

Final Report

CARBON FOOTPRINT ASSESSMENT OF THE HEALTHCARE FACILITIES IN BANGLADESH



IEDCR

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Executive Summary

The project “Carbon footprint assessment of the healthcare facilities in Bangladesh” is a pioneering initiative taken by the Institute of Epidemiology Disease Control and Research (IEDCR) with the technical assistance of World Health Organization to estimate the emissions generated from the healthcare sector in Bangladesh. The project aimed to evaluate and reduce carbon emissions from healthcare facilities in Bangladesh by: a) identifying and assessing direct and indirect greenhouse gas (GHG) emissions, including those from the supply chain, across primary, secondary, and tertiary healthcare facilities; b) analyzing the overall carbon footprint of the health sector based on this assessment; c) developing a dashboard to track, monitor, and project energy consumption; d) creating a mitigation plan to establish a sustainable, low-carbon healthcare system.

The Carbon Management Tool developed by the Aga Khan Development Network was used for the assessment of carbon emissions from 9 hospitals of different categories over the period of 3 months. The annual emissions were projected from 3 months assessment. From primary level hospitals, the carbon footprints of 3 months were 93.61 metric tonnes CO₂-e (Gournadi UHC), 78.86 metric tonnes CO₂-e (Sreemongol UHC), and 18.28 metric tonnes CO₂-e (Saidpur UHC). The secondary level hospitals had a higher carbon footprint for the same duration of data collection. Sirajganj District Hospital has the highest emissions in 3 months (312.95 metric tonnes CO₂-e), followed by Bandarban District Hospital (193.57 metric tonnes CO₂-e), and Satkhira District Hospital (170.58 metric tonnes CO₂-e). Among the tertiary level hospitals, Sylhet MAG Osmani Medical College Hospital had the biggest carbon footprint in 3 months (2688.64 metric tonnes CO₂-e), followed by Mymensingh Medical College Hospital (1994.42 metric tonnes CO₂-e), and Kurmitola General Hospital (1663.32 metric tonnes CO₂-e).

The carbon mitigation plan was developed for each of the hospitals considering carbon sequestration from tree species (existing and new plantation), and carbon trading mechanism (profit generation from waste management and investment of profit in carbon neutral village). The mitigation plan indicates that significant profits could be achieved through waste management. Hospitals could also generate revenue by supplying solar energy to the national grid. These funds could be invested in the carbon market to strengthen disaster resilience and improve health in local villages. Hospitals could improve their database management system to improve the record-keeping and make the data digitally accessible. Additionally, hospitals could foster behavioral changes to reduce carbon emissions, such as promoting carbon-neutral travel methods through staff recognition and tracking energy consumption to encourage competition in reducing emissions. By adopting the proposed mitigation strategies, hospitals could potentially achieve carbon neutrality or even negative emissions.

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Introduction

The consequences of climate change on health are complex and driven by various mechanisms, especially in heavily populated countries like Bangladesh with more recurrent direct and indirect effects [1]. The health care sector itself is found to be a major contributor to CO₂ emission even though it shoulders the burden of caring for the aftermath of climate change. Globally, the health care sector is responsible for as much as 4.4% of global net emissions [2,3]. Significant importance has been given to reducing emissions while ameliorating patient care quality. However, the carbon footprint of Bangladesh's healthcare system had not been mapped until World Health Organization (WHO) took the initiative. Medical institutions, both public and private, that require electricity to a greater extent emit more carbon than other institutions and are not explicitly covered by any national energy strategy or plan or carbon reduction targets in Bangladesh.

The only nationally mandated health system carbon accounting in the world occurs in England, overseen through the National Health Service (NHS). According to their findings, the health service's emissions totaled 25 megatons of carbon dioxide equivalent, a reduction of 26% since 1990, and a decrease of 64% in the emissions per inpatient finished admission episode. Of the 2019 footprint, 62% came from the supply chain, 24% from the direct delivery of care, 10% from staff commute and patient and visitor travel, and 4% from private health and care services commissioned by the NHS [4]. Economywide modeling showed that greenhouse gas emissions from the US health care rose 6 percent from 2010 to 2018, reaching 1,692 kg per capita in 2018—the highest rate among industrialized nations, which resulted in the loss of 388,000 disability-adjusted life-years in 2018 [5]. In Australia, an input–output LCA was conducted, finding that the provision of such health care was 7% of Australia's entire CO₂e emissions [6]. In similar studies around the world, it was found that carbon emissions are dominated mainly by purchased medical apparatus and resources than direct onsite emissions [7]. Research undertaken by the Department of Health & Human Services indicates that up to 60 per cent of a health service's total carbon footprint is related to the embodied carbon within the goods and services it uses every day.

Assessing the carbon footprint associated with health care would assist in demonstrating how serious this issue is and identify probable hotspots that could lead to more effective solutions for lessening CO₂ emissions in a society like Bangladesh where carbon discharge is increasing in

every sector. The findings of such research would offer crucial data that will enable carbon footprint comparability between Bangladesh's healthcare industry and other sectors of the economy and the broader healthcare industry of different parts of the world. The insights developed could be used to assist policymakers in the nation in comprehending the carbon footprints of nationalized healthcare systems so they may build effective GHG countermeasures.

The first step in decarbonizing health services is to locate and quantify the sources of CO₂ emissions [8]. There can be direct sources, including onsite natural gas, electricity generation from nonrenewable sources, and indirect sources, including plastic waste, and medical apparatus and drug manufacture used for the delivery of the services within a healthcare institution [6]. In a study conducted in China, purchasing medications, hospital instruments, and other products and services accounted for 84% of the carbon footprint in healthcare facilities, whereas infrastructure and transportation only represented 16% [7].

The project “Carbon footprint assessment of the healthcare facilities in Bangladesh” was undertaken to set the precedence for Bangladesh on measuring the climate burden of its healthcare sector. It was an initiative to make the hospitals in Bangladesh green or carbon free after identifying the strategy for the assessment.

Objectives

The aim of the project was to assess the carbon emissions from the healthcare facilities in Bangladesh and to develop a mitigation plan for designing long-term, low-carbon health system.

The specific objectives were:

1. Identify the direct and indirect GHG emission sources of healthcare services (including supply chain) and assess total GHG emissions at a primary, secondary, and tertiary level healthcare facilities
2. Analyze carbon footprint of total health sector based on the GHG emission assessment at three levels of hospitals
3. Develop a method to track, monitor and project energy consumption on a dashboard
4. Prepare an appropriate mitigation plan to develop a sustainable low-carbon health system

Methodology

Study Area

The proposed study site includes 9 hospitals with different bed capacities. Three tertiary level hospitals, three district level hospitals and three Upazila level hospitals have been chosen for the assessment. The bed capacity of tertiary, district and Upazila level hospitals are 500+, 100-250 and 50-100 respectively. The hospitals were selected considering the representation of the 8 divisions of Bangladesh, so that a comparison can be made based on the geographical distribution and bed capacity of hospitals. The study will compare emissions from different kinds of hospitals and from different sectors within the hospital, identifying the carbon hotspots in each of them.

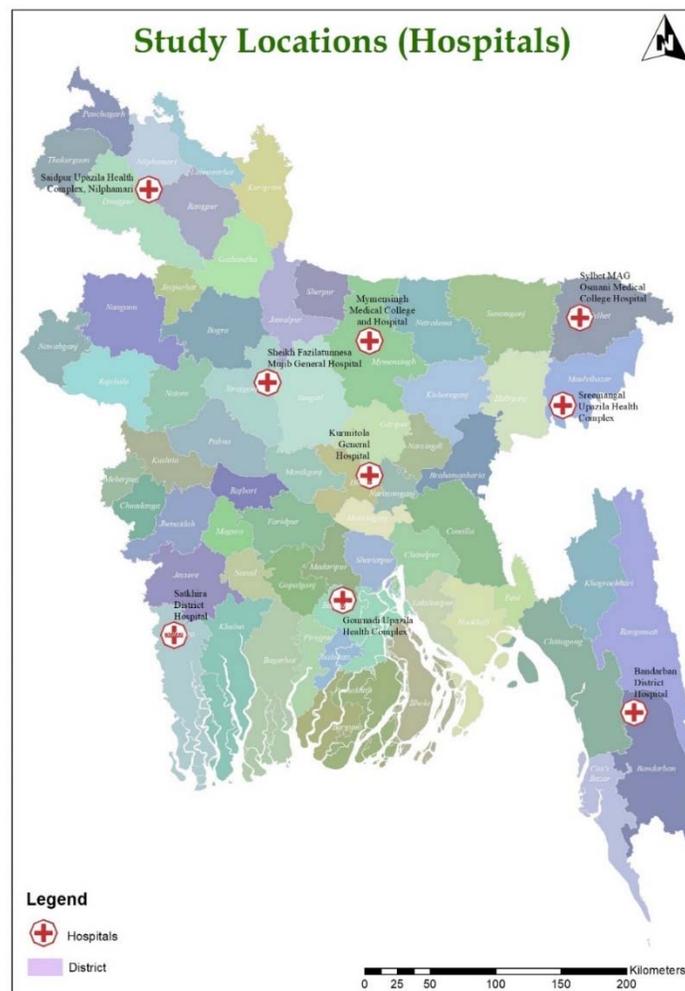


Figure 1: Map of Study area

Table 1: Study sites including Primary, Secondary and Tertiary level hospitals

Tertiary: Medical College hospital (500+ bed)	Secondary: District Sadar hospital (100-250 bed)	Primary: Upazila Health Complex (50-100 bed)
Kurmitola General Hospital (Dhaka)	Sirajganj 250 Bed Bongamata Sheikh Fazilatunnesa Mujib General Hospital (Rajshahi)	Saidpur Upazila Health Complex, Nilphamari (Rangpur)
Mymensingh Medical College and Hospital (Mymensingh)	Bandarban 250 Bed District Hospital (Chittagong)	Sreemangal Upazila Health Complex, Maulvibazar (Sylhet)
Sylhet MAG Osmani Medical College Hospital (Sylhet)	Satkhira District Hospital (Khulna)	Gournadi Upazila Health Complex, Barisal (Barisal)

The assessment of carbon footprint of 9 healthcare facilities has been conducted in the first half of the project duration by December 2023. The dashboard linked to automated metering system and carbon mitigation plan has been developed in the second half of the project by June 2024.

Data Collection

Tool

The Aga Khan Development Network (AKDN) has designed a Carbon Management Tool to measure the carbon footprint of different sectors and components of a healthcare center. The latest version of the tool can be accessed by mailing healthcarbonfootprint@akdn.org. The tool will be used to investigate the pattern and rate of energy consumption at the micro-level and target reduction of carbon footprint precisely from the ‘hotspots.’

The tool consists of the following sectors of healthcare facility/system:

1. Buildings: This sheet covers background information on the buildings, sites or campus. This means buildings owned, rented or occupied by the reporting organization. Most questions are Yes/No, some require limited text or numerical data.

2. Energy: This sheet covers all electricity, energy and fuel combustion in buildings and generators (solid, liquid and gaseous fuels, renewable electricity and grid electricity).
3. Vehicle: There are 3 sheets that calculate the emissions from Vehicles. The first sheet “Vehicle-Fuel” covers all fuel use in vehicles owned, rented or leased for use by the organization. The second sheet “Vehicle-Distance” covers kilometers travelled in vehicles owned, rented or leased by for use by the organization/agency. This sheet is to be completed only for vehicles where the data is not available to complete the 'Vehicle-Fuel' sheet. The third sheet “Travel-Other vehicles” covers all travel for business purposes by the organization’s staff. It covers travel by road, water or air, in vehicles not owned, leased or rented by your organization.
4. Anaesthetic gases: This sheet covers any anaesthetic gas use. All the anaesthetic gases listed here are greenhouse gases. Isoflurane and halothane are also ozone depleting substances. Once used they are exhaled and vented to atmosphere and contribute to Scope 1 emissions. Desflurane is a highly potent greenhouse gas and its use should be avoided. Where a percentage of these gases is metabolized this has been accounted for in the carbon calculations.
5. Refrigerant gases: This sheet covers all refrigerant gases leaking from, or used to top-up, air conditioning, cooling units, or walk in chillers. Refrigerants are often potent greenhouse gases or ozone depleting substances. Chillers tend to slowly leak these gases, or they can be accidentally released during maintenance. As this workbook assigns emissions Scopes on the basis of Operational control, all emissions arising from refrigerant release in owned or rented buildings will be classed as Scope 1.
6. Water: This sheet covers all water use. While water supply is not particularly carbon intensive, water can be a very limited natural resource. Water use can put pressure on the local environment and supply can be impacted by climate change. As such it is important to measure and manage and report the amount of water used.
7. Waste: This sheet covers all waste produced by your organization. Factors used here are health sector specific. However, these will provide a reasonable indicator of the scale of impact from waste management for other sectors. Carbon emissions are currently only calculated for incinerated, landfill or buried waste. Incineration emissions are based on a GHG Protocol factor derived using the typical plastics composition of healthcare waste.

Landfill emissions, arise largely from the methane released during the decomposition of food waste or other organic matter. Factors are based on published literature; however, emissions may vary with local climate and waste composition.

8. Inhalers: This sheet can be used to estimate all greenhouse gas emissions arising from inhaler devices prescribed or dispensed by the organization. Several types of inhalers are used to treat common respiratory conditions such as asthma or COPD. There are many different drugs delivered using inhalers sold under hundreds of brand names and in different dosages. The most common devices fall in to 4 categories. 1. Pressurized Metered Dose Inhalers (MDI), 2. Dry Powder Inhalers (DPI), 3. Nebulizers, 4. Soft Mist Inhalers. In MDI the drug is contained in a pressurized canister and delivered as an aerosol. While the most damaging CFC propellants have been phased out, the propellants used are still potent greenhouse gases. No propellants are used in DPI, nebulizer or soft mist devices.
9. Contractor Logistics: This sheet covers all logistics to move goods or materials on behalf of the organization. It focuses on travel by road in vehicles not owned, leased, or rented by the organization. This may include private ambulance services or contractors paid to move medical products, wastes or other materials on its behalf.
10. Construction materials: This sheet covers key materials used in construction.
11. Procurement: This sheet covers carbon emissions arising from supply chain. These emissions may arise from many different layers of interdependent manufacturing, logistics and economic activity. It is only ever possible to make estimates. It is possible however to drive carbon reductions, through purchasing and consumption behavior that reduces the amounts of higher carbon products used, and favoring lower carbon suppliers, products and services. Tier 2 supply chain footprinting is to support the identification of potential carbon hotspots in your supply chain and establish an initial baseline. This can help prioritization of your organization's work to reduce your Scope 3 supply chain emissions. To undertake Tier 2 footprinting, the organization's financial cost codes need to be mapped to the UK industry sector carbon intensity factors. A list of pre-mapped codes is currently included in the sheet. While the pre-mapped codes are unlikely to match any particular organization's financial cost codes, these can be used as a guide, adapting or removing them and adding as necessary.

This tool is configured to allocate the emissions to Scopes on the basis of Operational Control, i.e., all emissions arising from owned, leased or rented assets are accounted to the Scope 1 or 2 footprints as appropriate. It is also possible to account by Financial Control where only emissions arising from the assets that you directly own are allocated to your Scope 1 or 2 footprints. Under Financial Control accounting all emission from rented or leased assets would be reported as Scope 3 emissions

Methods

The primary data has been collected for calculating the carbon emissions in each sector of health care facilities. The reporting period was set to 3 months – July, August and September of 2023. The relevant department and personnel have been identified in the hospital administration as per the sectors of the tool. The sources of data have been mentioned in Table 2.

Table 2: Sources of data for each sector of the AKDN Tool

No.	Sectors	Source of data
1	Buildings	Public Works Department
2	Energy	Public Works Department/Ward Master/Accountant
3	Vehicle-Fuel	Driver
4	Vehicle-Distance	Driver
5	Travel-Other Vehicles	Driver/Head Assistant
6	Anaesthetic gases	Store Officer
7	Refrigerant gases	Store Officer
8	Water	Ward Master
9	Waste	City Corporation/Store Officer
10	Inhalers	Ward Master
11	Contractor logistics	Store Officer/Public Works Department
12	Construction materials	Public Works Department
13	Procurement_T2	Accountant (Annual Budget)

The reporting period for all the hospitals was July, August and September of 2023, i.e., the data was collected for those 3 months. At first, the Administrative head of the healthcare facilities were

contacted. An approval letter from IEDCR with the consent of DGHS was sent to each of the 9 hospitals. Upon visiting the site, approval from the administrative head was taken before the data collection.

The concerned departments and personnel including Accounts, Store, Public Works Department, Head Assistant, Driver and others were contacted for collecting our data. The data on Buildings was taken from PWD or Accounts section of the hospital. A checklist was prepared for systematic data collection.

Scope of Work

The scope of work includes all the sectors of the hospitals, except for Construction materials and Procurement_T3, which is supplier specific carbon intensities. In Bangladesh, the construction materials of a building are not segregated or kept record of, unlike in the UK. Since the tool was designed according to the UK standards and suppliers are different in Bangladesh, the assessment team have excluded this sector for the assessment.

Data Analysis

The tool calculated the carbon footprint according to Scope 1, Scope 2 and Scope 3 emissions. The analysis has been conducted in separate versions of the Tool for each hospital. First, the general information on the hospital were entered into the Cover Sheet. The conversion currency was updated in the Conversion sheet to 110 BDT per 1 USD. The currency conversion is only used for the Procurement sector. The overall carbon footprint is subject to minimal change with the change of exchange rate, and it is automatically updated within the excel sheets of the tool. Then, the data on buildings were fed into the tool for building/hospital (site) wise assessment. Subsequently, the data on other sectors were input from Energy to Procurement. The name of the building, ownership of the building and area covered by the building were used as primary data in the Buildings sheet.

The Energy sheet covered data on grid supplied electricity, renewable electricity generated, grid supplied gas, gas cylinders or tanks, solid fuel, liquid fuel and heat network. In Bangladesh, the healthcare facilities use grid supplied electricity, grid supplied gas and liquid fuel. Thus, the primary data was collected and fed into these tables only. The conversion factor for each KWh electricity was 0.412 kgCO_{2e}. For grid supplied gas, the conversion factor is 2.0316 kgCO_{2e} per cubic meters of natural gas. For liquid fuel, each liter diesel/gas oil used for generator and non-

generator purposes has been converted to 2.7586 kgCO_{2e}, and petrol used for generator and non-generator purposes has been converted to 2.3397 kgCO_{2e}.

In the Vehicle-Fuel sheet, the conversion factor for each liter of petrol and diesel has been set to 2.34 and 2.7 kgCO_{2e} respectively. In the Vehicle-Distance sheet and Contractor logistics sheet, the conversion factors for different categories of vehicles for per kilometer travelled are given in Table A4.

The conversion factors for Travel-Other vehicles are shown in Table A5. The conversion factors for the Anaesthetic and Refrigerant gases are tabulated in Table A6 and A7.

Water has no direct carbon footprint; therefore, no conversion factor was assigned to this sector. There are separate conversion factors assigned to different types of waste disposal, given in Table A8.

Two types of inhalers are frequently used in Bangladesh – Salbutamol and Salmeterol. The conversion factors are shown in Table A9. The procurement data was calculated by expenditure on a list of items per 1000 US\$ (Table 9).

The pie-charts for carbon footprint of each hospital were autogenerated in the Totals sheet of the Tool. For comparison of carbon footprint of hospitals belonging to the same category, bar graphs were created using Microsoft Excel.

The annual carbon footprint was estimated from the 3-month assessment of each hospital. The data was collected for a period of 3 months, which was converted to 12 months for the annual estimation. The carbon mitigation plan was developed specifically for each hospital including the following approaches:

- Carbon sequestration from tree species:
 1. Carbon stored in existing tree species
 2. Carbon offsetting from plantation of new trees
- Carbon trading mechanism:
 1. Profit generation from waste management
 2. Investment of profit in carbon market (carbon neutral village)

Consultation Workshop

The consultation workshop was held on 27 June 2024 where results of the project were presented followed by a discussion session. Members from the Institute of Epidemiology Disease Control And Research (IEDCR), World Health Organization (WHO), Health Services Division, Directorate General of Health Services, Ministry of Planning, Ministry of Health and Family Welfare, Department of Environment (DoE), International Centre for Diarrheal Disease Research, Bangladesh (icddr,b), Bangladesh Meteorological Department, North South University, and other organizations were present. The initiative was greatly appreciated by all the participants of the workshop. Suggestions were made to make the mitigation plan more practical. The comments were addressed by-. Some discrepancies were pointed out during the discussion, such as relatively higher values for waste in Bandarban district hospital compared to other secondary hospitals. The data sheets were rechecked, and the ambiguities were removed. The TWG office order and attendance of participants in the consultation workshop is presented in Annex A.

Results and Discussion

Tertiary level Hospital

Kurmitola General Hospital

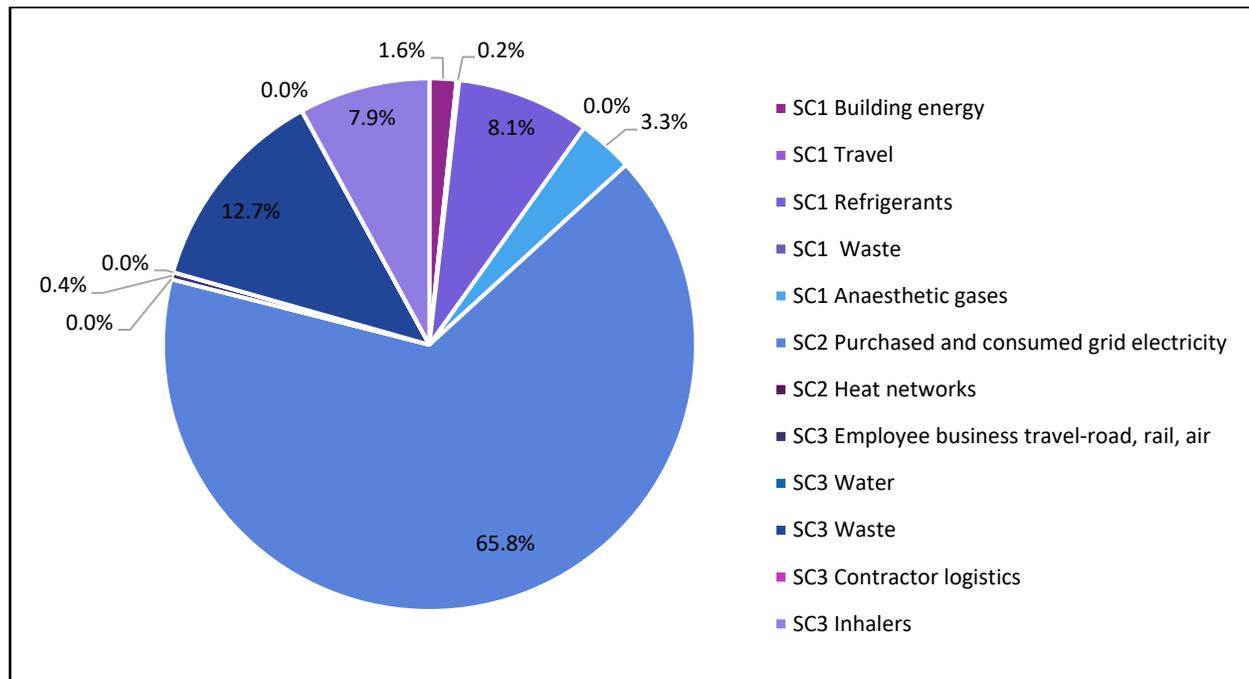


Figure 2: Scope 1,2 and 3 emissions (excluding supply chain) from Kurmitola General Hospital. The pie chart represents the percentage of total emissions from the hospital in 3 months.

The majority of carbon emissions was generated from Electricity in Kurmitola General Hospital. Electricity accounted for 65.8% of the total emissions, followed by Waste (12.7%). The hospital generated 88,750 kg of waste in 3 months. Refrigerants account for 8.1% of the emissions. Two types of refrigerant gases were used for the cooling systems – R410A and R22. The highest usage was of 410A in the month of September. 7.9% of the total emissions came from Inhalers. The hospital used 2 types of inhalers within the study period – Azmasol and Salflu. Between them, Azmasol was dispensed the most in September. Anaesthetic gases comprised 3.8% of total emissions. In 3 months, the staff travel covered a distance of 28,350 km and the contractor logistics covered 120 km. The hospital used 51,350,000 liters of water within this period.

Mymensingh Medical College Hospital

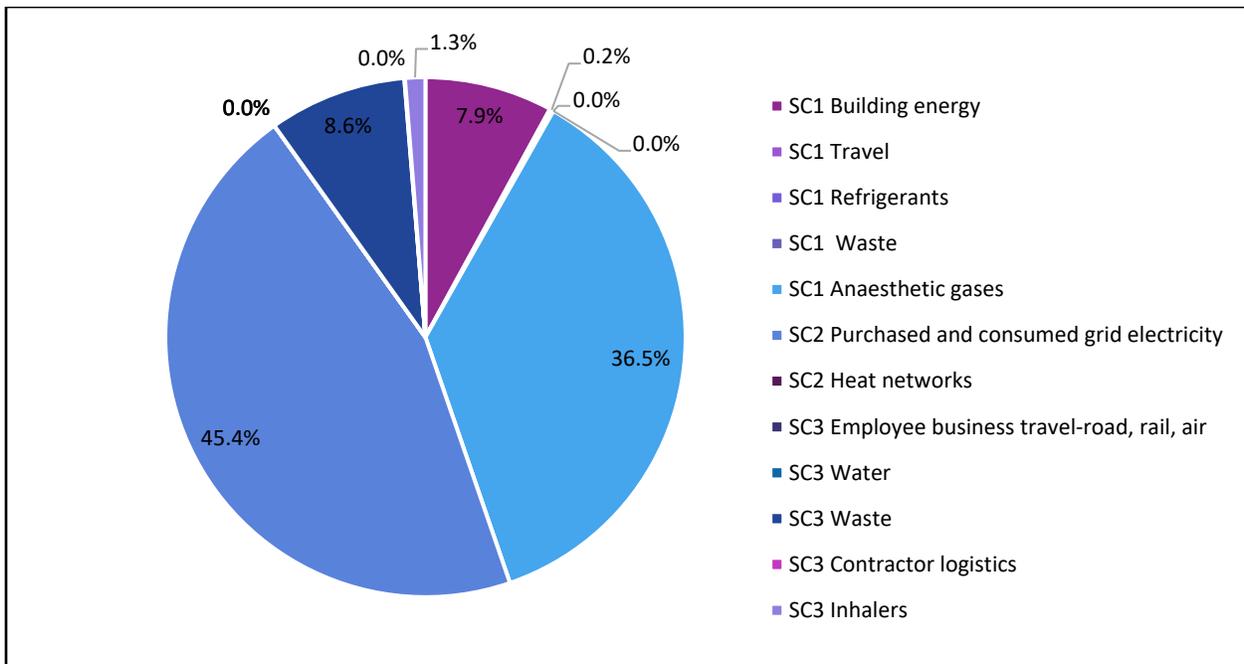


Figure 3: Scope 1,2 and 3 emissions (excluding supply chain) from Mymensingh Medical College Hospital. The pie chart represents the percentage of total emissions from the hospital in 3 months.

In Mymensingh Medical College Hospital, the highest emissions were from Purchased and consumed grid electricity (45%). Anaesthetic gases were responsible for 37% of the total emissions. Three types of Anaesthetic gases were used from July to September – Nitrous Oxide, Haloethane and Isofluroane. Among these, Nitrous Oxide has the highest usage upto 2160 kg in 3 months. On an average, 24 cylinders of nitrous oxide weighing 30 kg per cylinder are used every month in operation theaters. The departments that use Anaesthetic gases for surgery are Ophthalmology, ENT, Pediatrics, Orthopaedics, Gynaecology, Emergency.

Waste accounted for 8.6% and Building energy accounted for 7.9% emissions based on data for 30 buildings. In 3 months, 150660 kg of waste was generated. The hospital used 3,20,000 liters of water within this period. A distance of 1,452 km was covered for contractor logistics.



Figure 4: Discussion with Administrative Head at Mymensingh Medical College Hospital

Sylhet MAG Osmani Medical College Hospital

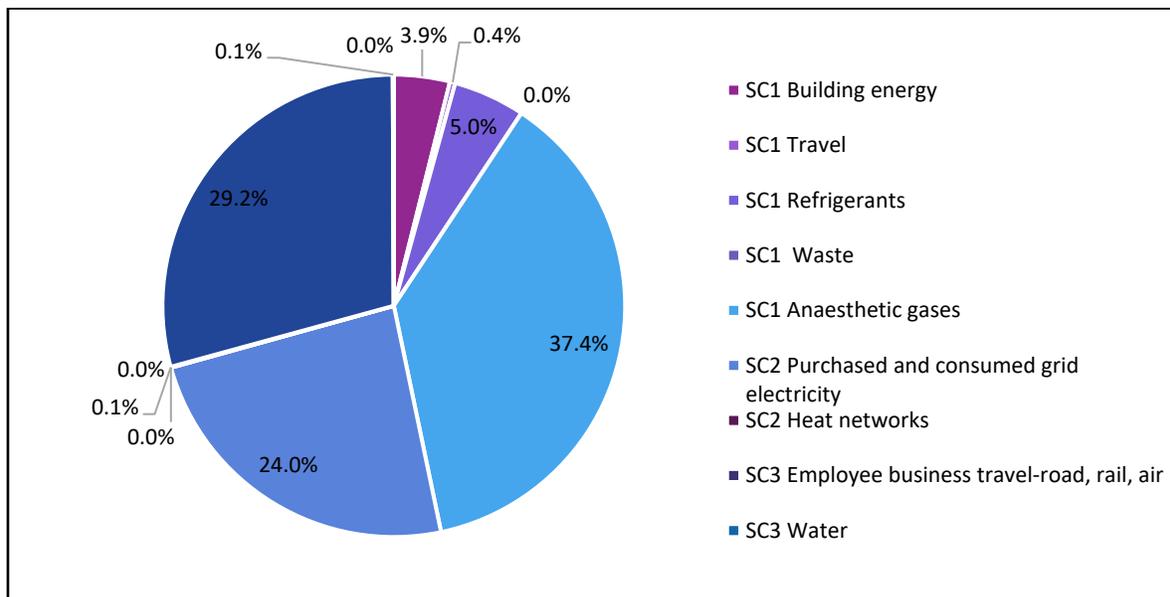


Figure 5: Scope 1,2 and 3 emissions (excluding supply chain) from Sylhet MAG Osmani Medical College Hospital. The pie chart represents the percentage of total emissions from the hospital in 3 months.

In Sylhet Medical College Hospital, Anaesthetic gases accounted for the highest portion of carbon emissions (37.4%). This may have been caused due to the high number of surgery and emergency patients. Nitrous oxide was used the most (895 kg) in August. The second highest emissions came from waste (29.2%). Purchased and consumed grid electricity accounted for 24% of the emissions.

Refrigerant gases accounted for 5% of the carbon emissions. Two types of refrigerant gases were used for the cooling systems – R410A and R22. The highest usage was of the gas 410A in the month of July. Building energy emitted 3.9% of carbon emissions. In 3 months, the employee business travel covered a distance of 6350 km. The hospital used 26,950,000 liters of water and generated 421,360 kg of waste within this period.

Comparison of Carbon Footprint from Tertiary level Hospitals

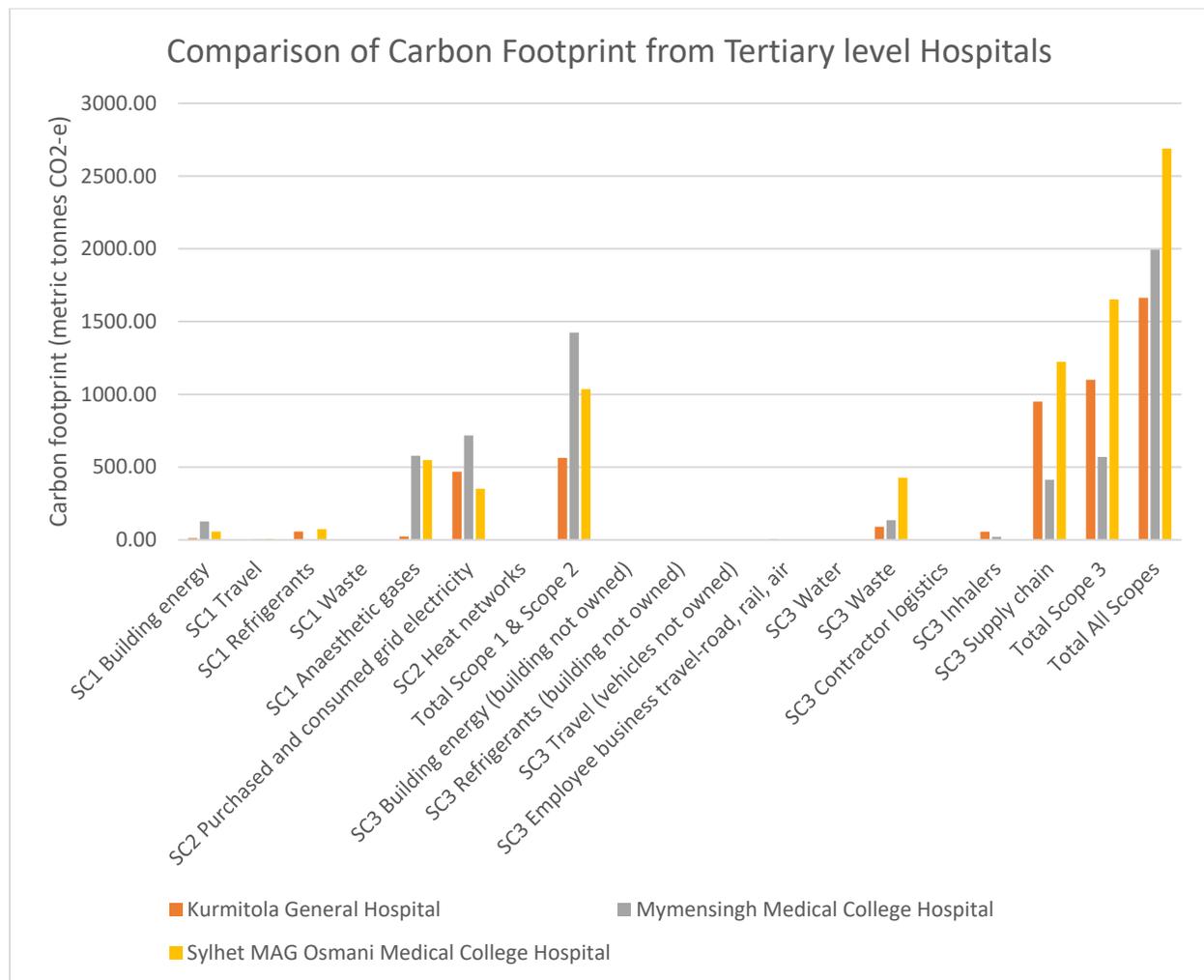


Figure 6: Comparison of Carbon Footprint from Tertiary level Hospitals

Among the tertiary level hospitals, Sylhet MAG Osmani Medical College Hospital had the biggest carbon footprint of 2688.64 metric tonnes CO₂-e in 3 months. Most of its emissions were generated from supply chain, followed by anaesthetic gases and waste.

Mymensingh Medical College Hospital had the second largest carbon footprint of 1994.42 metric tonnes CO₂-e in 3 months. The highest emissions from this hospital were generated by electricity. The frequency of surgery and operations that take place in this hospital is very high. On an average, 60-70 caesarean section operations are conducted every day in the Gynae department alone.

Kurmitola General Hospital had the lowest carbon footprint of 1663.32 metric tonnes CO₂-e in 3 months. Among all the hospitals, supply chain had the highest impact of carbon emissions. The goods and materials provided to the hospitals are highly carbon intensive. In tertiary level hospitals, the record-keeping and database management were more structured and organized in comparison to the district and Upazila level hospitals. The dataset for comparison of carbon footprint of tertiary level hospitals is given in Table A1.

District level Hospital

Sirajganj 250 Bed Bongamata Sheikh Fazilatunnesa Mujib General Hospital

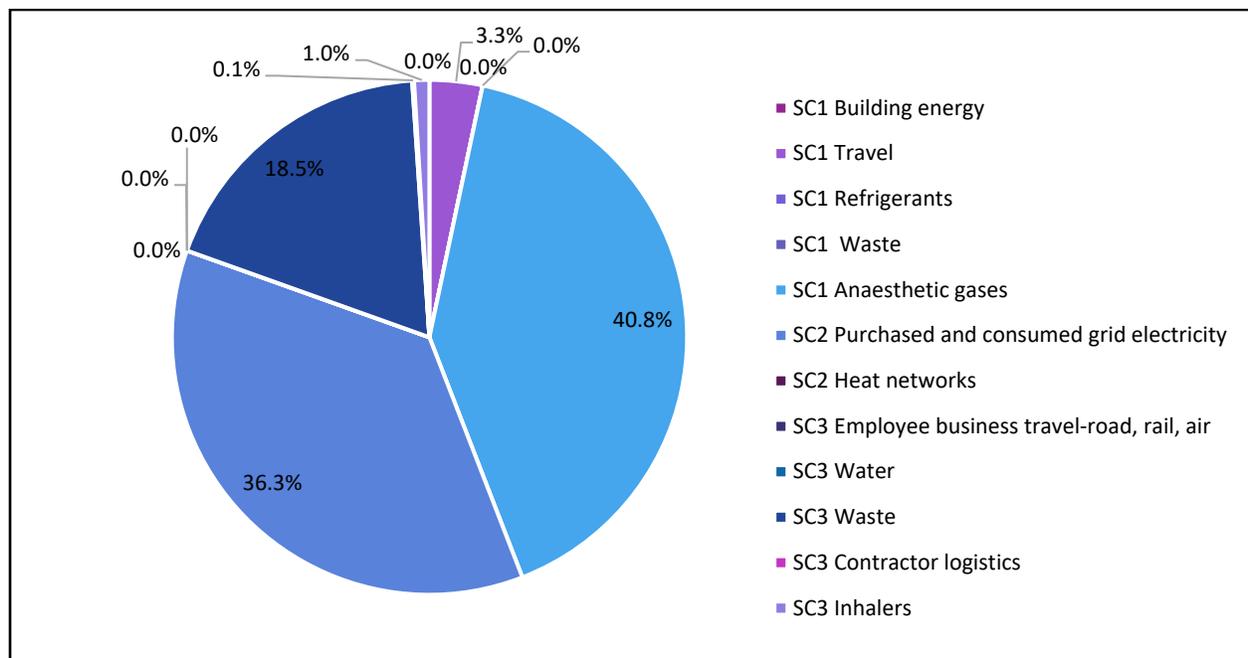


Figure 7: Scope 1,2 and 3 emissions (excluding supply chain) from Sirajganj 250 Bed Bongamata Sheikh Fazilatunnesa Mujib General Hospital. The pie chart represents the percentage of total emissions from the hospital in 3 months.

The highest carbon emissions were generated from Anaesthetic gases (40.8%) in Sirajganj 250 Bed Bongamata Sheikh Fazilatunnesa Mujib General Hospital. In August, the usage of Nitrous Oxide was the highest (330 kg). The electricity sector was responsible for 36.3% of the total emissions. The hospital generated 46,000 kg of waste and used 1,801,000 liters of water within this period. Waste accounted for 18.5% of the emissions. In 3 months, a distance of 585 km was covered under Contractor logistics.



Figure 8: Front view of Sirajganj 250 Bed Bongamata Sheikh Fazilatunnesa Mujib General Hospital

Satkhira District Hospital

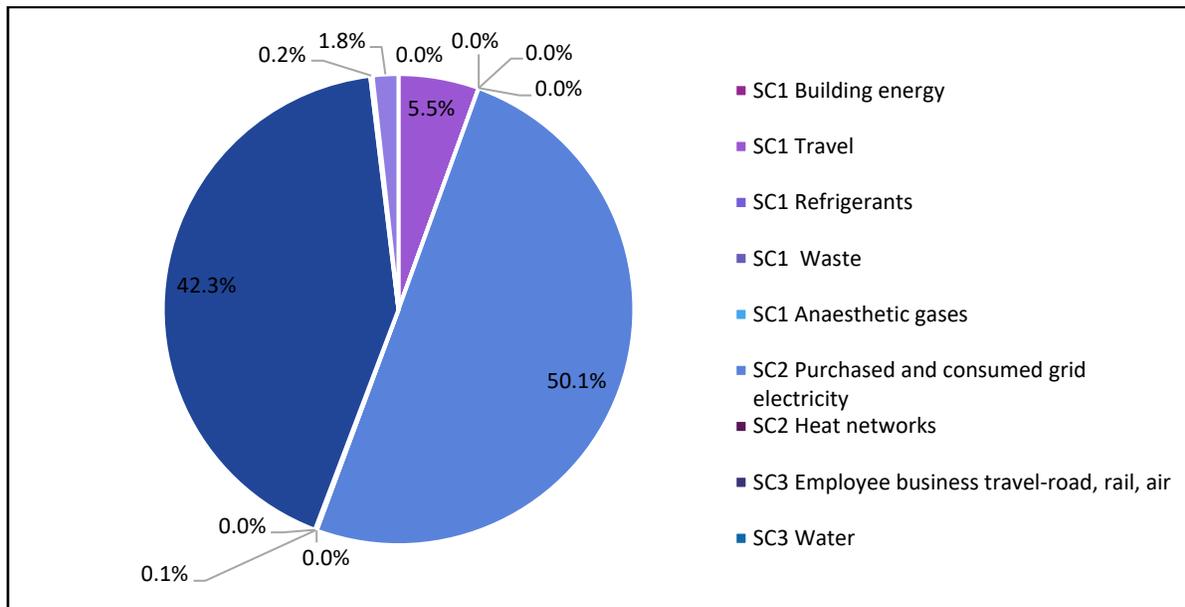


Figure 9: Scope 1,2 and 3 emissions (excluding supply chain) from Satkhira District Hospital. The pie chart represents the percentage of total emissions from the hospital in 3 months.

The majority of carbon emissions was generated from Electricity in Satkhira District Hospital. Electricity accounted for 50% of the total emissions, followed by Waste (42.3%). Only 5.5% emissions were generated from Travel. In 3 months, the employee business travel covered a distance of 825 km whereas 360 km was covered under Contractor logistics. The hospital used 4,968,000 liters of water and generated 32,934 kg of waste within this period.



Figure 10: Front view of Satkhira District Hospital

Bandarban 250 Bed District Hospital

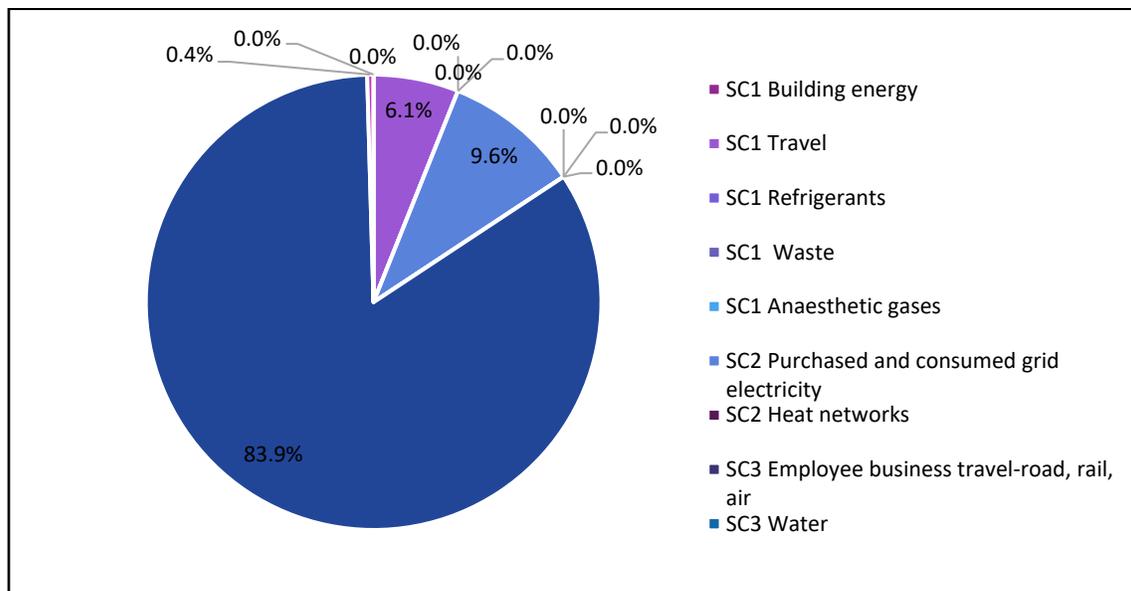


Figure 11: Scope 1,2 and 3 emissions (excluding supply chain) from Bandarban 250 Bed District Hospital. The pie chart represents the percentage of total emissions from the hospital in 3 months.

In Bandarban District Hospital, the majority of carbon emissions was generated from Waste (83.9%). A total of 138,000 kg of waste was generated in 3 months. Purchased and consumed grid electricity generated 9.6% of the total emissions, followed by Travel (6.1%). In 3 months, the contractor logistics covered a distance of 1,500 km. The hospital used 3,550,000 liters of water within this period.

Comparison of Carbon Footprint from District level Hospitals

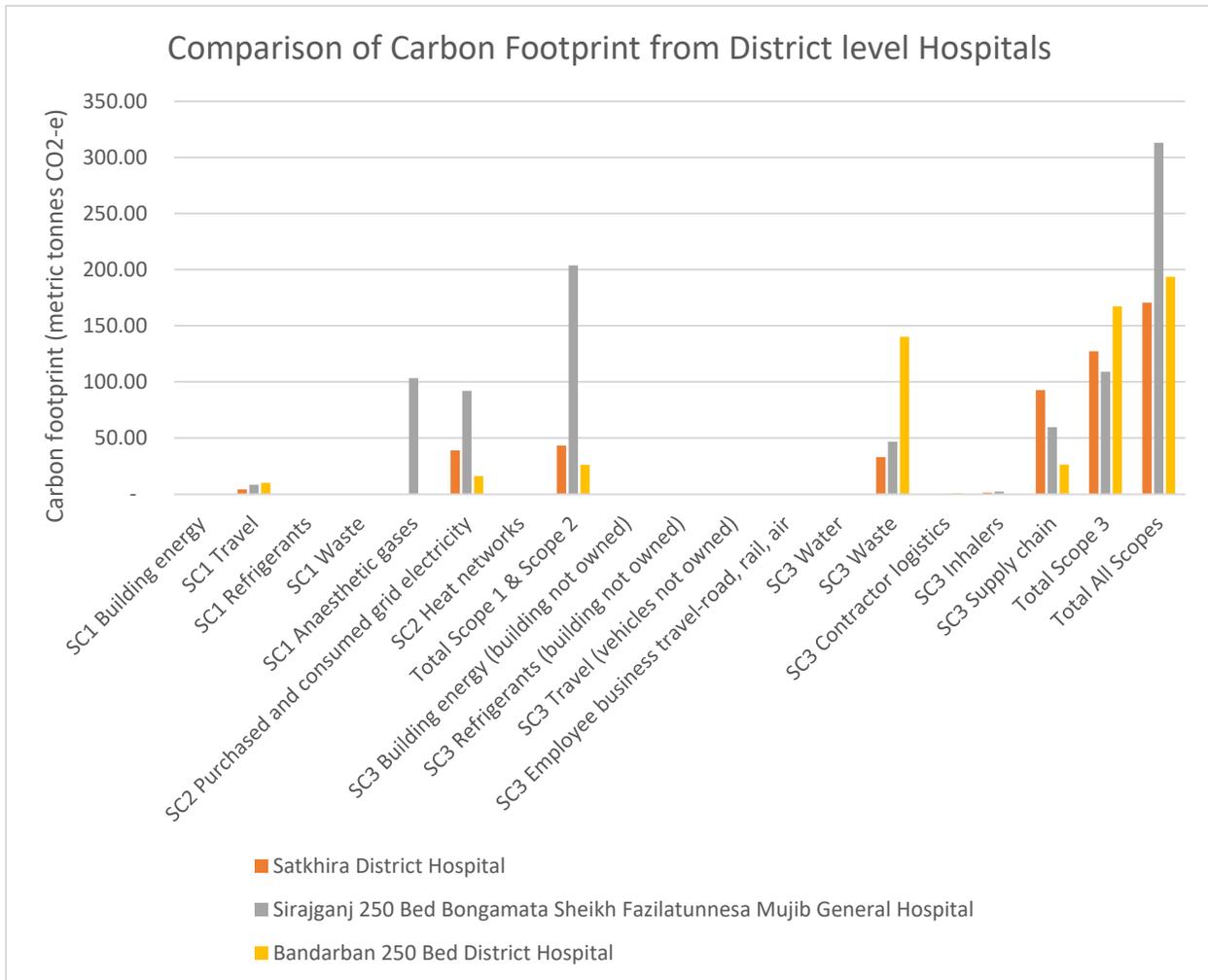


Figure 12: Comparison of Carbon Footprint from District level Hospitals

Carbon footprint of district level hospitals is less than the tertiary level hospitals on average. Less bed capacity and patient number may explain the intensity of carbon emissions from this category of healthcare facilities. Sirajganj 250 Bed General Hospital had the biggest carbon footprint among the district level hospitals. The carbon footprint of this hospital for 3 months was 312.95 metric

tonnes CO₂-e. The healthcare seeking behavior of the people in Sirajganj maybe responsible for the high impact. Besides, the other two hospitals are situated in remote locations of Bangladesh, where accessibility to healthcare is relatively limited. Satkhira District Hospital had the lowest carbon footprint of 170.58 metric tonnes CO₂-e for 3 months. Supply chain was responsible for the majority of the emissions at this hospital. In Bandarban 250 Bed District Hospital, waste sector had the highest carbon impact of all other sectors. Its overall carbon footprint was 193.57 metric tonnes CO₂-e for 3 months. The dataset for comparison of carbon footprint of district level hospitals is given in Table A2.



Figure 13: Front view of Bandarban 250 Bed District Hospital

Upazila level Hospital

Saidpur Upazila Health Complex

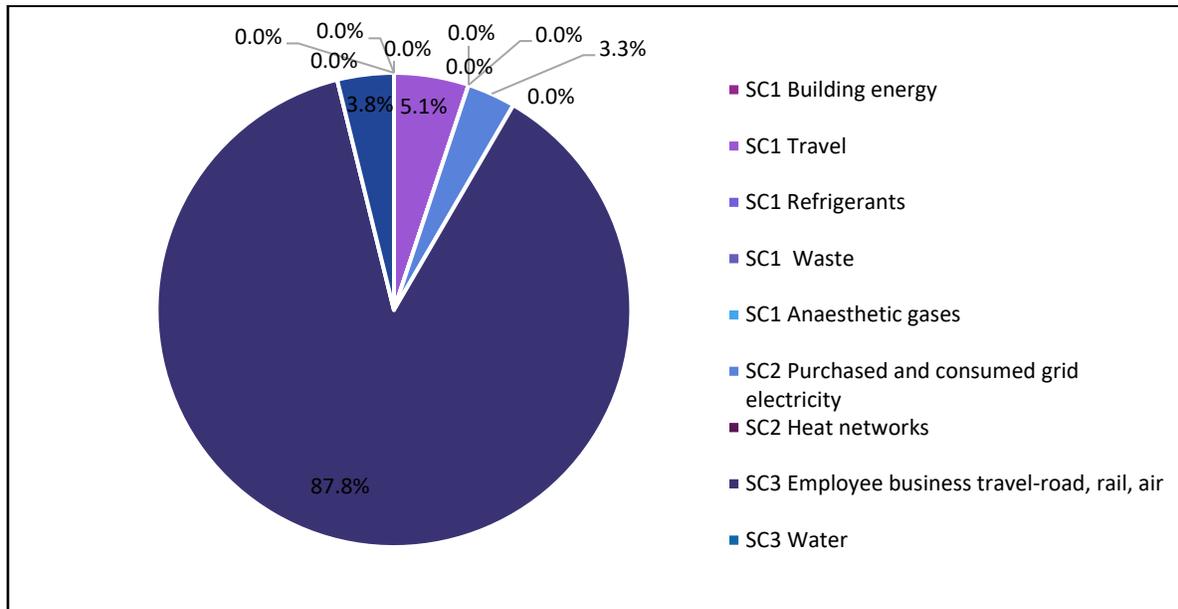


Figure 14: Scope 1,2 and 3 emissions (excluding supply chain) from Saidpur UHC. The pie chart represents the percentage of total emissions from the hospital in 3 months.

The Upazila Health Complex (UHC) at Saidpur is an exceptional case because it is a non-infrastructural healthcare facility. There is no provision for indoor patients in this UHC, allowing only outdoor patients.



Figure 15: Data collection at Saidpur UHC

The majority of carbon emissions was found from staff travel. Employee business travel generated 87.8% of the total emissions, followed by 5.1% in travel. Waste and electricity were the least carbon intensive sectors, generating only 4% and 3% of the total emissions.

Gournadi Upazila Health Complex

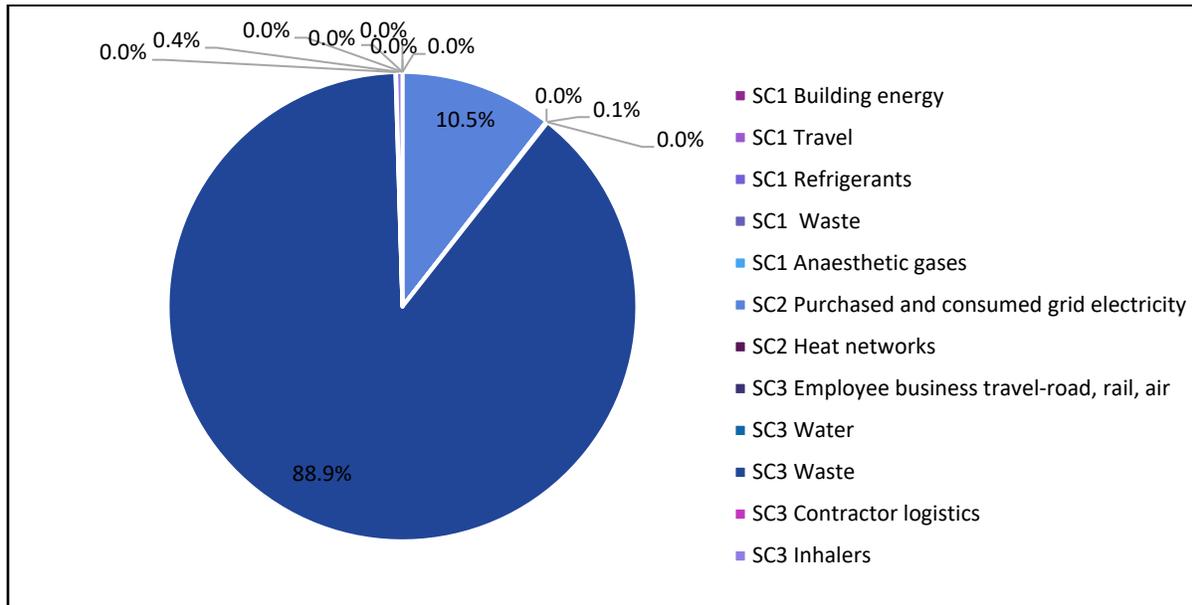


Figure 16: Scope 1,2 and 3 emissions (excluding supply chain) from Gournadi UHC. The pie chart represents the percentage of total emissions from the hospital in 3 months.

Waste sector was found to be the most carbon intensive in Gournadi UHC. As much as 88.9% of carbon emissions came from the waste sector. Purchased and consumed grid electricity accounted for 10.5% of carbon emissions.



Figure 17: Data collection at Gournadi UHC

In 3 months, the employee business travel covered a distance of 630 km and contractor logistics covered 120 km. The hospital used 1,367,000 liters of water and generated 63,200 kg of waste within this period.

Sreemangal Upazila Health Complex

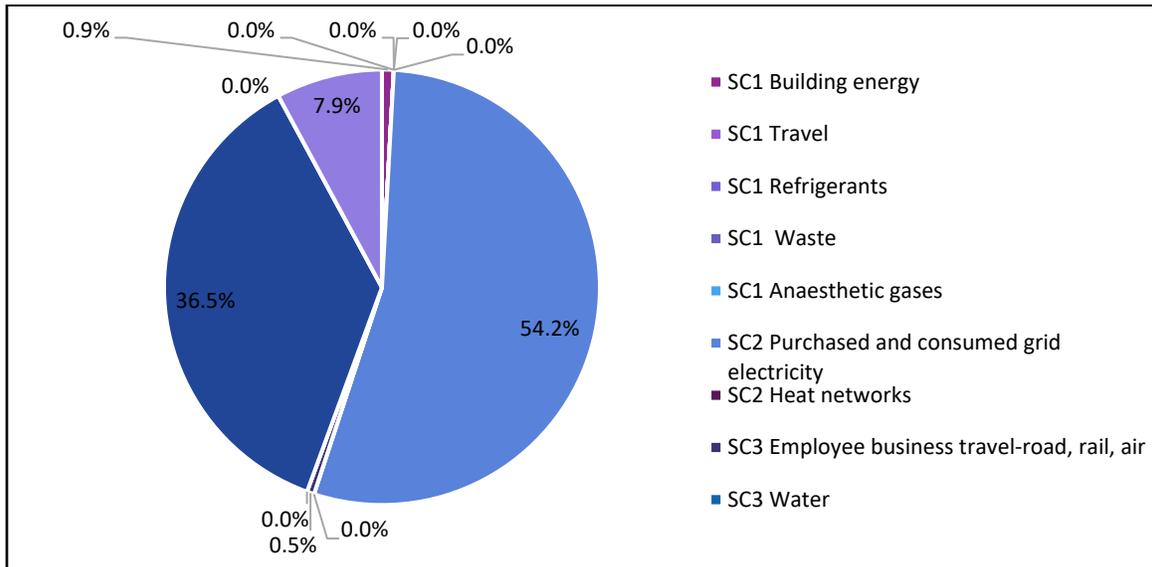


Figure 18: Scope 1,2 and 3 emissions (excluding supply chain) from Sreemangal UHC. The pie chart represents the percentage of total emissions from the hospital in 3 months.

Around half of the total carbon emissions was generated from Electricity in Sreemangal UHC. Electricity accounted for 54.2% of the total emissions, and Waste emitted 36.5% emissions. Inhalers comprised 7.9% of total emissions. In 3 months, the employee business travel covered a distance of 830 km. The hospital used 9,936,000 liters of water and generated 6,840 kg of waste within this period.



Figure 19: Sreemangal UHC

Comparison of Carbon Footprint from Upazila level Hospitals

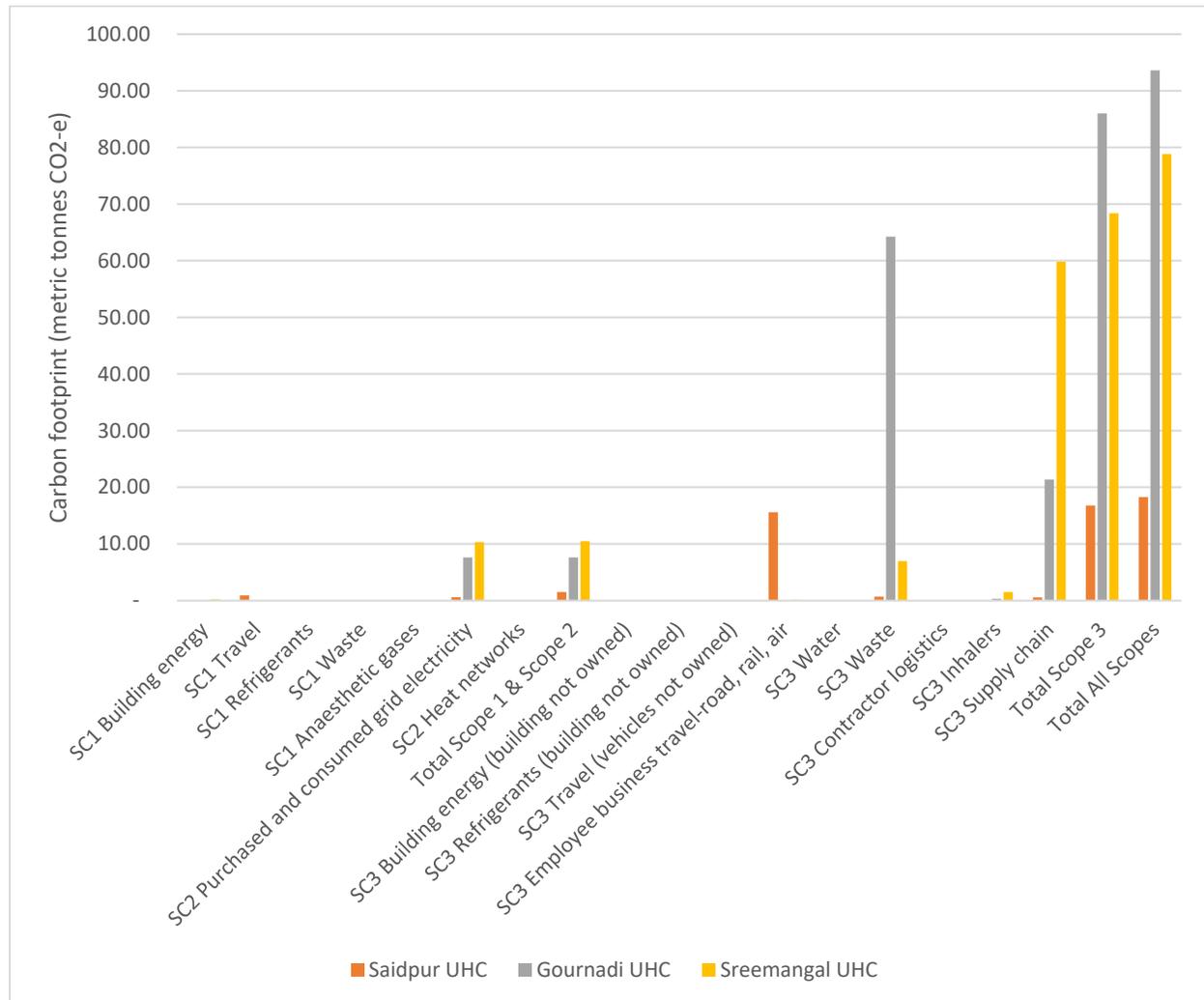


Figure 20: Comparison of Carbon Footprint from Upazila level Hospitals

The UHCs had limited data records due to lack of organization and small premises. However, the initial assessment shows that Gournadi UHC had the biggest carbon footprint among 3 UHCs. The total emission from Gournadi UHC was 93.61 metric tonnes CO₂-e in 3 months, for which the waste sector was largely responsible. The intensity of waste sector may be explained by the patient load of the healthcare facility. Around 250-300 patients visit Gournadi UHC daily to seek medical services. The waste is mainly produced due to the patient load, emitting 64.23 metric tonnes CO₂-e in 3 months.

Saidpur being a non-infrastructure hospital had the smallest carbon footprint. This is because there is no provision for indoor patients at Saidpur UHC. The employee travel is responsible for the

majority of emissions at Saidpur UHC. The carbon footprint of Saidpur UHC and Sreemangal UHC in 3 months were 18.28 and 78.86 metric tonnes CO₂-e respectively. The dataset for comparison of carbon footprint of Upazila level hospitals is given in Table A3.

Layout mapping of the hospitals

A survey was conducted at all the 9 hospitals to collect information on how much open space is available for plantation activities and how much rooftop space is available for potential installation of solar panels. Later, a layout map was created for each of the hospitals.

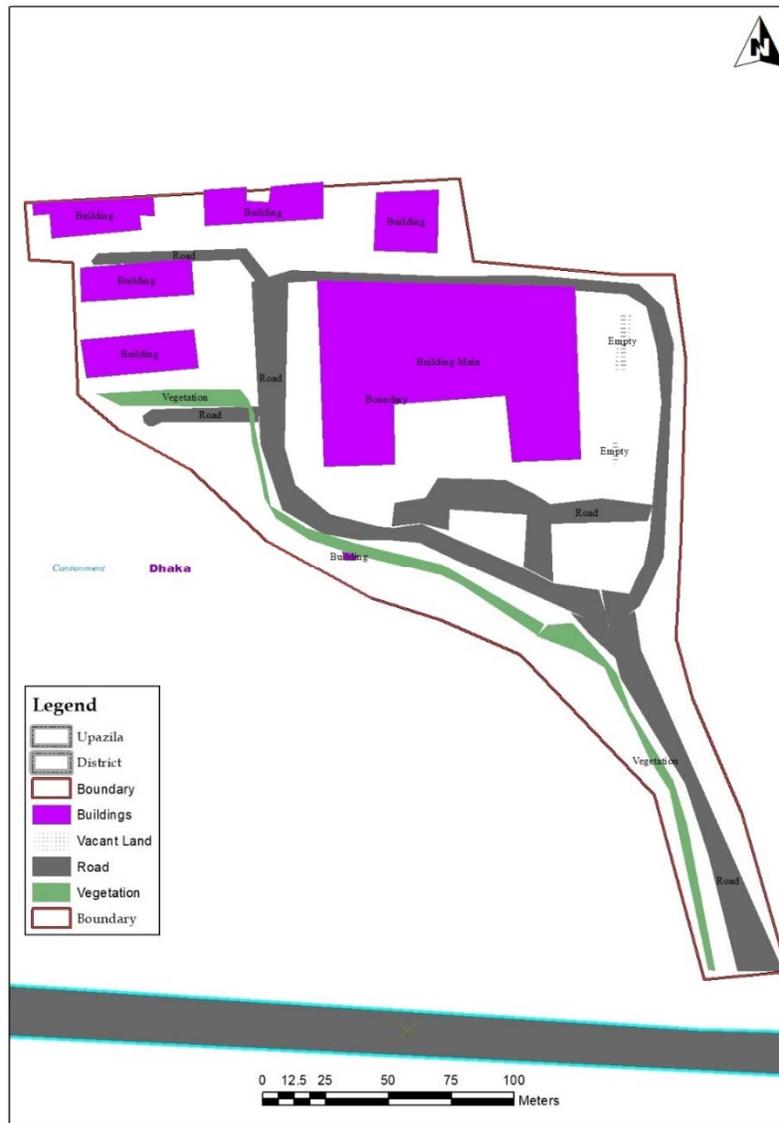


Figure 21: Layout Map of Kurmitola General Hospital



Figure 22: Layout Map of Mymensingh Medical College and Hospital

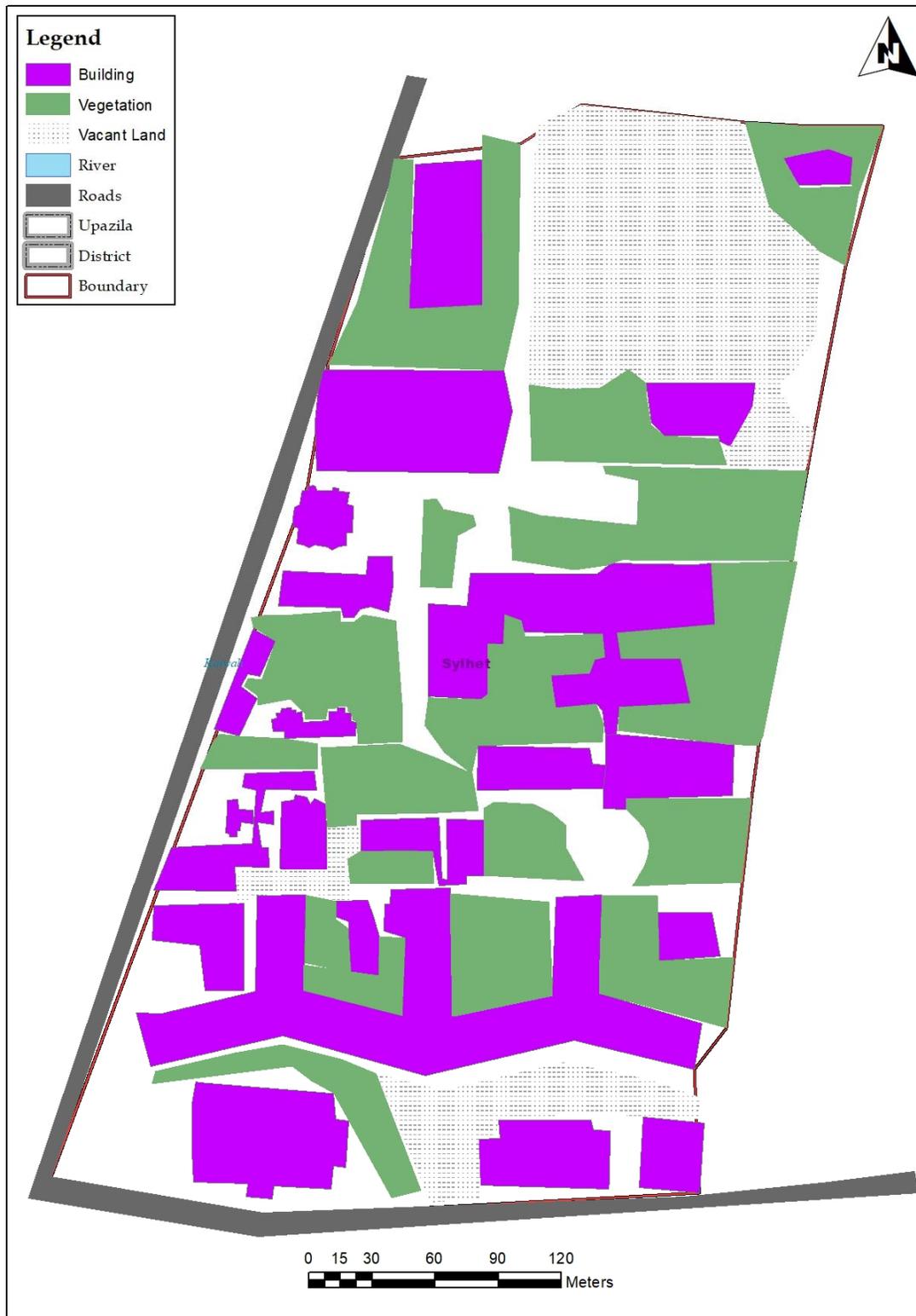


Figure 23: Layout Map of Sylhet MAG Osmani Medical College and Hospital

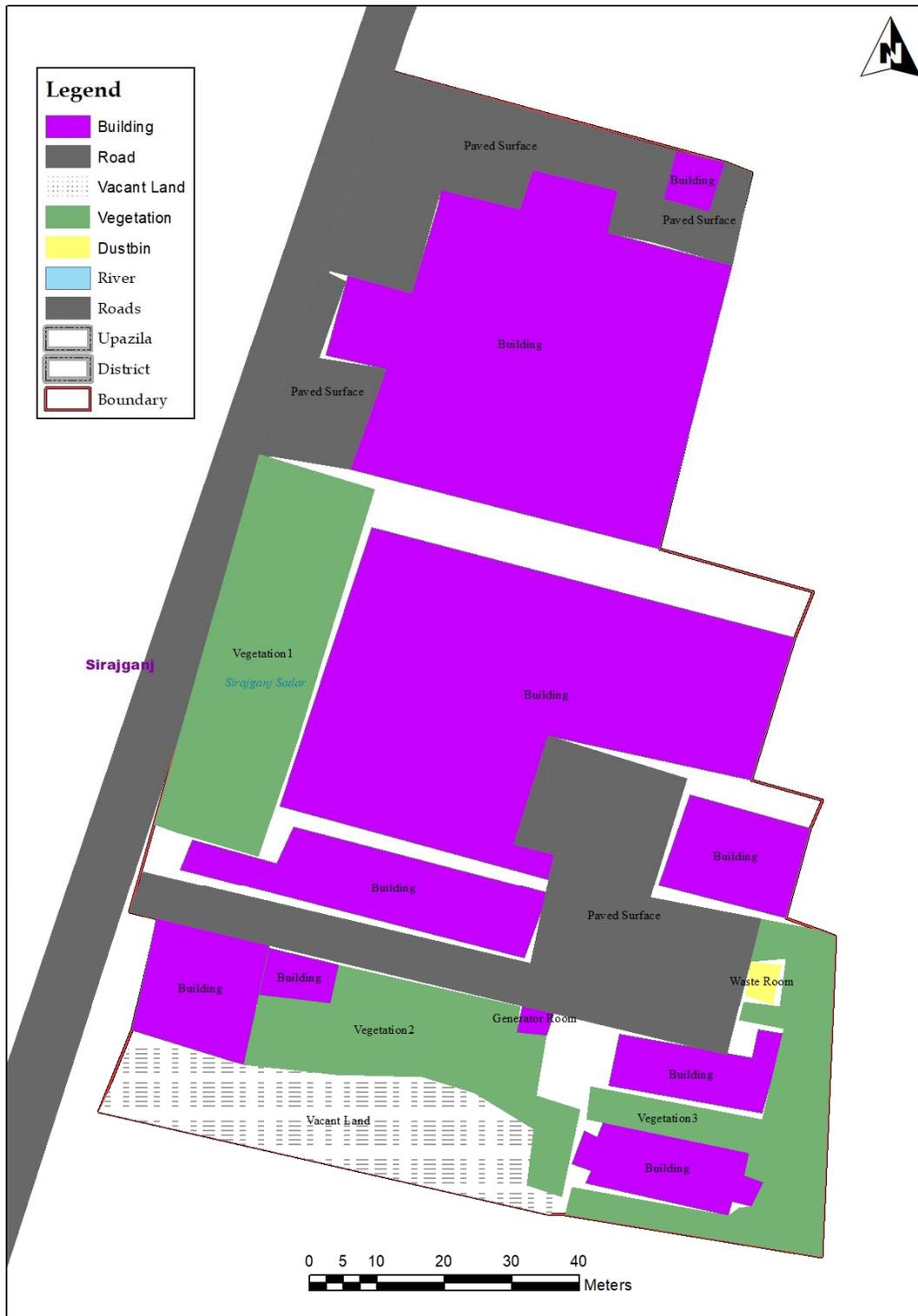


Figure 24: Layout Map of Sirajganj District Hospital

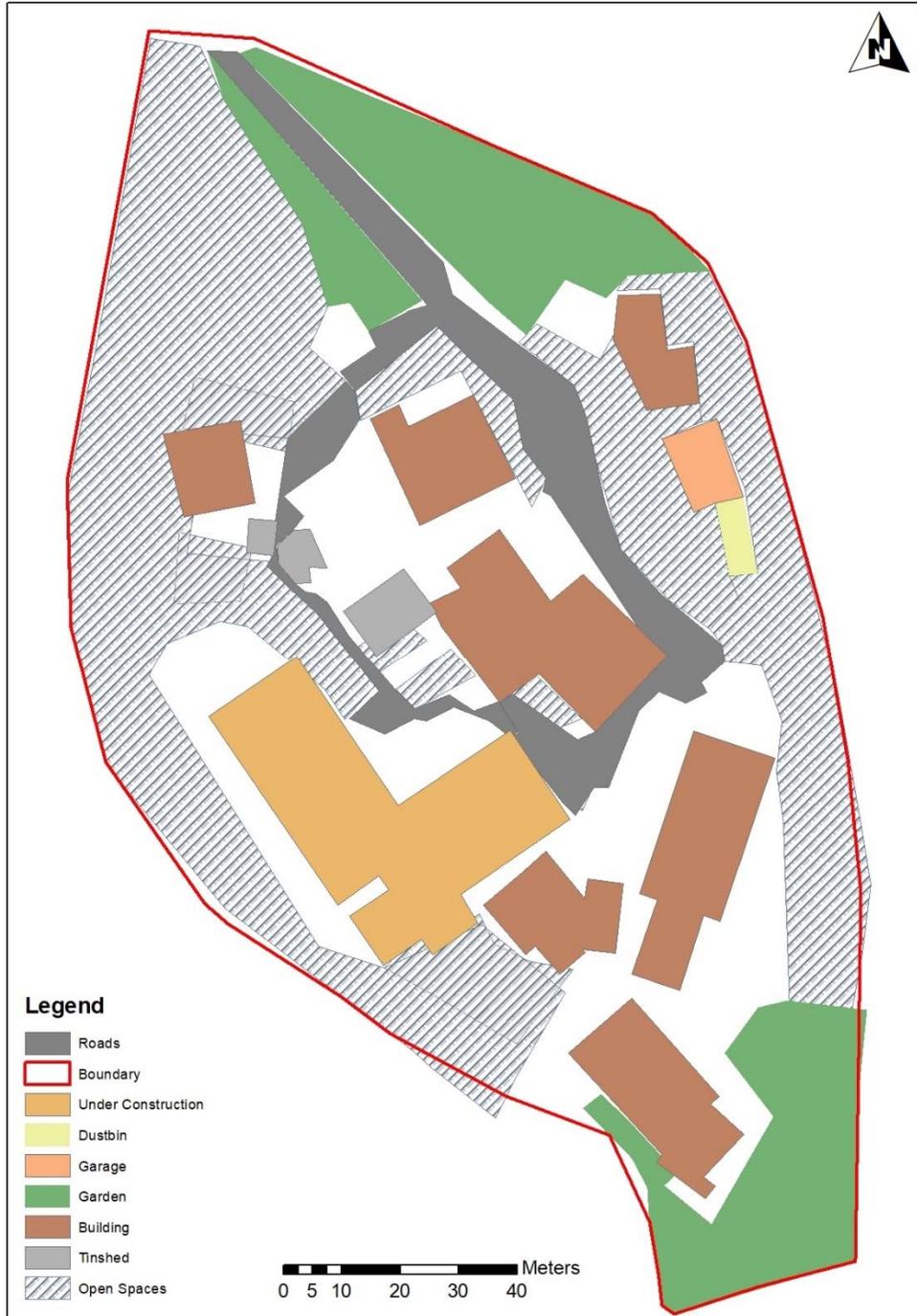


Figure 25: Layout Map of Bandarban District Hospital



Figure 26: Layout Map of Satkhira District Hospital

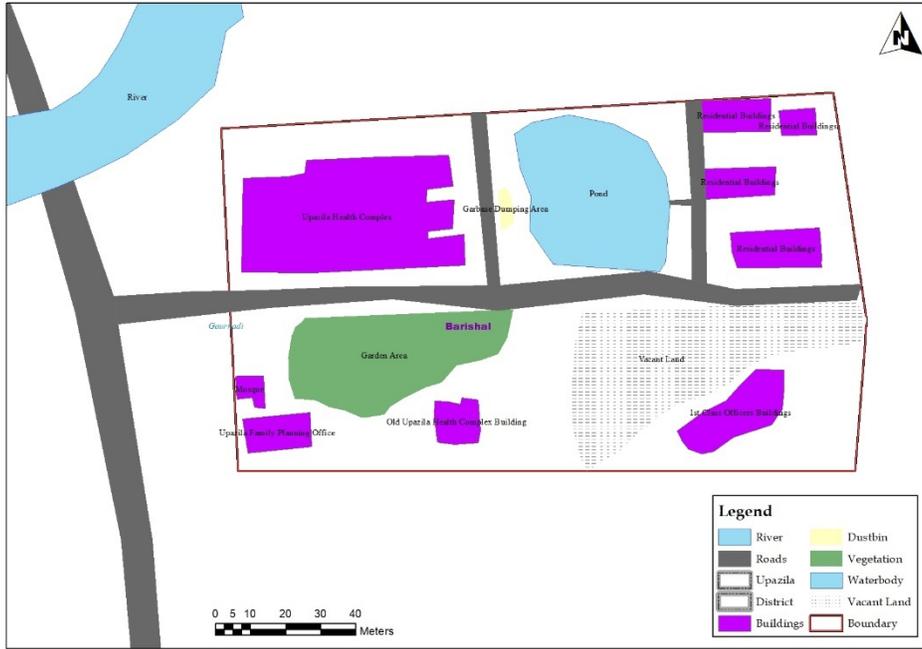


Figure 27: Layout Map of Gournadi UHC



Figure 28: Layout Map of Saidpur UHC



Figure 29: Layout Map of Sreemangal UHC

Monitoring of energy consumption in the hospitals

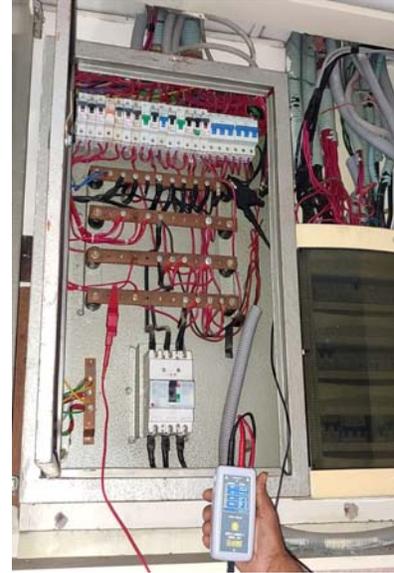
The monitoring system to track energy consumption was set up in Kurmitola General Hospital. Three automated meters were installed each at the ICU, Emergency and Admin units of the hospital. The readings were recorded for 20 days for a 24-hour period. A dashboard was developed to display the results of energy consumption from the meter readings in each of the sectors. The access to the dashboard has been given to the administration of Kurmitola General Hospital so that they can plan for sector-wise carbon mitigation accordingly.



a)

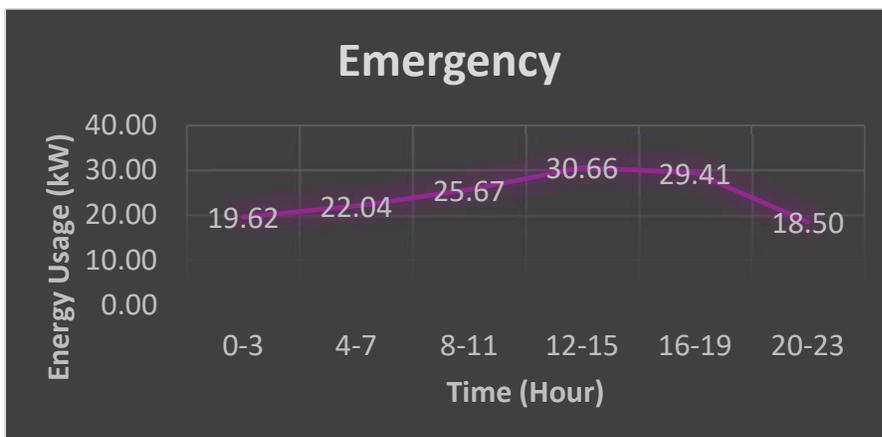
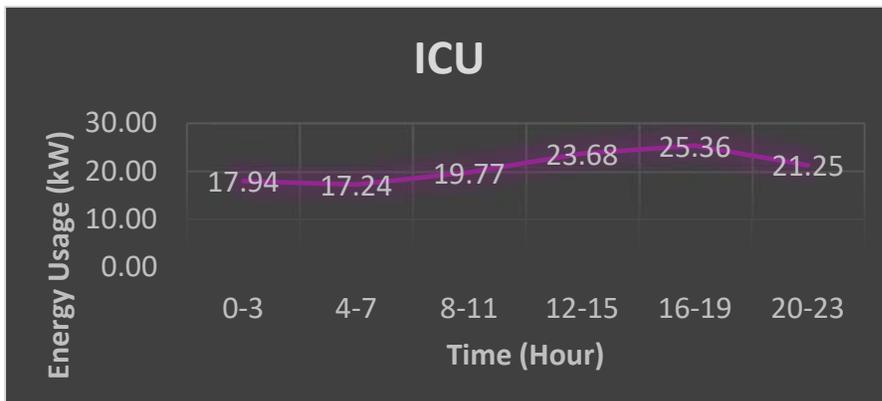


b)



c)

Figure 30: Meter installation at a) ICU; b) Emergency; and c) Admin units of Kurmitola General Hospital



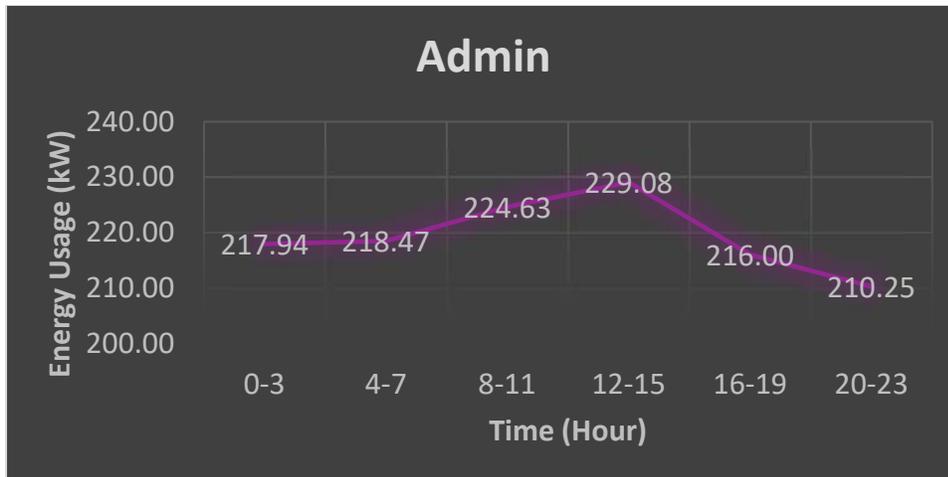


Figure 31: Meter readings of ICU, Emergency and Admin units taken over 24 hours for 20 days

It is possible to develop this system without changing the original structure of energy distribution in the hospital. The automation of energy meters will also help to create friendly competition among the units of the hospital to reduce energy consumption. The authority of Kurmitola General Hospital has reported that they have reduced energy consumption by taking measures such as keeping lights switched off during daytime and keeping the temperature at 25°C.

Carbon Mitigation Plan

The carbon mitigation plan was developed by incorporating the carbon sequestration from existing trees, carbon offsetting by selling compost from hospital waste and investing the profit in the carbon market. It has been demonstrated that the hospitals can become green and carbon negative only by improving their waste management and trading compost for carbon credits as proposed in the mitigation plan.

Additional mitigation measures can be taken to curb emissions, such as improving energy efficiency by using LED bulbs and energy saving lights, keeping lights switched off during the day, and using renewable (solar) energy for corridor and street lighting.

Tree Plantation

Tree plantation is an effective carbon mitigation measure due to its ability to sequester carbon dioxide from the atmosphere and store it in biomass and soil. Trees absorb CO₂ during photosynthesis, converting it into oxygen and carbon-based compounds that make up their structure. This process helps reduce the concentration of greenhouse gases in the atmosphere, thus mitigating the impacts of climate change.

On average, a mature tree can absorb about 22 kilograms (48 pounds) of CO₂ per year. Over its lifetime, a single tree can sequester approximately 1 tonne (2,204 pounds) of CO₂. A sapling starts sequestering carbon after 10 years. Trees absorb the most carbon during their rapid growth phase, which generally occurs when they are young to middle-aged. The age at which trees are most efficient at carbon sequestration can vary depending on species, environmental conditions, and forest management practices. Typically, trees sequester the most carbon during the first 20-50 years of their life, a period characterized by rapid growth and biomass accumulation. During this phase, trees grow quickly, expanding their canopy and increasing their trunk diameter, which allows them to absorb large amounts of CO₂ from the atmosphere.

While younger trees sequester carbon more rapidly, older trees continue to store significant amounts of carbon in their biomass and soils. Even as the rate of carbon uptake slows with age, mature forests act as substantial carbon reservoirs, maintaining stored carbon and continuing to sequester CO₂, albeit at a reduced rate.

The assessment team has selected five geographic regions for the tree plantation and identified suitable native species.

Locations	Bandarban	Satkhira	Sunamganj	Bogra	Sreemangal
Name of trees	<i>Dipterocarpus turbinatus</i> (Garjan)	<i>Heritiera fomes</i> (Sundari)	<i>Syzygium cumini</i> (Jamun)	<i>Mangifera indica</i> (Mango)	<i>Dipterocarpus turbinatus</i> (Garjan)
	<i>Shorea robusta</i> (Sal)	<i>Excoecaria agallocha</i> (Gewa)	<i>Barringtonia acutangula</i> (Hijal)	<i>Artocarpus heterophyllus</i> (Jackfruit)	<i>Artocarpus heterophyllus</i> (Jackfruit)
	<i>Tectona grandis</i> (Teak)	<i>Avicennia officinalis</i> (Baen)	<i>Pongamia pinnata</i> (Karanja)	<i>Syzygium cumini</i> (Jamun)	<i>Mangifera indica</i> (Mango)
	<i>Gmelina arborea</i> (Gamar)	<i>Sonneratia apetala</i> (Keora)	<i>Tamarindus indica</i> (Tamarind)	<i>Azadirachta indica</i> (Neem)	<i>Syzygium cumini</i> (Jamun)
	<i>Artocarpus chama</i> (Chapalish)	<i>Ceriops decandra</i> (Goran)	<i>Terminalia arjuna</i> (Arjun)	<i>Tamarindus indica</i> (Tamarind)	<i>Tectona grandis</i> (Teak)
	<i>Terminalia belerica</i> (Bahera)	<i>Nypa fruticans</i> (Golpata)	<i>Ficus racemosa</i> (Cluster Fig)	<i>Ficus religiosa</i> (Peepal)	<i>Gmelina arborea</i> (Gamar)
	<i>Terminalia chebula</i> (Haritaki)	<i>Rhizophora mucronata</i> (Red Mangrove)	<i>Madhuca indica</i> (Mahua)	<i>Terminalia arjuna</i> (Arjun)	<i>Terminalia arjuna</i> (Arjun)
	<i>Syzygium cumini</i> (Jamun)	<i>Bruguiera gymnorhiza</i> (Kankra)	<i>Aegle marmelos</i> (Bael)	<i>Albizia lebbek</i> (Siris)	<i>Albizia lebbek</i> (Siris):
	<i>Bambusa spp.</i> (Bamboo species)	<i>Xylocarpus mekongensis</i> (Passur)	<i>Holarrhena antidysenterica</i> (Kutaj)	<i>Dalbergia sissoo</i> (Sheesham)	<i>Dalbergia sissoo</i> (Sheesham)
	<i>Ficus spp.</i> (Fig trees)	<i>Phoenix paludosa</i> (Wild Date Palm)	<i>Azadirachta indica</i> (Neem)	<i>Bambusa spp.</i> (Bamboo species)	<i>Shorea robusta</i> (Sal)

Locations	Bandarban	Satkhira	Sunamganj	Bogra	Sreemangal
	<i>Swintonia floribunda</i> (Telsur)		<i>Bambusa spp.</i> (Bamboo species)	<i>Tectona grandis</i> (Teak)	<i>Ficus benghalensis</i> (Banyan)
				<i>Swietenia mahagoni</i> (Mahogany)	<i>Ficus religiosa</i> (Peepal)
				<i>Madhuca indica</i> (Mahua)	<i>Bambusa spp.</i> (Bamboo species)
				<i>Diospyros malabarica</i> (Gaub)	<i>Swietenia mahagoni</i> (Mahogany)
					<i>Madhuca indica</i> (Mahua)
					<i>Diospyros malabarica</i> (Gaub)
					<i>Lagerstroemia speciosa</i> (Jarul)
					<i>Toona ciliata</i> (Toon)
					<i>Cinnamomum verum</i> (Cinnamon)

Waste Management

According to the World Health Organization (WHO), about 85% of the waste generated by health-care activities is general, non-hazardous waste comparable to domestic waste [13]. This portion can be considered organic as it does not pose any particular biological, chemical, radioactive, or physical hazard. Approximately 360-544 kg of compost can be generated from 907 kg of waste [14]. On average, 907 kg of organic waste produces 452 kg of compost. The market price of 1 kg of compost in Bangladesh is BDT 40. As per this rate, the assessment team have estimated the potential profit that each hospital can earn from composting hospital waste and incorporated them into the carbon market investment in the mitigation plan.

Switch to renewable energy: Solar panels

Solar energy is one of the cleanest renewable energy sources that can reduce the carbon footprint. One solar panel can generate 730 kWh of electricity per year [15]. The solar energy potential was estimated by the floor space available in each hospital. The savings in electricity bill and carbon were projected for each hospital. The profit earned from saving electricity bill would be invested in the carbon market.

Carbon trading mechanism: Carbon neutral village

Carbon trade is the buying and selling of credits that permit a company or other entity to emit a certain amount of carbon dioxide or other greenhouse gases. While critics are concerned that emissions trading schemes may fail to achieve the goal of reducing emission reductions, The assessment team propose an innovative carbon trading mechanism where hospitals can buy carbon credits from a village and make them carbon neutral. The farmers who practice climate smart agriculture are playing a pivotal role in transforming agricultural production towards sustainability. At the same time, there is a chance that their new farming practices generate less greenhouse gas emissions compared to the traditional methods. The industries and other parties who are responsible for the carbon emissions may offset their emissions by funding these green farming practices. In Bangladesh, the number of marginal and small farmers is high, who have no financial safety net. Thus, this incentive-based method may encourage them to take up more climate-friendly agricultural practices, acting as a positive feedback loop. Through this initiative, the farmers and landowners will benefit from individuals and businesses willing to offset their carbon emissions and achieve a smaller carbon footprint. Investments in renewable energy, efficient irrigation systems, and climate-smart technologies can help reduce emissions and enhance the resilience of agricultural systems to climate change. This may create the opportunity for a village to go carbon neutral by practicing green farming.

To sustain the model of carbon neutral village, a climate resilient fund could be developed within the community or village. The fund will cater to the community people in times of need, such as disaster shocks, social responsibilities and other non-profit community welfare activities. The fund will be generated through carbon offsetting mechanisms, whereby the local farmers will receive credits for plantation and green farming methods. The fund will be utilized for community development and disaster resilience activities after sharing a certain percentage to the landowners.

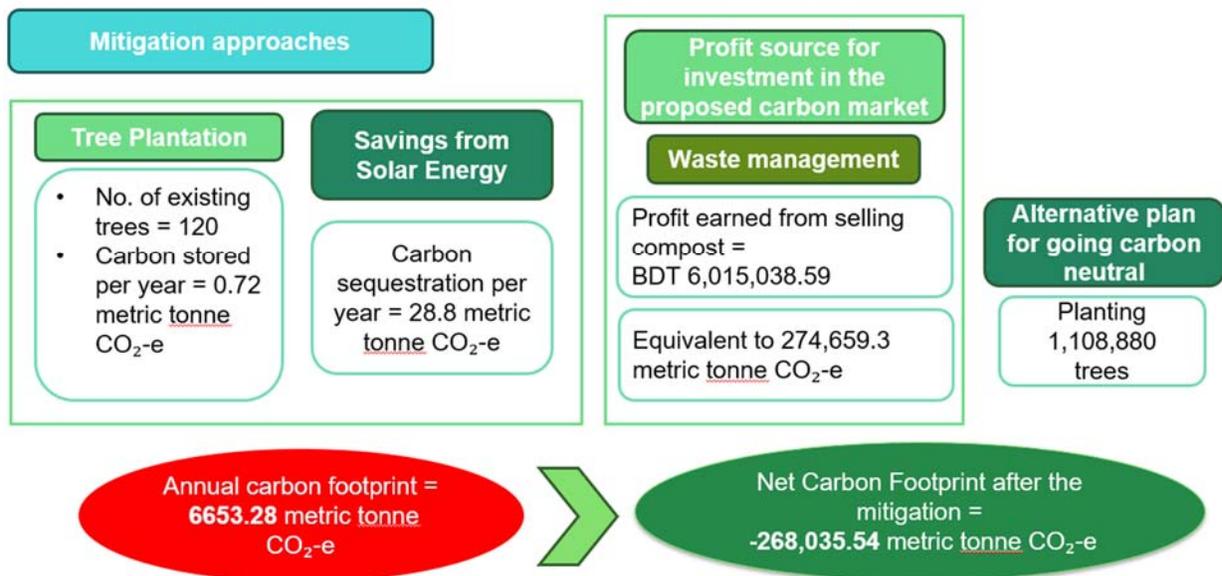
The idea will benefit both the environment and the people, especially those who are tied closely with the nature. It will not only reduce the emission of greenhouse gases from agriculture sector, but also decrease the burden of agricultural waste. The farmers will be trained on green farming approaches, such as composting instead of using chemical fertilizers, sustainable irrigation and water management practices etc. This approach will not only offset the emissions from hospitals, but also make a village disaster resilient and improve their health-seeking behavior.

Kurmitola General Hospital

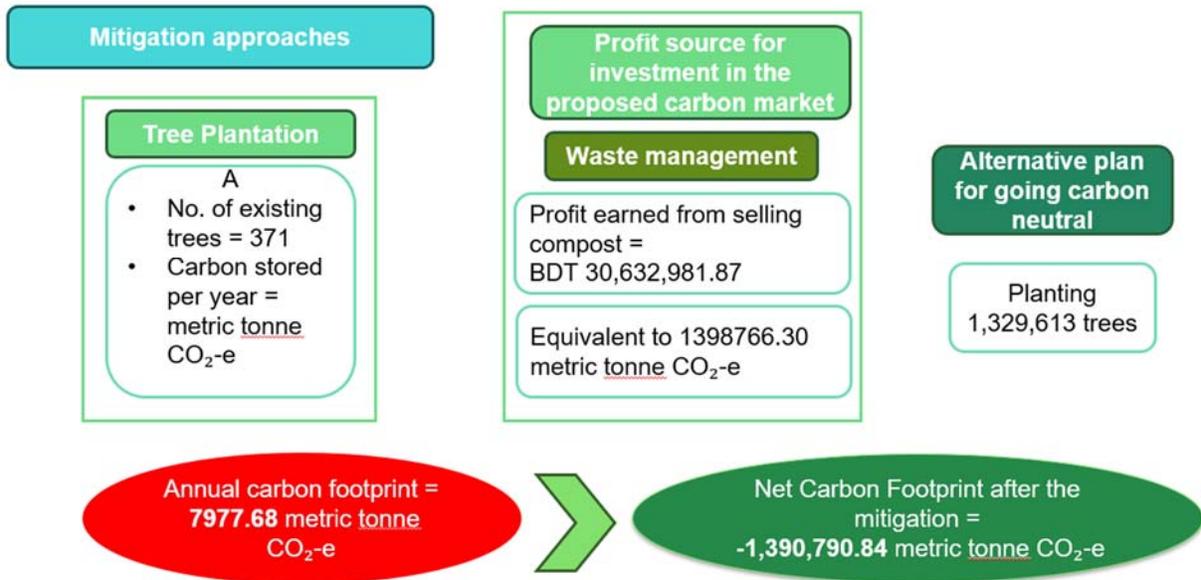
Currently, there are 120 trees planted in the premises of Kurmitola General Hospital, which contributes to 0.72 metric tonnes of carbon storage each year. The hospital has solar panel installed on the rooftop, which sequesters around 28.8 metric tonne CO₂-e.

By composting biodegradable waste from the hospital waste and selling the compost, the hospital can make a profit of BDT 6 million per year, which is equivalent to saving carbon of 0.2 million metric tonne CO₂-e. The net carbon footprint becomes negative if the total plan is implemented. Alternatively, the hospital may choose to offset its annual emission of 6653.28 metric tonne CO₂-e by planting 1 million trees. The tree plantation section highlights the suitable location and species of trees.

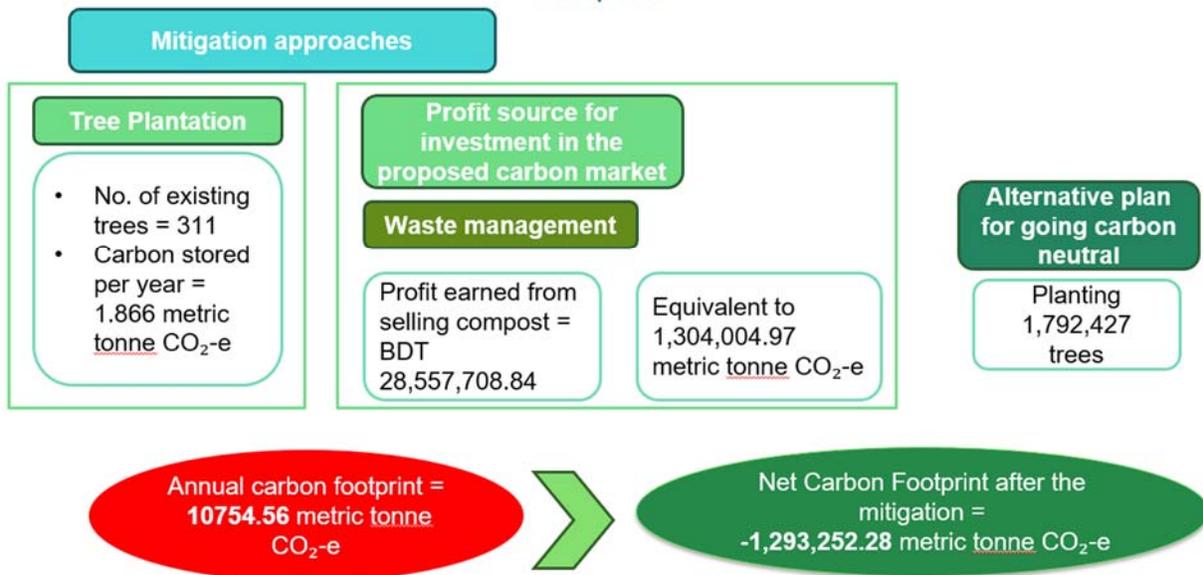
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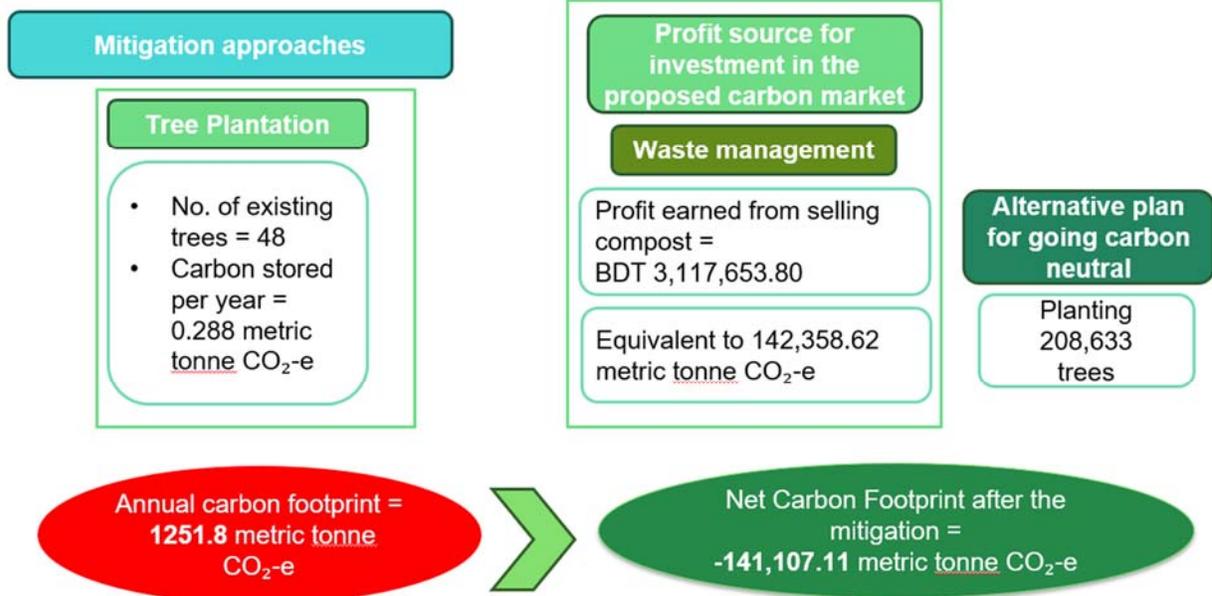
Annual Carbon Mitigation Plan of Mymensingh Medical College Hospital



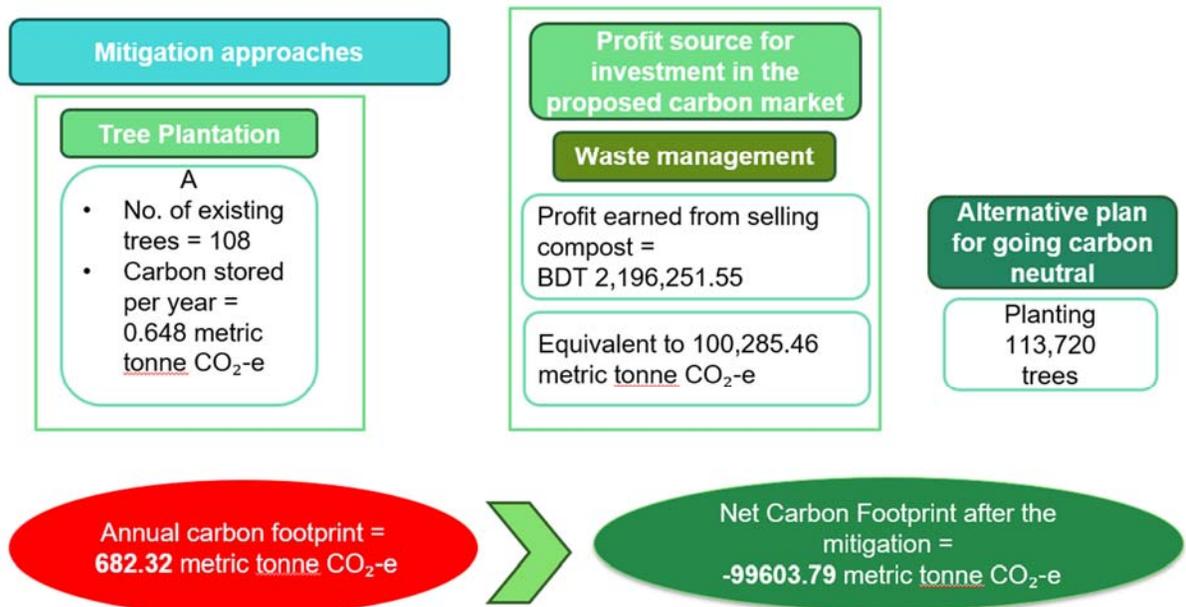
Annual Carbon Mitigation Plan of Sylhet MAG Osmani Medical College Hospital



Annual Carbon Mitigation Plan of Sirajganj District Hospital

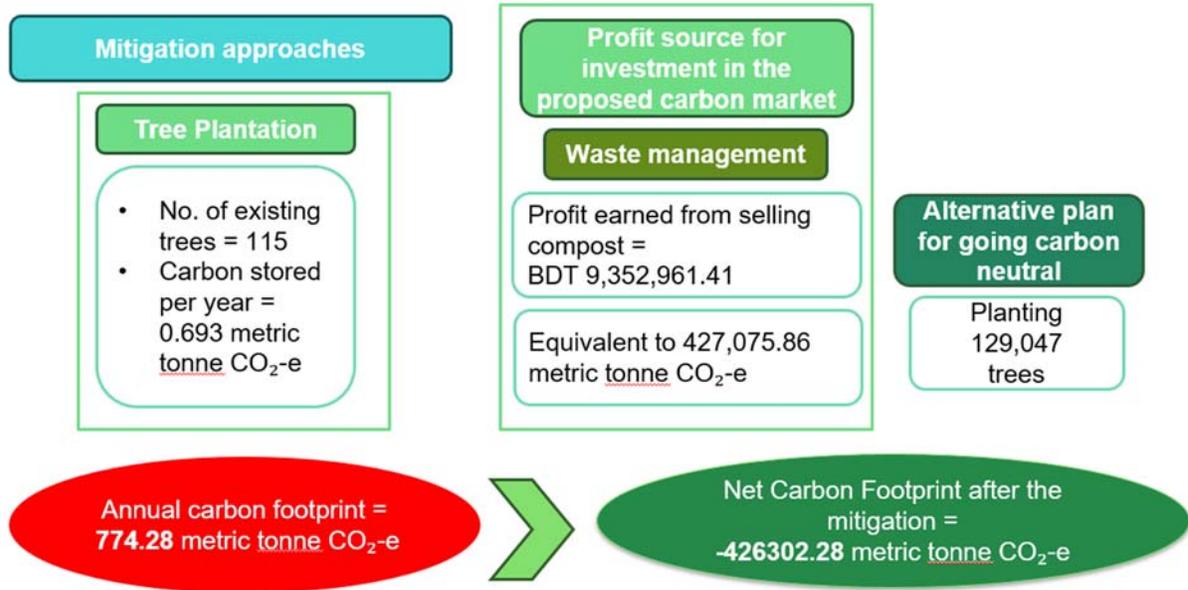


Annual Carbon Mitigation Plan of Satkhira District Hospital



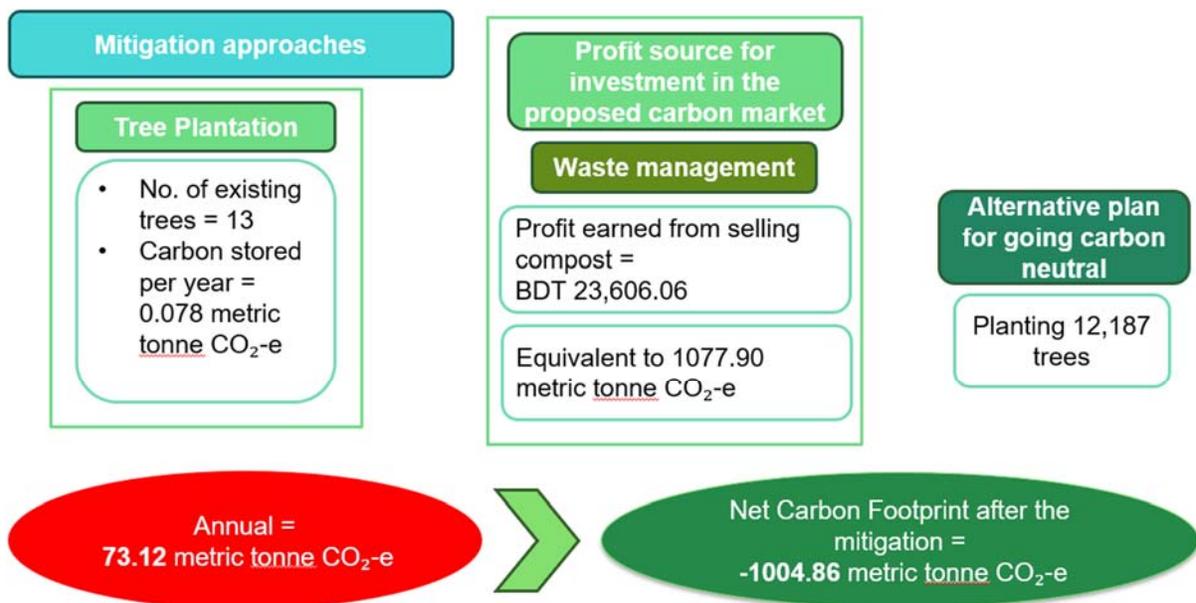
Bandarban 250 Bed District Hospital

Annual Carbon Mitigation Plan of Bandarban District Hospital



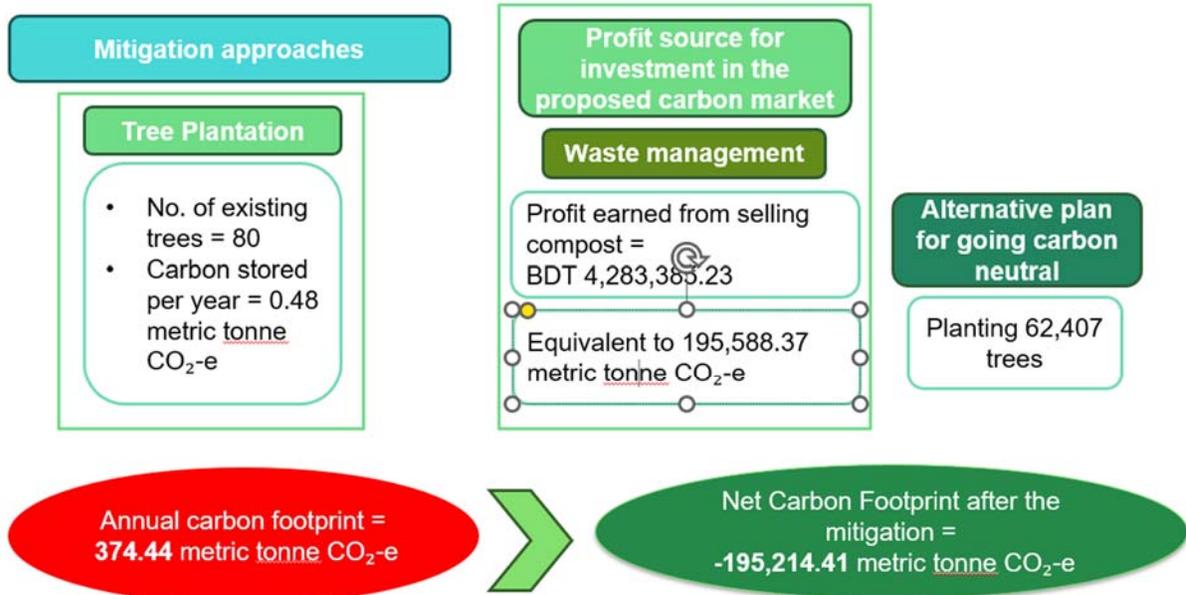
Saidpur Upazila Health Complex

Annual Carbon Mitigation Plan of Saidpur UHC



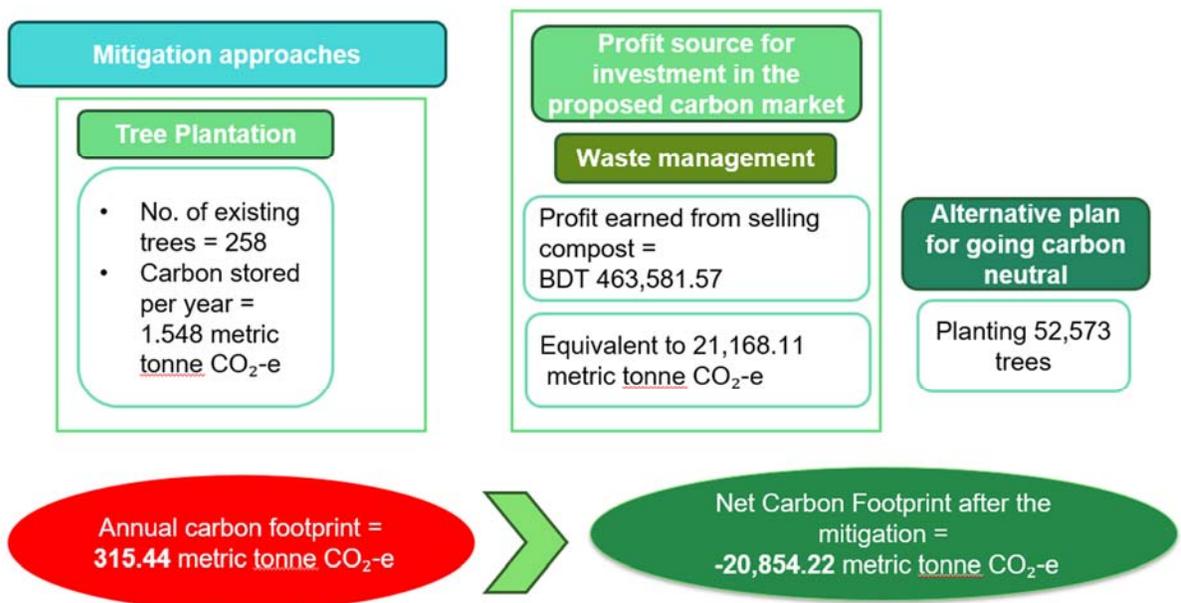
Gournadi Upazila Health Complex

Annual Carbon Mitigation Plan of Gournadi UHC



Sreemangal Upazila Health Complex

Annual Carbon Mitigation Plan of Sreemangal UHC



Recommendations and Conclusion

It is recommended that the hospitals improve their data management and storage facilities and make it digitally accessible. Further extensive assessment including larger sample size and duration is suggested for accurately projecting the total carbon footprint of the healthcare sector in Bangladesh.

The mitigation plan showed that a substantial profit can be generated from waste management. The hospitals can also make profit from supplying solar energy to the national grid. This profit can be invested in the carbon market to make the villages disaster resilient and improve their health. The hospital authority can also bring about behavioral changes to reduce carbon emissions, for example by encouraging carbon neutral methods of travel through annual appraisal or recognition of hospital staff and tracking energy consumption and creating a healthy competition to reduce emissions from individual sectors of the hospital.

The hospitals can engage in developing a business venture for turning waste into compost through public-private partnership. And if the mitigation plan is continued to be implemented, the hospitals can target more villages to offset their carbon emissions which will benefit both the villages and the environment. By offsetting annual carbon emissions implementing our proposed mitigation plan, it is possible to make the hospitals carbon neutral or negative.

Finally, it can be said that the project was a praiseworthy initiative taken by WHO and successful within its scope. Further assessment is needed to project the overall carbon footprint of the healthcare sector of Bangladesh. Such initiatives will help achieve the targets of SDG 13 “Climate Action,” and the proposed mitigation measures can help reduce the climate burden of healthcare in Bangladesh.

Limitations

The collection of primary data was challenging because of the lack of systematic data management. Most of the data were stored haphazardly in hand-written records. There was no provision for keeping records for the waste and water sector. Therefore, the assessment team had to take daily estimates from the waste collectors and water pump operators. Estimates were taken for Travel-Other vehicles from the Statistician/Accountant by obtaining the total number of staff and radius

of commute. The data for remaining sectors were stored under different administrative departments. High quality data was obtained for the energy gas from meter readings. If the information was stored centrally in a digital system, it would be a lot easier to assess the carbon footprint and come up with a mitigation plan. The report calls for an automated metering system in the hospitals of Bangladesh.

The assessment was conducted on a small scale with limited time and resources for only 9 hospitals. But it is a steppingstone for Bangladesh to estimate carbon emissions from its healthcare sector. It is essential to carry out the assessment on a broader scale in the future to estimate the total carbon emissions from the entire healthcare sector in Bangladesh.

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Appendix

Table A1: Comparison of carbon footprint of Tertiary level hospitals for 3 months

Scope	Emission area	Kurmitola General Hospital (metric tonne CO ₂ - e)	Mymensingh Medical College Hospital (metric tonne CO ₂ -e)	Sylhet MAG Osmani Medical College Hospital (metric tonne CO ₂ -e)
Scope 1	SC1 Building energy	11.61	125.62	57.27
	SC1 Travel	1.11	3.83	5.43
	SC1 Refrigerants	57.56	0.00	73.57
	SC1 Waste	0.00	0.00	0.00
	SC1 Anaesthetic gases	23.85	577.70	548.24
Scope 2	SC2 Purchased and consumed grid electricity	468.72	717.70	351.03
	SC2 Heat networks	0.00	0.00	0.00
Total Scope 1 & Scope 2	Total Scope 1 & Scope 2	562.86	1424.85	1035.54
Scope 3	SC3 Building energy (building not owned)	0.00	0.00	0.00
	SC3 Refrigerants (building not owned)	0.00	0.00	0.00
	SC3 Travel (vehicles not owned)	0.00	0.00	0.00
	SC3 Employee business travel-road, rail, air	3.07	0.00	0.95
	SC3 Water	0.00	0.00	0.00
	SC3 Waste	90.20	135.29	427.37
	SC3 Contractor logistics	0.06	0.63	0.84
	SC3 Inhalers	56.64	19.98	0.26
	SC3 Supply chain	950.49	413.65	1223.69
Total Scope 3	Total Scope 3	1100.46	569.57	1653.10
Total All Scopes	Total All Scopes	1663.32	1994.42	2688.64

Table A2: Comparison of carbon footprint of District level hospitals for 3 months

Scope	Emission area	Satkhira District Hospital (metric tonne CO ₂ -e)	Sirajganj 250 Bed Bongamata Sheikh Fazilatunnesa Mujib General Hospital (metric tonne CO ₂ -e)	Bandarban 250 Bed District Hospital (metric tonne CO ₂ -e)
Scope 1	SC1 Building energy	-	-	-
	SC1 Travel	4.30	8.39	10.12
	SC1 Refrigerants	-	-	-
	SC1 Waste	-	-	-
	SC1 Anaesthetic gases	-	103.35	-
Scope 2	SC2 Purchased and consumed grid electricity	39.01	92.04	16.14
	SC2 Heat networks	-	-	-
Total Scope 1 & Scope 2	Total Scope 1 & Scope 2	43.31	203.79	26.26
Scope 3	SC3 Building energy (building not owned)	-	-	-
	SC3 Refrigerants (building not owned)	-	-	-
	SC3 Travel (vehicles not owned)	-	-	-
	SC3 Employee business travel-road, rail, air	0.09	0.00	0.00
	SC3 Water	-	-	-
	SC3 Waste	32.93	46.75	140.25
	SC3 Contractor logistics	0.13	0.29	0.75
	SC3 Inhalers	1.37	2.42	-
	SC3 Supply chain	92.74	59.70	26.31
Total Scope 3	Total Scope 3	127.27	109.17	167.31
Total All Scopes	Total All Scopes	170.58	312.95	193.57

Table A3: Comparison of carbon footprint of Upazila level hospitals for 3 months

Scope	Emission area	Saidpur UHC (metric tonne CO ₂ -e)	Gournadi UHC (metric tonne CO ₂ -e)	Sreemangal UHC (metric tonne CO ₂ -e)
Scope 1	SC1 Building energy	-	-	0.17
	SC1 Travel	0.91	-	-
	SC1 Refrigerants	-	-	-
	SC1 Waste	-	-	-
	SC1 Anaesthetic gases	-	-	-
Scope 2	SC2 Purchased and consumed grid electricity	0.58	7.60	10.31
	SC2 Heat networks	-	-	-
Total Scope 1 & Scope 2	Total Scope 1 & Scope 2	1.49	7.60	10.48
Scope 3	SC3 Building energy (building not owned)	-	-	-
	SC3 Refrigerants (building not owned)	-	-	-
	SC3 Travel (vehicles not owned)	-	-	-
	SC3 Employee business travel-road, rail, air	15.57	0.07	0.10
	SC3 Water	-	-	-
	SC3 Waste	0.68	64.23	6.95
	SC3 Contractor logistics	-	0.03	-
	SC3 Inhalers	-	0.31	1.50
	SC3 Supply chain	0.54	21.37	59.82
Total Scope 3	Total Scope 3	16.79	86.01	68.38
Total All Scopes	Total All Scopes	18.28	93.61	78.86

Table A4: Conversion factors for Vehicle-Distance and Contractor Logistics

Type of Vehicle	Type of Fuel	Conversion factor (kgCO ₂ e/km)
Van-up to 1.305 tonnes	Petrol	0.20
Van-up to 1.305 tonnes	Diesel	0.14
Van 1.305 to 1.74 tonnes	Petrol	0.20
Van 1.305 to 1.74 tonnes	Diesel	0.18
Van 1.74 to 3.5 tonnes	Petrol	0.33
Van 1.74 to 3.5 tonnes	Diesel	0.25
Truck, rigid axel >3.5 - 7.5 tonnes	Diesel	0.50
Car small	Petrol	0.15
Car small	Diesel	0.14
Car medium	Petrol	0.18
Car medium	Diesel	0.17
Car large	Petrol	0.28
Car large	Diesel	0.21
Motorbike small	Petrol	0.08
Motorbike medium	Petrol	0.10
Motorbike large	Petrol	0.13

Table A5: Conversion factors for Staff Travel

Method of travel	Number of people travelling	Units of distance used	Conversion factor (kgCO ₂ e/unit)
Small Car	1	km	0.14
Medium Car	1	km	0.10
Large Car	1	km	0.13
Small Motorbike	1	km	0.08
Medium Motorbike	1	km	0.10
Large Motorbike	1	km	0.13
Taxi (car)	1	km	0.21
Local bus	1	passenger.km	0.11
Coach	1	passenger.km	0.03
National rail	1	passenger.km	0.15

Table A6: Conversion factors for Anaesthetic gases

Anaesthetic gas type	Bottle size (litres)/ Nitrous cylinder size	Total weight of nitrous oxide or volatile gas used (kg)	Conversion factor (kgCO ₂ e)
Nitrous oxide	1	1	265.00
Halothane/Fluothane	1	1	40.00
Isoflurane/AErrane	1	1	508.98

Table A7: Conversion factors for Refrigerant gases

Refrigerant gas used in chillers (report on gas used grouped by type)	Conversion factor (kgCO ₂ e/unit)
R410A	2088
HFC-32/R32 = difluoromethane	675

Table A8: Conversion factors for Waste disposal

Type of disposal	Conversion factor (kgCO ₂ e/kg)
Landfill	1.016
Recycled, composted, sold or animal feed	0.000
Incinerated: On-site in owned incinerator	0.898
Incinerated: Off-site in owned incinerator	0.898
Incinerated: Waste company incinerator	0.898

Table A9: Conversion factors for Inhalers

Device type	Estimated propellant weight per actuation (Total propellant weight divided by total actuations) (kgCO ₂ e/unit)
Salbutamol Propellant Inhaler (Metered Dose Inhaler)	0.038
Salbo HFA, Salbutamol Propellant Inhaler	0.103

Table A10: Conversion factors for Spend mapping and Procurement

No.	Cost code categories	kg CO ₂ per \$ derived from mapping to UK factor set
1	Anesthetic Gases	1.617
2	Building fuels, generator diesel, gas etc.	2.583
3	Animal and Animal Supplies	0.841
4	Cleaning Supplies	0.148
5	Dental supplies	1.617
6	Communication Accessories	0.597
7	Communication Equipment	0.603
8	Communication Supplies	0.305
9	Computer Hardware Maintenance	0.495
10	Computer S/W License & Rental	0.192

No.	Cost code categories	kg CO2 per \$ derived from mapping to UK factor set
11	Construction Materials	0.310
12	Electricity	2.387
13	Employee Apparel	0.264
14	Enteral Feeds	0.544
15	Facilities Maintenance Equipment	0.105
16	Fast Moving Consumer Goods	0.105
17	Food Supplies	0.370
18	Fuel and Lubricants	3.094
19	Furniture & Fixture	0.251
20	Gift shop supplies	0.470
21	Gas (Utility)	8.626
22	Household Equipment	0.645
23	Imaging Supplies	0.462
24	IT Accessories	0.495
25	IT Equipment	0.543
26	IT Supplies	0.616
27	Journals	0.132
28	Kitchen & Laundry Equipment	0.177
29	Laboratory Consumables, Chemicals & Supplies	1.617
30	Linen Supplies	0.905
31	Medical Equipment	1.617
32	Medical Surgical and Laboratory Equipment	1.617
33	Medical Surgical Supplies	1.617
34	Minor Equipment	0.116
35	MRO Supplies	0.321
36	Office Equipment	0.116
37	Office Refreshments TJS	0.257
38	Office Stationery Supplies	0.132

No.	Cost code categories	kg CO2 per \$ derived from mapping to UK factor set
39	Patient attire/bedding	0.570
40	Pharmaceuticals	1.617
41	Photography	0.535
42	Plant, HVAC, MEP Equip & Auxil	0.177
43	Published and Printed Material	0.132
44	Repair and Maintenance-Equipment	1.094
45	Safety & Fire Protection Supplies	0.177
46	Serving Items	1.113
47	Spares & Accessories-Equipment	0.321
48	Sports & Rehabilitation Equipment	1.523
49	Sports Goods	1.523
50	Staff Travel (by Air) International + Domestic	1.065
51	Surgical Instruments	1.617
52	Vehicles	0.144
53	Vehicles Fuel	2.583
54	Water	0.295
55	Vehicle Maintenance-Equipment, Insurance, Rent	0.842
56	Refrigerant gases for cooling systems	0.177
57	Buildings or land rent/lease	0.140
58	Other professional fees	0.315
59	Insurance	0.315
60	Bank fees	0.315
61	Construction Contracts (not materials)	0.310

Annex A

The TWG office order and attendance of participants in the consultation workshop

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
রোগতত্ত্ব, রোগ নিয়ন্ত্রণ ও গবেষণা ইনস্টিটিউট (আইডিভিসিআর)
মহাখালী, ঢাকা ১২১২।

টেলিফোনঃ ৮৮০২-২২২২৮০৩৭৬, ৮৮০২-২২২২৯৮৬৯১। ফ্যাক্সঃ ৮৮-০২২২২৮০৪৪০

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স্মারক নং-আইডিভিসিআর/ক্রাইমেট চেঞ্জ- জেফ প্রজেক্ট/২০২৩/ ৫৯৫ তারিখঃ ১৮/১০/২০২৩খ্রিঃ

অফিস আদেশ

বিশ্বব্যাঘ্র সংস্থা বাংলাদেশের কারিগরি সহায়তায় আইডিভিসিআর Building Resilience of Health System in Asian LDCs to Climate Change নামক প্রকল্প পরিচালনা করে আসছে। উক্ত প্রকল্পের আওতায় আইডিভিসিআর বিশ্বব্যাঘ্র সংস্থার সহযোগিতায় Carbon Footprint Assessment of the Healthcare Facility শীর্ষক গবেষণা কার্যক্রম বাংলাদেশের নয়টি নির্বাচিত হাসপাতালে পরিচালনা করবে। গবেষণার উদ্দেশ্য হলোঃ নির্বাচিত প্রাইমারী, সেকেন্ডারি ও টারশিয়ারি হাসপাতালসমূহের প্রত্যক্ষ ও পরোক্ষ গ্রিন হাউজ গ্যাস (GHG) নির্গমনের উৎস সমূহ সনাক্ত করা ও GHG নির্গমনের একটি তথ্য উপাত্তের বেইসলাইন তৈরি করা। যা ভবিষ্যতে বাংলাদেশের উপযুক্ত GHG নির্গমনের মিটিগেশন পরিকল্পনা প্রস্তুত ও টেকসই কম কার্বন নিঃসরণ স্বাস্থ্য ব্যবস্থা প্রতিষ্ঠাতে বিশেষ ভূমিকা রাখবে।

এমতাবস্থায় গবেষণা কার্যক্রম পরিচালনা ও প্রয়োজনীয় কারিগরি বিকনির্দেশনার নিমিত্তে নিম্নোক্ত সদস্যদের সমন্বয়ে একটি টেকনিক্যাল কমিটি গঠন করা হলো।

টেকনিক্যাল কমিটিঃ (জ্যেষ্ঠতার ভিত্তিতে নয়)

অধ্যাপক ডাঃ তাহমিনা শিরীন পরিচালক, আইডিভিসিআর	সভাপতি
ডাঃ মোঃ ওমর কাইয়ুম কিউরেটর, আইডিভিসিআর	সদস্য
ডাঃ নিগার সুলতানা ডিপিএম ৯, হসপিটাল সার্ভিস ম্যানেজমেন্ট, স্বাস্থ্য অধিদপ্তর	সদস্য
অধ্যাপক মোঃ যাকারিয়া পরিবেশ বিজ্ঞান ও ব্যবস্থাপনা বিভাগ, নর্থ সাউথ বিশ্ববিদ্যালয়	সদস্য
জনাব আহমেদুল কবির ন্যাশনাল কমস্যালট্যাট, বিশ্বব্যাঘ্র সংস্থা বাংলাদেশ	সদস্য
জনাব শামসুল গফুর মাহমুদ এনভায়রনমেন্টাল হেল্থ সায়েন্টিস্ট ও প্রাক্তন এনপিও-ওয়ার্ল্ড, বিশ্বব্যাঘ্র সংস্থা বাংলাদেশ	সদস্য
ডাঃ মোহাম্মদ ফেরদৌস রহমান সরকার এসএসও, আইডিভিসিআর	সদস্য সচিব

কমিটির সদস্যবৃন্দ প্রয়োজনীয় সভার মাধ্যমে গবেষণা কার্যক্রম পরিচালনা করবেন।

(অধ্যাপক ডাঃ তাহমিনা শিরীন, পিএইচডি)
পরিচালক
আইডিভিসিআর

স্মারক নং-আইডিভিসিআর/ক্রাইমেট চেঞ্জ- জেফ প্রজেক্ট/২০২৩/

তারিখঃ ১০/১০/২০২৩খ্রিঃ

অনুলিপি সদয় অবগতি ও প্রয়োজনীয় ব্যবস্থা গ্রহণের জন্য প্রেরণ করা হলোঃ (জ্যেষ্ঠতার ভিত্তিতে নয়)

১. মহাপরিচালক (স্বাস্থ্য সেবা), স্বাস্থ্য অধিদপ্তর, মহাখালী, ঢাকা (দৃষ্টি আকর্ষণঃ সহকারী পরিচালক, সমন্বয়)।

২. অতিরিক্ত মহাপরিচালক (প্রশাসন/পরিকল্পনা ও উন্নয়ন), স্বাস্থ্য অধিদপ্তর, মহাখালী, ঢাকা।

৩.।

৪.।

৫. ডা. মোঃ ফেরদৌস রহমান সরকার, উর্ধ্বতন বৈজ্ঞানিক কর্মকর্তা ও প্রোগ্রাম ম্যানেজার, Building Resilience of Health System in Asian LDCs to Climate Change, মহাখালী, ঢাকা।

৬. Dr. Ahammadul Kabir, NCCC, WHO Office, Bangladesh

৭. হিসাব রক্ষক, আইডিভিসিআর, মহাখালী, ঢাকা।

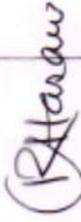
৮. অফিস কপি।

(অধ্যাপক ডাঃ তাহমিনা শিরীন, পিএইচডি)
পরিচালক
আইডিভিসিআর

Project
Carbon Footprint Assessment of Healthcare Facility

Venue: Institute of Epidemiology Disease Control & Research (IEDCR), DG Health Campus, Mohakhali, Dhaka-1212

Attendance

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Project

Carbon Footprint Assessment of Healthcare Facility

Venue: Institute of Epidemiology Disease Control & Research (IEDCR), DG Health Campus, Mohakhali, Dhaka-1212

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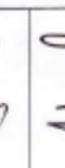
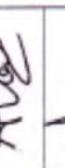
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Project

Carbon Footprint Assessment of Healthcare Facility

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