 kg of carbon footprints per year. From this it can be clearly seen that there are (224,100,000- 427051.1) 223,672,948.9 kgs of carbon footprints that remains the university campus every year. So it clearly indicates that, in order to attain a balanced environmental condition in carbon footprints the amount of trees must have to be increased

Conclusion

It has been observed form the study that a detail analysis based on primary field survey gives us a clear picture of the species diversity, their distribution, density and sustainability. The present study area i.e. Dibrugarh University is located at tri-junction of three prominent bio diversity hot spots viz. i) Monsoon deciduous type by Indian climatic condition, ii) Evergreen type (indo-Myanmar bio-diversity), and iii) Evergreen and coniferous (Eastern-Himalayan biodiversity); which made the area a rich bio-diversity. The findings of the study will definitely help the administration to take necessary steps for sustainable development of the campus from environmental point of view.

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