Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 06, June-2019

Carbon Footprint Assessment of MESITAM

Megha S Ramesh, Sulthana B.S, Ajmi A, Sanoj S
UG Scholars: Dept. of Civil Engineering
MES Institute of Tehnology And Management
Chathannoor, Kollam, Kerala, India

Razna Rahim
Assistant Professor: Dept Of Civil Engineering
Mes Institute of Tehnology And Management
Chathannoor, Kollam, Kerala, India

***Abstract*— The carbon footprint is the sum of all emissions of CO_2, which is induced by our activities in a given time frame. The objective of this study is to assess the Carbon dioxide emission from various emission inventories namely LPG consumption, water consumption, buildings, wastewater consumption, burning of paper waste, food waste, human respiration, electricity, transportation and green coverage. The study area selected is MESITAM campus, Kollam. The study area selected has a total built-up area of 21548.75sq.m. Carbon footprint from different sources was estimated by multiplying activity data with the corresponding emission factor. Emissions from various inventories were quantified using the emission factors given by Department for Environment, Food, and Rural Affairs, UK (DEFRA). The maximum and the minimum emission was found to be from electricity and burning of paper waste which was obtained as 5159.754 kg CO2/month and 3.016 kg CO2/month respectively. The net carbon footprint from the selected inventories was quantified as – 10024.38 kg CO2/month.**

Keywords—Carbon footprint, Data collection, MESITAM, Emission factor, Remedial measures

I. INTRODUCTION

A carbon footprint is historically defined as the total emissions caused by an individual, event, organization, or product, expressed as carbon dioxide equivalent. Greenhouse gases (GHGs), including carbon dioxide, can be emitted through land clearance and the production and consumption of food, fuels, manufactured goods, materials, wood, buildings, transportation and other services. In other words: When you drive a car, the engine burns fuel which creates a certain amount of CO_2, depending on its fuel consumption and the driving distance. (CO_2 is the chemical symbol for carbon dioxide). When you heat your house with oil, gas or coal, then you also generate CO_2. Even if you heat your house with electricity, the generation of the electrical power may also have emitted a certain amount of CO_2. When you buy food and goods, the production of the food and goods also emitted some quantities of CO_2.

Today, the term "carbon footprint" is often used as shorthand for the amount of carbon (usually in tons) being emitted by an activity or organization. The carbon footprint is also an important component of the Ecological Footprint, since it is one competing demand for biologically productive space. Carbon emissions from burning fossil fuel accumulate in the atmosphere if there is not enough biocapacity dedicated to absorb these emissions. Therefore, when the carbon footprint is reported within the context of the total Ecological Footprint, the tons of carbon dioxide emissions are expressed as the amount of productive land area required to sequester those carbon dioxide emissions. This tells us how much biocapacity is necessary to neutralize the emissions from burning fossil fuels.

II. METHODOLOGY

A. Study area

The area of study is **MES INSTITUTE OF TECHNOLOGY AND MANAGEMENT** (MESITAM) located at Kollam district. The study area is located at 8.8684^0 N Latitude and 76.7081^0 E Longitude. Our project procedure is carried out in three buildings i.e. main block, department block, mechanical block and canteen. Its scale is huge, spanning plinth area of 24782.949sq.m.

B. Data collection

The various CO_2 emissions occurring in MESITAM are from electricity, vehicles, humans, water consumption, sewage, paper waste, food waste and from buildings. The relevant data from these emission inventories were collected. All the emission factors for different emission inventory database were identified.

C. Method of calculation

Standard emission factors published by Department for Environment, Food, and Rural Affairs, UK (DEFRA) were used in this study for calculating the GHG emissions. Thus, the Carbon footprint from different sources was estimated by multiplying activity data with the corresponding emission factor.

D. Carbon sequestration

Due to carbon sequestration, reduction in overall CO_2 emission occur. Plants, trees are the carbon sinks situated in the institution. Considering carbon sequestration by trees overall carbon emissions of our campus is calculated. A tropical tree can absorb 9.5 Kg CO_2/ m^2 area/ year.

III. DATA COLLECTION

A. Transportation

According to the area of study, the CO_2 emissions in MESITAM campus include consumption of fuels due to the running of vehicles owned by the college, staff and students. The transportation details of the study area was collected by conducting a survey among the occupants of the study area, questions were asked about mode of transportation, fuel used and type of vehicle.The included data collection method was manual survey. The data was collected for a period of 4 months.

International Journal of Engineering Research & Technology (IJERT)
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B. Lpg consumption

The data was collected from MESITAM cafeteria by direct questioning. The data includes number and mass of cylinder consumed for four months.

C. Electricity

Indirect emissions are calculated from electricity. The electricity consumption for 4 months is collected is given below. The data can be collected from electricity bill of months. The details regarding the electricity readings of all buildings have been collected for the month of December 2018 To March 2019.

D. Emission from water consumption

The data collected for water consumed for 4 months. The data is collected from calculating the capacity of tank and considering the institutional water demand which is equal to 20 l/head/person.

E. Waste water generation

75% of water consumed is taken as waste water. The data is collected for 4 months.

F. Paper waste

The burning of paper waste cause GHG emission. The data was collected from collecting the amount of paper waste produced in 4 months.

G. Food waste

The burning of food waste cause GHG emission. The data was collected from collecting the amount of food waste produced in 4 months.

H. Human factor

The number of staffs and students were noted to calculate the co2 emission from human factor.

I. Buildings

Our campus consists of three buildings and they are main block, department block, and mechanical block respectively. The details of the total built up area of buildings in the campus were calculated. Built up area for each building was calculated using AutoCAD software.

J. Green coverage area

From the topographical map of the campus the total area was collected. The area of different department blocks was also noted. Thus, the green coverage area was obtained by assuming 10 % of the result.

IV. EMISSION FACTORS

Standard emission factors published by Department for Environment, Food, And Rural Affairs, UK (DEFRA) were used in this study for calculating the GHG emissions and the same is given in table.

V. CALCULATION

Activity data x emission factor = carbon emissions

TABLE 1. EMISSION FACTORS

Components	Emission factors
Petrol	2.19/ L
Diesel	2.60/ L
LPG	2.71/ Kg
Electricity	0.856/ kwh
Water consumption	0.34/ KL
Paper burning	0.928/ Kg
Human factor	0.4/ kg/ person/ day
Food waste	3.59/ Kg
Concrete work	0.2/ m^2/ year

VI. RESULT AND DISCUSSION

A. Transportation

Based on these details, the total fuel consumed per month by employees and students is determined and CO_2 emission associated with it is obtained by multiplying it with the conversion factors and the corresponding emissions were quantified as 302.795 Kg CO_2/month.

B. LPG Consumption

The total co2 emission is obtained by multiplying the total LPG consumed with the emission factor and the result obtained was 102.98 Kg CO_2/month

C. Electricity

The emission due to energy consumption is calculated by noting the power consumed values for the four months considered for our study. Hence the result obtained is 5159.754 Kg CO_2/month.

D. Water consumption

The water consumption has been calculated by considering the institutional water demand and the total number of staff and students. The CO_2 emitted is 93.84 Kg CO_2/month.

E. Waste water generation

Waste water generation and recycling also causes GHG emissions. 75% of water consumed is consider as waste water generated. The total emission obtained was 144.905 Kg CO_2/month.

F. Paper waste

The waste generated in each month is collected and the CO_2 emission is calculated by using the conversion factor for paper waste. The corresponding carbon emission is 3.016 Kg CO_2/month.

G. Food waste

The food waste generated in each month is collected and the CO_2 emission is calculated by using the conversion factor for food waste. The result obtained is 39.487 Kg CO_2 /month.

H. Human factor

The CO_2 emission is calculated by using the conversion factor with the total number of students and staffs. The emission is about 5006.4 Kg CO_2/month

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I. Emissions from buildings

Total built area of all the buildings in the study area was found to be 21548.75sq.m. and the corresponding emission were quantified as 357.709 Kg CO_2/month.

J. Carbon sequestration

Total green coverage of the college was to be 1500sq.m. Emissions absorbed by trees was quantified as 1186.5 Kg CO_2.

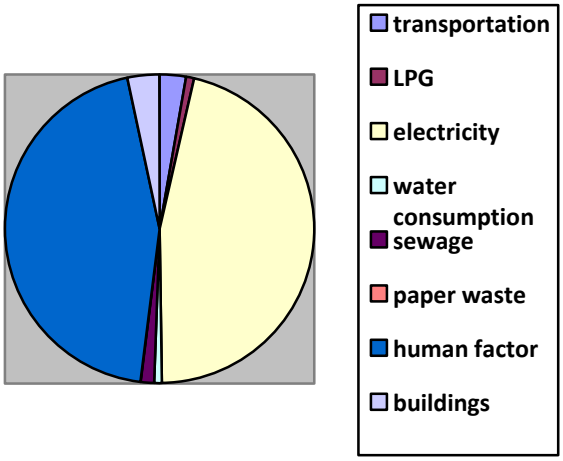

Figure 1. Average emission per month

TABLE 2. TOTAL EMISSION FROM ELECTRICITY

Month	Power consumed (KWH)	CO_2 Emission (Kg)
December	5393	4616.408
January	5776	4944.256
February	6402	5480.112
March	6540	5598.24

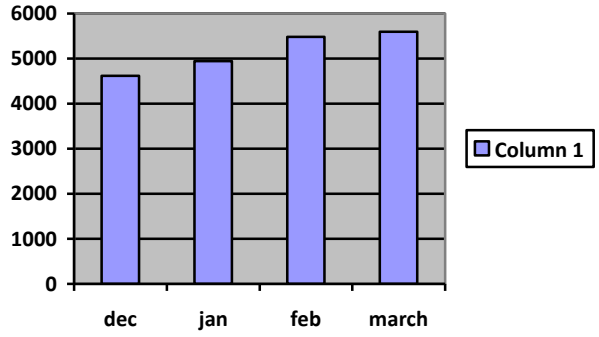

Figure 2. Graph of total emission from electricity

TABLE 3. TOTAL EMISSION FROM PAPER WASTE

Month	Dec	Jan	Feb	March
Waste generated in kg	4	3.5	3.5	4
Co_2 in kg	1.856	3.248	3.248	3.712

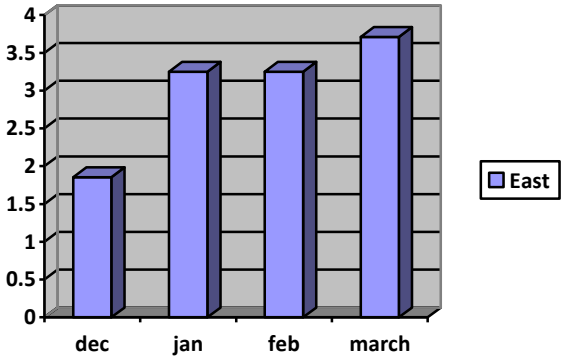

Figure 3. Graph of total emission from paper waste

VII. REMEDIAL MEASURES

1.Explore possibilities for installing solar panels & biogas plant.
2.Conduct awareness programs to save energy.
3.Purchase an energy efficient vehicle fleet such as E-cycle.
4. Plant a greater number of trees in the campus
5.Reduce all waste, especially paper, disposable items, and packaging materials.
6. Establish programs to encourage the use of e-mail and double-sided printing.
7.Compost food waste.
8. Provide proper doors and windows for natural lightning and ventilation.
9. Rather than burning the paper waste we can sell it to scrapers.
10. Adopt 3R (reduce, reuse, recycle) concept.
11. Use stairs rather than use of elevators, which reduces electricity consumption.
12. Support clean energy sources. Whenever we can, advocate for clean alternatives to fossil fuel such as wind, solar, hydrothermal, fuel cell, biomass energy etc.

VIII. CONCLUSION

Nowadays the carbon footprints as well as carbon credits carries an importance in our daily life. Everyone should realize its effects and should try to protect the nature from its adverse effect. Therefore, if we use all our resources available, and stop being spoiled, the earth's carbon footprint can be drastically reduced.

- Operational phase carbon foot print of MESITAM institution has been calculated and it was found that an average of 10.024 tons of CO_2 is emitted each month.
- It has been found out that the major factors which are contributing to the CO_2 emissions are electricity consumption, human factor, emissions from building and transportation.
- Electricity causes 35.78% of overall emission and paper waste causes 0.026% emission.
- It has been observed that energy sector contributes the maximum and burning of paper waste contributes the minimum to GHG emission.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 06, June-2019

- The scope of such a study is very much relevant in the current scenario of rising CO_2 levels in our very own ecosystem.

ACKNOWLEDGMENT

First and foremost, I thank THE ALMIGHTY for giving us life, health and strength for the successful and timely completion of the project**.** We avail this opportunity to express our ardent and sincere gratitude to our project supervisor Prof. RAZNA RAHIM, Assistant Professor, Department of Civil Engineering, for the tutelage, encouragement and guidance for translating my efforts to fruition. We are also indebted to all the teaching and non-teaching staff, Department of Civil Engineering, for their heartfelt co-operation and tremendous support. Last but not the least, we would like to acknowledge all our friends and well-wishers who had helped us a lot in our endeavor.

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