Carbon Footprint: A Case Study

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Abstract

Global warming is a condition of change in the climate. The major source of this condition are Green House Gases like Carbon dioxide, Methane, Nitrous oxide, Ozone etc. Carbon Footprint is the increased carbon dioxide concentration. This may leads to severe impacts in the atmosphere. Majorly due to the activities of particular individual, organization or a community. In this study, an attempt made to estimate the carbon emission in Govt. Medical College, Manjeri. For this study electrical sources, Food waste, Transportation which emits carbon are taken into account.

Keyword: *Global warming, Green House Gases, Carbon footprint.*

I. INTRODUCTION

Global warming, the observed increase in average temperatures of the Earth's atmosphere and oceans, has become a worldwide concern. It has an impact on every human being on the planet, and, unless addressed effectively, it will have severe consequences in our way of life. Scientists have found a direct relationship between carbon emission and global warming. Carbon emissions are the primary greenhouse gas emitted into the atmosphere by human activities. Although carbon dioxide is naturally present in the atmosphere, human activities are altering the carbon cycle which is the natural circulation of carbon across the atmosphere, oceans, soil and plants by adding more carbon into the atmosphere and influencing the ability of natural sinks like forests to remove CO_2 from the atmosphere.

II. METHODOLOGY

Govt. Medical College, Manjeri is divided into several sections in order to collect data regarding the electrical equipments. Also, Waste and transportation quantity assessment is carried out. Green area of the locality also found using GIS tool to check carbon sequestered in the surrounding.
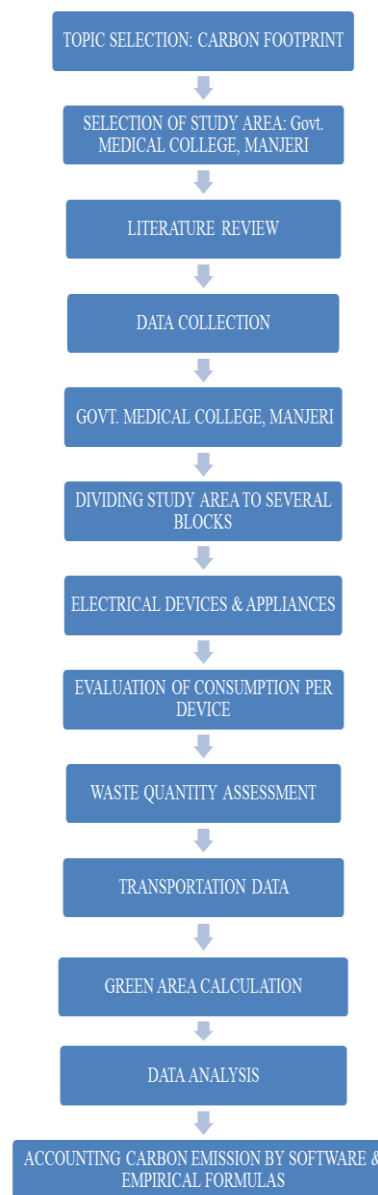

Figure 1:Flow diagram of methodology.

Figure 2: Map of Medical College, Manjeri.

III. DATA COLLECTION

➢ Electricity
The study area divided into various blocks and energy consumption in each block assessed.

GHG Emission Calculation

KWh=(Hour/Day/Year)÷(1000) (1)

CarbonEmission = KWh × EF   (1)

 EF = 0.82

Table 1: List of electrical equipments and its carbon emission concentration

BLOCK	EQUIPMENT NAME	NO. OF EQUIPMENT	NO. OF WORKING HOUR PER DAY	WATTS	KWh	EMISSION FACTOR	CARBON CONTENT (kg CO₂)
Ground Floor	Ceiling Fan	16	20	16	1.2	0.82	0.984
	Refrigerator	1	24	1500	36	0.82	29.52
	Spot Light	2	10	8	0.08	0.82	0.0656
	Wall Fan	1	20	55	1.1	0.82	0.902
	Tube Light	26	24	40	0.96	0.82	0.7872
	Led Bulb	10	18	5	0.09	0.82	0.0738
	Computer	1	18	30	0.84	0.82	0.4428
	Printer	1	4	450	1.82	0.82	1.476
	CCTV	1	24	20	0.48	0.82	0.3936
	CFL	2	16	15	0.24	0.82	0.1968
Janatha Pharmacy	CFL	8	18	15	0.27	0.82	0.2214
	Tube light	5	16	40	0.64	0.82	0.5248
	Computer	5	8	30	0.24	0.82	0.1968
	Printer	2	3	450	1.35	0.82	1.107
	Wall Fan	2	8	5	0.04	0.82	0.0328
	LED Bulb	5	6	55	0.33	0.82	0.2706
	AC	2	24	1500	0.36	0.82	29.52
	Ceiling Fan	3	8	60	0.48	0.82	0.3936
1ˢᵗ Floor	Tube light	3	18	40	0.72	0.82	0.5904
	Ceiling Fan	3	20	60	1.2	0.82	0.984
	LED Bulb	1	20	5	0.1	0.82	0.082
	CFL	1	16	15	0.24	0.82	0.1968
	TV	1	5	400	2	0.82	1.64
2ⁿᵈ Floor	Ceiling Fan	11	8	60	0.48	0.82	0.3936
	Tube light	15	14	40	0.56	0.82	0.4592
	CFL	3	12	15	0.18	0.82	0.1476
	AC	2	8	1500	12	0.82	9.84
Operation Theatre	AC	2	24	1500	36	0.82	29.52
	CFL	1	24	15	0.36	0.82	0.2952
	Tube light	9	24	40	0.96	0.82	0.7872
	LED	1	20	5	0.1	0.82	0.082
Preparation Room	AC	2	10	1500	15	0.82	12.3
	CFL	1	18	15	0.27	0.82	0.2214
	Tube light	4	15	40	0.6	0.82	0.492
Operation Theatre (10)	Tube light	8	24	40	0.96	0.82	0.7872
	AC	2	24	1500	36	0.82	29.52
	CFL	1	18	15	0.27	0.82	0.2214

Operation Theatre (11)	Tube light	8	24	40	0.96	0.82	0.7872
	AC	2	24	1500	36	0.82	29.52
	CFL	1	16	15	0.24	0.82	0.1968
Operation Theatre (S)	Tube light	16	24	40	0.96	0.82	0.7872
	AC	4	24	1500	36	0.82	29.52
Anesthesiologist	Tube light	18	12	40	0.48	0.82	0.3936
	CFL	7	16	15	0.24	0.82	0.1968
	Computer	11	16	30	0.48	0.82	0.3936
	Printer	4	2	450	0.9	0.82	0.738
	AC	10	20	1500	30	0.82	24.6
	Ceiling Fan	3	2	60	0.12	0.82	0.0984
OT Store	Ceiling Fan	3	8	60	0.48	0.82	0.3936
	Tube light	24	10	40	0.4	0.82	0.328
	CFL	3	10	15	0.15	0.82	0.123
Recovery Room	Ceiling Fan	1	10	60	0.6	0.82	0.492
	Tube light	8	18	40	0.72	0.82	0.5904
SICU	AC	2	24	1500	36	0.82	29.52
	Ceiling Fan	2	2	60	0.12	0.82	0.0984
	Wall Fan	2	4	55	0.22	0.82	0.1804
	Tube light	7	24	40	0.96	0.82	0.7872
Changing Room	Ceiling Fan	2	18	60	1.08	0.82	0.8856
	Tube light	4	20	40	0.8	0.82	0.656
Verandah	Tube light	5	24	40	0.96	0.82	0.7872
4th Floor	CFL	8	6	15	0.09	0.82	0.0738
	Tube light	15	16	40	0.64	0.82	0.5248
	Ceiling Fan	25	20	16	1.2	0.82	0.984
	LED Bulb	4	5	5	0.025	0.82	0.0205
	Refrigerator	1	24	1500	36	0.82	29.52
4th Floor	Ceiling Fan	15	20	60	1.2	0.82	0.984
	Tube light	6	16	40	0.64	0.82	0.5248
	CFL	9	21	15	0.3150	0.82	0.2583
	LED Bulb	2	12	5	0.06	0.82	0.0492
	Bulb	2	6	60	0.36	0.82	0.2952
	Refrigerator	1	24	1500	36	0.82	29.52
	Exhaust	1	8	60	0.48	0.82	0.3936
Orthopedics	Ceiling Fan	20	24	120	1.44	0.82	1.1808
	CFL	2	18	15	0.027	0.82	0.2214
	Tube light	6	10	40	0.4	0.82	0.328
	Bulb	5	6	60	0.36	0.82	0.2952
Blood Bank	Refrigerator	5	24	1500	36	0.82	29.52
Operation Theatre (11)	Monitor	1	24	80	1.92	0.82	1.5744
	Shadow less Light	1	16	500	8	0.82	6.56
Operation Theatre (12)	Monitor	1	24	80	1.92	0.82	1.5744
	Shadow less Light	1	16	500	8	0.82	6.56
	OT Table	1	16	150	2.4	0.82	1.968

Carbon Emission from electrical sources = 420. 7584 KgCO$_2$

➢ Transportation

In this average fuel consumption of the fuel of all vehicles are analyzed by conducting automobile survey at Govt. Medical College, Manjeri. For this each vehicle is categorized according to type of vehicle and type of fuel.

$$F_C = A_C \times V \times R_D \tag{2}$$

Where,

F_C = Fuel consumption (Diesel/ Petrol) in L
A_C = Average fuel consumption in L
V = Number of each type of vehicle
R_D = Amount of running per day by the vehicle

$$EM\ (CO_2) = F_C \times SG_F \times CP_F \times EF_F \tag{3}$$

Where,

SG_F = Specific gravity of fuel (Kg/m^3)

CP_F = Calorific power of the fuel (kcal/kg)
EF_F = Emission factor of the fuel (tco$_2$/TJ)

Table 3: Chemical properties of fuel.

TYPES OF FUEL	SG_F (Kg/cum)	CG_F (Kcal/kg)	EF_F (tCO$_2$/TJ)
Diesel	885	10700	74.1
Petrol	737	11464	69.3

Table 4: Type of vehicle and its count

TYPES OF VEHICLE	V	R_D (km)	A_C (L/km)
Car (Petrol)	50	2	0.05
Car (Diesel)	258	2	0.03
Auto (Diesel)	308	1	0.028
Bike (Petrol)	465	4	0.02
Goods (Diesel)	4	6	0.04

Table 4: Emission from the automobiles

TYPE OF VEHICLES	F_C (lit)	E_M CO$_2$(tons)
Car (Petrol)	5	0.3
Car (Diesel)	15.48	10.86
Auto (Diesel)	8.624	0.6
Bike (Petrol)	37.2	21.78
Goods (Diesel)	0.96	0.61

➢ Waste

Greenhouse gas emission also occur during organic waste decomposition. As far as GHG emissions from organic waste degradation are

concerned, composting is an aerobic degradation process whereby a large fraction of the degradable organic carbon in the waste material is converted into CO_2.

➢ *Composting*

$C = MSW \times \Theta g \times DOC \times DOCf \times 44/12$ (4)

Where,

    MSW = Municipal solid content

    DOC = Degradable organic carbon content

    DOC_f=Actual decomposition of degradable organic carbon in the process of compost

    44/12 = Molecular weight ratio of CO_2/C

    Θ_g =Proportion of MSW to be composting.

MSW = 12000 Kg, Θ_g = 0.88, DOC= 13.245, DOC_f = 0.5

$C = 12000 \times 0.88 \times 13.245 \times 0.5 \times 44/12$

    = 256518.2186 $KgCO_2$

➢ Overall Carbon Emission

Total Carbon Emission= Sum of carbon emitted from each sources

    =420.7584+ 256518.2186+35.14×10³

➢ Green Coverage

    To find the carbon sequestered by the surrounding green coverage at Govt. medical college, Manjeri is measured by the help of GIS tool. Boundary of green area is evaluated and the whole green area is divided into different section in order to find the total green area.
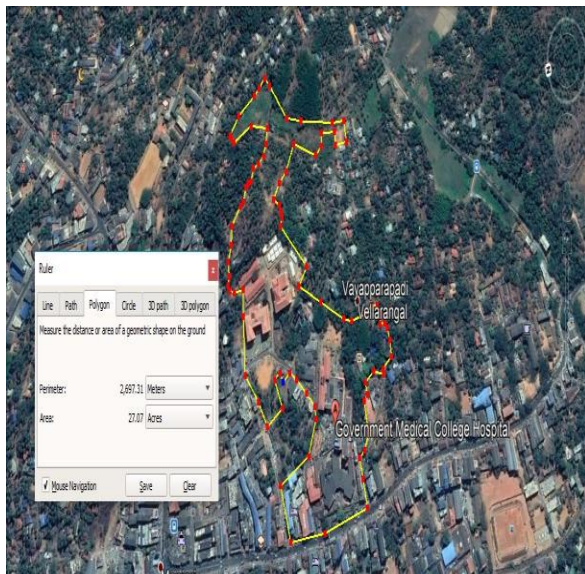

Figure 3: Green boundary of Govt. Medical College, Manjeri

Total Green Area   =12.31 Acres

Total Perimeter   = 3130.45 m

Green area in carbon Equivalence = (Unit of CO_2/ acre/ year) ×(44/12)   (5)

  = (292078.977 /12.31/1) × (44/12)

  = 86998.88294 Kg CO_2 sequestered

➢ Other GHG Emission

    According to the study proposed in KinfraPark, Kakkanchery by the Pollution Control Board of Malappuram district, since Kakkanchery is an industrial area the GHG emission in the industrial area is taken as major source in the overall district. The greenhouse gases like N_2O, SO_2… etc. are emitted which leads to pollution in the area. From the study it is observed that GHG emission in Kakkanchery is approximately taken as GHG emission in Malappuram because Kakkanchery industrial area is the major source of GHG emission. The greenhouse gas other than CO_2 converted to carbon terms by multiplying with Global Warming Potential (GWP) value which is different for each greenhouse gas. So, by calculation GHG emission in Malappuram 3456.345 tons of CO_2.

IV. RESULT

    The objective of the project is to estimate the overall carbon emission in the Govt. Medical College, Manjeri. By the help of Microsoft excel total carbon emission due to electrical equipments and the carbon equivalence which produced in powerhouse is found by conducting an electrical equipment survey in the study area by dividing each block into different sections.

    The total carbon emission due to general electrical equipments and bio-medical equipments are 420.758 $KgCO_2$.

    The transportation is also one of the source which is to be considered since Manjeri Medical college is a popular hospital in the Manjeri municipality and according to 2011 census report population is 97104. So, automobiles can be considered as one of the source for carbon emission. Results are obtained by considering both diesel and petrol vehicles separately also type of vehicle is accounted. The emission from automobiles is 3514 Kg CO_2.

Waste also one of the source from which carbon is emitted. According to previous studies conducted in other places waste is analysed by classifying its method of disposal like, Incineration, Landfills, Composting… etc. and the result obtained is 256518.2186 Kg CO_2

Also, the green area within the boundary of the study area is estimated by Google earth point in which the total green area is divided into separate section and by polygon method of calculation in Google earth point green area obtained is 12.31 acres and from the results it is found that the 12.31 acres green area of the medical college campus can only sequester a CO_2 content of 125.44 kg indicating the insufficient green coverage for achieving carbon neutrality.From the study of Pollution Control Board,Malappuram GHG emission in Kinfrapark, Kakkanchery is considered approximately equal to GHG emissions in Malappuram and according to the PCB results the GHG emissions obtained in carbon equivalence is 3456.345 tonnes of CO_2.

V. CONCLUSION

The main objective of this study was to understand the implications, explore options and strategies for net zero carbon footprint in the building. The emission of the carbon cannot be eliminated completely. It is essential to maintain desirable atmospheric conditions such as to obtain frequent rain, desirable temperature, availability of clean water, food, and energy. At the same time an increment in the carbon content causes serious destruction in everyday living. So, Carbon Neutrality is a concept which deals with how to maintain carbon content and obtain a balanced condition. From the study it is observed that the carbon emission due to electrical equipment, waste, also due to automobiles is above the limit of carbon content that can be sequestered by the green coverage in the medical college campus is insufficient. So, from the study the overall carbon emission due to such sources are very high and can lead to serious environmental impacts. Also, from the comparison study observed from the recent results of Pollution Control Board, they have considered Kakkanchery Kinfra Park as the major source of emission in Malappuram district. Hence, it is to be considered that in Malappuram district Manjeri Medical college should also be considered as a source of emission.

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