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EVALUATION AND DEVELOPMENT OF WEB APPLICATION FOR CO_2 EMISSION OF RESIDENTIAL BUILDINGS

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Abstract - *CO_2 emission has been increasing day by day from various sources like motor vehicles, factories, industries and construction activities. CO_2 contributes 81% of total Green House Gas (GHG) emission. According to UN environment Global status Report 39% of total CO_2 emission is from buildings and construction activities. CO_2 emission of two residential building is calculated by surveying all the inventories that emit considerable amount of CO_2 using emission factor. Emission Factor is obtained from CPCB and DEFRA, UK. Surveyed inventories for the study are Electricity, Transportation, Human Releases, Solid waste by open burning, Waste water generation, Food waste, Fuel consumption, Building materials. Carbon Sequestration is also calculated by surveying about trees. The net carbon emission of the study area was found to be 55658.188 Kg and 51322.751 kg for residential building 1 and 2 respectively. Carbon sequestration is also calculated. In this study Residential Building 1 is zero CO_2 emitting building. By analyzing the two building it is clear that Residential Building 2 is completely a zero carbon emission building design. A web application is also developed to calculate easily.*

Key Words: **Green House Gas, Emission Factor, Carbon Sequestration, inventories, CPCB, DEFRA.**

1. INTRODUCTION

This document is CO_2 is the main green house gas emitting from human Activities. We produce greenhouse gas emissions from burning petrol when we drive, burning oil or gas for home heating, or using electricity generated from coal, natural gas, and oil, food waste, water consumption, buildings, burning of paper etc. These gases persist in the atmosphere and trap heat. CO_2 is estimated by using standard emission factors published by Department for Environment, Food, and Rural Affairs, UK (DEFRA) and Central Pollution Control Board, India (CPCB) were used in this study for calculating the GHG emissions. Emission factor the sum of emissions of CO_2 of the human activity described as mass unit of CO_2 reference flows. Two different residential area is chooses as study area. Materials used for construction also responsible for emission. Carbon sequestration is also calculated by analyzing trees.

1.1 Objectives

Main objective is to calculate total CO2 emission from selected inventories. Carbon sequestration is calculated by analyzing trees in the surrounding area. A web application is developing using php and html for easy analysis.

1.2 Scope

Relevant in the current scenario of rising CO_2 levels in our very own ecosystem, this study reveals the importance of plants and trees in the residential surroundings.

2. METHODOLOGY

First step is to select study area. The area of study selected is two residential building of 1542 and 1658 sq. feet area. Second step is to collection of data from various inventories that emit co_2. Emission factor from DEFRA and CPCB is multiplied by activity collected to get total emission. Finally, carbon sequestration is calculated to get net result.

3. CALCULATION

3.1 Electricity

Total electricity consumption for residential building 1 and 2 are 839 and 660 kWh respectively. Emission factor is 0.82. Total CO2 emission is 687.98 and 541.2 kgCO2.

3.2 Transportation

Emission Factor for two wheeler and four wheelers are 0.035 and 0.0145 respectively.
Total co2 emission = No. of each type of vehicle × emission factor × average distance travelled by each vehicle in a year.

CO2 emitted by house 1 = 2 × 0.035× 7120 + 1× 0.0145×13447 = 692.98 kg
CO2 emitted by house 2 = 1 × 0.035× 2880 = 101.08 kg

3.3 Human Release

Emission Factor for human release is 0.4
Total CO2 emission by house 1 = 0.4 × 5=2 kg
Total CO2 emission by house 2 = 0.4 × 4=1.6 kg

3.4 Water Consumption

Emission Factor for water consumption is 0.34
CO2 emitted by house 1 = 0.34 × 1.35 ×364 = 167 kg

CO2 emitted by house 2 = 0.34 × 0.8× 364 = 99.008 kg

3.5 Liquid Waste

Total liquid waste is taken as 75-80% of total water consumption

Emission Factor for liquid waste is 0.003124
CO2 emitted by house 1 = 0.003124 × 1.08 ×364 = 1.228 kg
CO2 emitted by house 2 = 0.003124 × 0.64× 364 = 0.727 kg

3.6 Solid Waste

Per capita solid waste for residential building for middle income and low income group are 0.74 and 0.41 kg respectively. Emission Factor for solid waste is 0.002989
CO2 emitted by house 1 = 0.002989 × 0.74 ×5×364 = 4.02kg
CO2 emitted by house 2 = 0.002989 × 0.74×4× 364 = 0.176 kg

3.7 LPG Consumption

The total CO_2 emission is obtained by multiplying the total LPG consumed with the emission factor (2.71/kg) and the result obtained was as follows
CO_2 emitted by house 1 = 460.02 kg
CO_2 emitted by house 2 = 345.06kg

3.8 Construction Material

Table -1: Carbon Emission from Materials

Materials	Emission Factor	Quantity (kg)		Total Carbon Emission (kg)	
		B1	B2	B1	B2
Cement	0.967	2500	23500	24175	22724.5
Fine aggregate	1.2	3750	4300	4500	5160
Course aggregate	0.002	7300	6500	14.6	13
stone	2.33	1400	950	3262	2213.5
Wood	0.2	200	200	40	40
Concrete mixture	0.159	12016	11433	1910.5	1817.9
Brick	0.327	500	650	163.5	212.55
steel	5.457	19099.5	3200	156	17462.4
paint	0.89	35.6	28	63	24.92
Electric Work	2.84	55	68	260	193.12
water	0.42	150	220	19099.5	92.41
labor	0.4	700	400	280	160

3.9 Carbon Sequestration

The formula for finding amount of Carbon sequestrated is as follows [5]

Formula = Stem Volume x Biomass Conversion Factor x Density of wood (soft wood or hard wood) x Carbon Fraction (Biomass to carbon equivalent) x Carbon to CO2 Fraction.
Where, Stem volume = $(\pi/4)\ d^2$,
Biomass Conversion factor for softwood = 1.12 and for hardwood = 1.33,
Specific gravity (density) for softwood = 0.463and for hardwood = 0.569.
Carbon fraction (biomass to carbon equivalent) for softwood and hardwood = 0.5,
Carbon to Carbon dioxide fraction = 3.67

Table -2: Carbon Sequestration in Building 1

Tree	Number	Stem Diameter	Average Height	Carbon Sequestrated
Coconut	4	0.05	3.5	38.25
Neem	1	0.2	1.8	0.7
Banana	5	0.025	1	0.034
Jackfruit	1	0.07	1.5	0.08
Mango	1	0.03	2.5	2.454

Table -3: Carbon Sequestration in Building 2

Tree	Number	Stem Diameter	Average Height	Carbon Sequestrated
Coconut	9	0.025	1	6.135
Mahagony	1	0.02	1.8	0.789
Bilimbi	2	0.02	2	1.745
Jackfruit	2	0.07	2	21.37
Mango	1	0.03	2.5	2.454
Goa	3	0.015	1.5	1.104
Teak	2	0.06	3	70.67
Banana Tree	9	0.025	1	6.135

4. DESIGN OF WEB APPLICATION

Web application is developed using php (personal home page) and html (hypertext makeup language). When application opens four options are available as shown in figure 1.

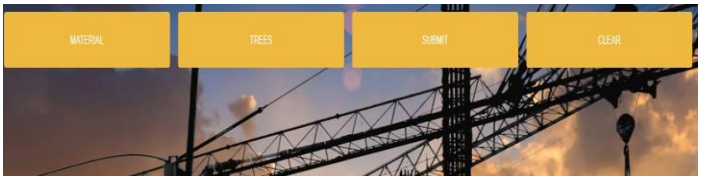

Fig -1: options displayed when application opens

In material option all materials along with emission factor is displayed as in figure2. When we choose material the program will automatically calculate the co2 emission.

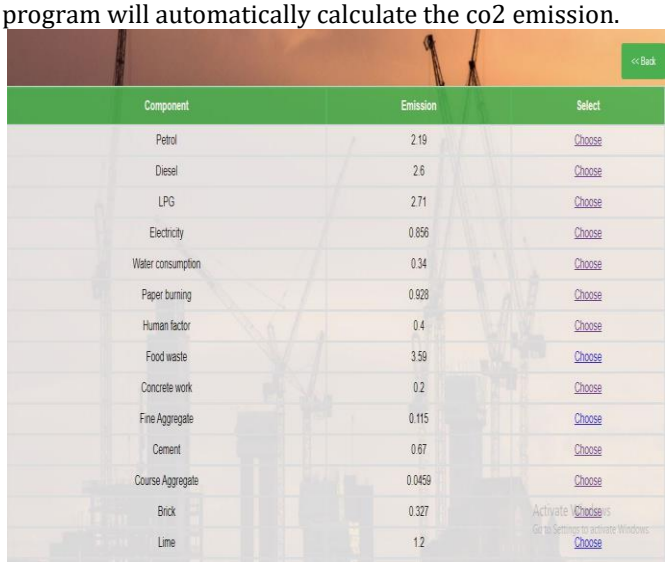

Fig -2: Different Components in Material Box.

A back option is also provided to exit from the page. We can also add materials that are not listed using the option below as shown in figure3.

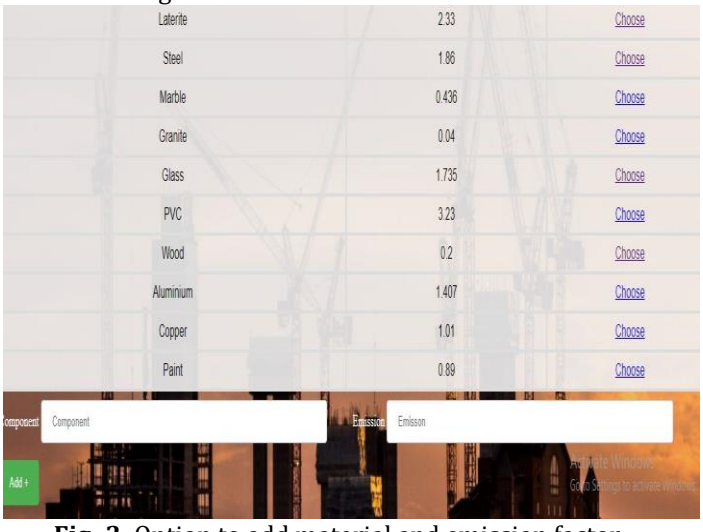

Fig -3: Option to add material and emission factor

Different trees can also be selected by clicking trees and choose option in figure 4. After that, surveyed details of the trees are added as in figure 6. We can also add tree and details that are not listed. Program will automatically calculate amount of carbon sequestrated by choosing tree option.

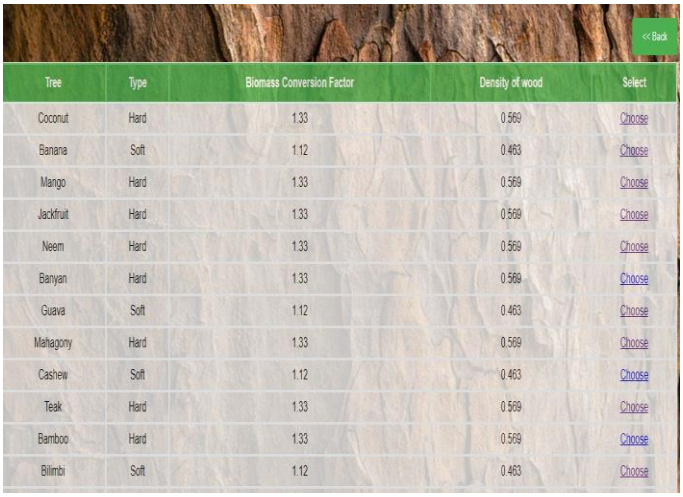

Fig -4: Tree Details with BCF and Density.

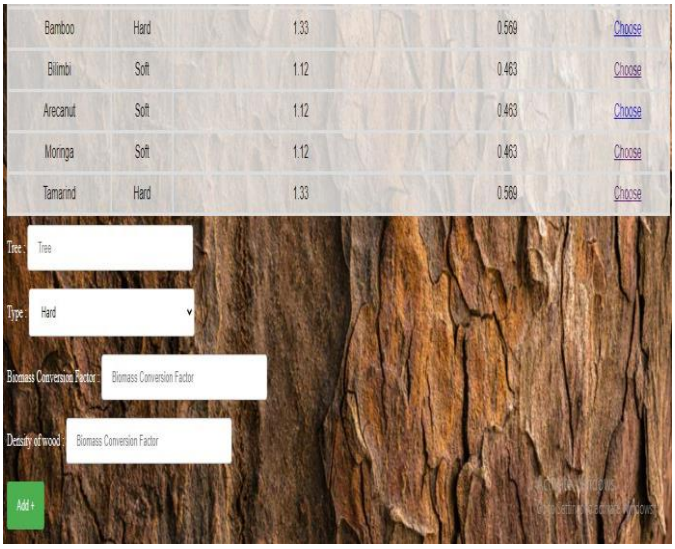

Fig -5: Option to add tree and its details.

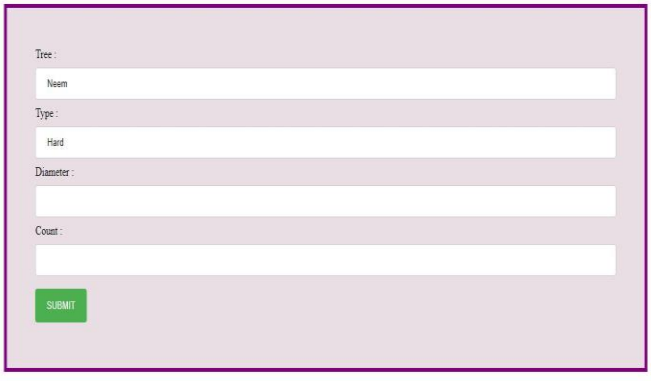

Fig -6: Details display when tree option is chosen.

Final calculations are displayed after inputting all the details and is obtained by clicking submit button in figure1. Results of two buildings are obtained as total carbon emission, amount of carbon sequestrated and result as shown in figure 7 and figure 8.

Fig -7: Final Result of Residential Building 1

Fig -8: Final Result of Residential Building 2

5. CONCLUSIONS

The net carbon emission of the study area was found to be 55658.188 Kg and 51322.751 kg for residential building 1 and 2 respectively. It has been observed that electricity and LPG consumption is emitting more CO_2 among other inventories. By analyzing the two building it is clear that Residential Building 2 is completely a zero carbon emission building design. It is mainly because number of trees and green coverage is more and also use of less carbon emitting building materials like wooden frames instead of steel, solar lights fitted at the outside save considerable amount of energy. 14417.105 kg of extra carbon sequestration is possible, which is about 28.09 % of CO_2 emitted by that building. But plantation in residential building 1 emits CO_2 40545.638 kg CO_2 in excess of sequestration. From this analysis carbon emission can be reduced either by planting trees or by replacing high CO2 emitting materials with low CO2 emitting materials.

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