Calculation of Carbon Emissions and Establishing Carbon Sinks in an Educational Institute

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Abstracts:

A Carbon footprint is a quantitative tool that measures total emissions from the greenhouse Gas generated directly or indirectly by any individual, association or any product in terms of equivalent CO2 emissions. In this study, we will calculate carbon emission from various sources as per scopes defined by GHG Protocol Corporate Standard.

Introduction:

Scope 1: It caters for all the carbon that is directly emitted in the atmosphere by both stationary emissions, mobile emissions and fugitive emissions of any educational institute. Scope 2**:** These are the indirect emission generated due to purchase of electricity which is used to run various units like lighting, coolers, fans, printers and HVAC etc. Scope3**:** These are also indirect emission but are neither produced by the institute itself nor controlled by it. These are the consequence of set of activities that Employees and students using their own vehicles to commute regularly comes under this category.

Data collection:

The campus Government Polytechnic Kishanganj lies in the plain area but the Foothill of Himalaya near Nepal Border. where this is observed the distinct weather. This area received ever snowfall and thus a weather Variations and its impacts can be observed in the various activity. By following the guidelines by GHG protocol corporate standards following carbon emission & carbon sinks data is collected under various scope categories like Fossil fuel (LPG) consumption, Fuel Consumption through institute owned vehicle, Electricity consumption for the institute, Paper consumption for various institute activities, Solid Waste Landfill, Waste Water Disposal, Employee Commuting of fuel consumption & Human Respiration.

 https://doi.org/10.5281/zenodo.14764201

Total carbon Emission in the institute

Sr. No	Scope Category	Carbon Emission (kg)	Data sources
1	Scope -1		
	Statics emission	22189.04kg	Girls Hostel, Boys Hostel and Institute Canteen
	Mobile emission	1456.49kg	Institution owned vehicle
2	Scope -II		
	Electricity	44195.75kg	Lighting and Heating system in institution, Girl &Boys Hostel and staff quarters.
3	Scope-III		
	Employee Commuting	15153.60kg	Personal vehicle
	Solid Waste landfill	2238.07kg	Institution, Girls& Boys Hostel, canteen and staff quarter.
	Waste Water disposal	15293.85kg	Institution, Girls and Boys Hostel, canteen and staff quarters
	Paper/stationary consumption	946.24kg	Office works and Academic activities
Total carbon Emission=1,01,473.04kg			
4	Human respiration	2,01,108.09kg	Human respiration activities in college campus
Total carbon Equivalent=3,02,581.13Kg			

To suggest the measures for establishing carbon sinks : In order to suggest measures to make the campus as carbon neutral, the first step is taken to identify the carbon sequestration potential of the existing tree cover within the operational boundary of the campus. Environment ecosystem is one of the most important carbon sinks of the terrestrial ecosystem and plays a very important role in the global carbon cycle by sequestering. For this tree census is conducted and by making use of allometric equation.

 https://doi.org/10.5281/zenodo.14764201

ISSN: 0369-8963

Allocation Equation for AGB calculation (In Kg)

Above Ground Biomass (**AGB)** = $0.0673(\rho \times D^2 \times H)^{0.976}$

where, **ρ =**Wood density in gcm3, **D =** DBH in cm, and **H =** Tree height in m

Allocation Equation for BGB calculation (In Kg)

Below Ground Biomass (**BGB)** = $0.034\times D^{2.388} \times H^{0.051}$

Total Biomass (TB) calculation (In Kg)

TB (In Kg) =AGB+BGB

Equivalent sequestration potential of trees or total carbon sink

clearly indicates the sequestration potential of each tree on below table.

Tree census and their sequestration Potential

Sr.No	Type of Tree	Nos	AGB(Kg)	BGB(Kg)	TB(Kg)
1	Palm tree	04	506.10	75.9	582.0
2	Neem	04	1200.80	104.4	1305.2
3	Neelkanthi	02	384.4	16.8	401.2
4	Ashoka	20	2325.75	105.6	2431.35
5	Papaya	04	630.7	150.7	781.4
6	Neeli Gulmohar	03	1379.80	257.00	1636.80
7	Mahogani	15	17537.53	1686.66	19224.19
8	Peepal	01	205.8	14.8	220.6
9	Jackfruits	04	406.9	86.8	493.7
10	Areca nut palm	60	27692.16	2496.9	30189.06
11	Black plum	03	548.54	65.4	613.94
12	Mango	05	667.5	108.5	776.0
13	Guava	05	798.4	95.8	894.2
					Equivalent (TB Kg) = 59549.64
					Total Carbon sink=1,09,154.49Kg

Total carbon sink=Equivalent total Biomass *Carbon Emission factor

(**Carbon sinks factor of tree=1.833**) reference[8]

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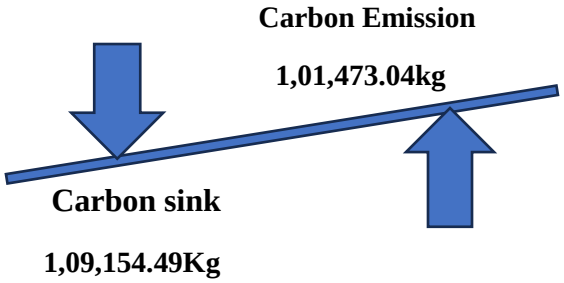
Result: Based on the inventory list prepared by following ISO 14064-1 guidelines, data is collected for each category as specified by GHG Protocol Corporate Standards. The data depicted in table 5.1 includes the carbon emission because of human respiration as well. By multiplying this data with suitable conversion factor in the analysis total carbon emission has been calculated. The current study is done by following a bottom-up approach in Life Cycle Analysis under ISO guidelines. Total carbon emission is found to be **1,01,473.04kg** when only 3 scope categories, as defined by GHG Protocol Corporate Standards, are taken into account. When human respiration is included, total carbon emission is found to be **3,02,581.13Kg.** The above table clearly indicates the total carbon emission under each scope category including human respiration.



Balancing the Equation for Carbon Sink and Carbon Emission (Excluding Human Respiration)

Conclusion:

A detailed survey of the campus and its operational activities led to the identification of the numerous emission sources and thus helped in preparing the inventory list under the guidelines of ISO 14064-1 in bottom-up approach used in Life Cycle Analysis.

1.The total emission under various direct and indirect sources is found to be **1,01,473.04kg** out of which electricity consumption under scope 2 contributed nearly 43.55%.

2.Inclusion of emissions through human respiration will increase the total emission to **3,02,581.13Kg** which is more than twice of the emission identified under the categories specified by GHG Protocol Corporate Standards and is the biggest source of carbon emission identified in the institution.

3.Average carbon emission for the institute is found to be approximately 504.00 Kg/ person, considering total strength of 600 persons including students, faculty and other staff members.

4.Existing carbon sink in the form of tree cover is first identified through tree census and their sequestration potential is then calculated using Allometric Equations.

5.Average carbon sequestration potential is found to be 1281 Kg/ Mahogani tree which is more than 2.5 times the carbon emission per person. If sufficient amount of such adequately mature Mahogani tree is present, it will provide enough sink for the given population. Carbon Sink Mahogani Tree @ sufficient maturity 2.5x Carbon Emission/Person.

6.Thus, considering only scope 1,2 and 3 categories, the institute is operating as a carbon neutral campus. But since human respiration is also considered, further sinks need to be identified or suggested in the form of solar rooftop panels, operational rainwater harvesting system and by adopting various green products and activities like making use of star rated appliances, efficient water and energy fittings, making use of daylight hours etc.

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7.Additionally, in order to make institute more sustainable, Carbon offset is also identified. The students of the institute in association with State Forest Department have planted nearly 200Mahogani and 300 Areca nut palm trees in the forest reserve land and have pledged to take care of these trees, which will then serve as a huge carbon offset in the future to come.

8.Although the institute's campus is carbon neutral, additional sinks such as rainwater harvesting systems and solar rooftop panels are required. Along with identifying carbon offsets, students plant 200Mahogani and 300Areca nut palm trees on forest reserve area.

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