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CARBON NEUTRAL MALAPPURAM

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Abstract - – *The serious after effects due to rising carbon levels in the atmosphere paves way for the world nations to mitigate excess carbon production. So the project aims to propose sector-wise strategies to develop Malappuram district in Kerala state (study area) as a 'Carbon Neutral District ' by carrying out a carbon emission analysis in the Transportation sector, Energy sector, Waste sector, Agriculture Forest and other Land use sector (AFOLU), and the analysis of sequestration capacity of present vegetation. Carbon neutrality is the idea which points out a net-zero carbon emission.*

Key Words: **Carbon neutrality, sequestration capacity, carbon emission, net-zero carbon, transportation, energy, waste, AFOLU etc...**

1.INTRODUCTION

It is seen that the global average surface temperature has risen by 0.7degree Celsius in the last century. If this rate of global warming is endured, by 2030 there will be a tremendous increase in surface temperature. The emissions of greenhouse gases like carbon dioxide, nitrous oxide, methane and others have resulted in an increase of global temperature by around 1 degree Celsius.

The rise in global average temperature is attributed to the increase in greenhouse gas emissions. The Intergovernmental Panel on Climate Change (IPCC) has reported that 2.7degrees Fahrenheit could be reached in as little as 11 years and almost certainly within 20 years without major cuts in carbon dioxide emissions. Limiting the global warming to 1.5 degree Celsius compared with 2 degree Celsius would reduce the challenging impacts on ecosystems, human health, and well-being. Under the 2015 Paris agreement, it has been agreed by every country in the world that to keep the global temperature well below 3.6 degree Fahrenheit. The IPCC reports contributes the scientific input into the Paris agreement, which is aimed to strengthen the global response to threat of climate change by holding the increase in the global average temperature to well below two degree Celsius above pre industrial levels and to pursue efforts to limit temperature to 1.5 degree Celsius above pre industrial lands.

The concept of carbon neutral district puts forth the zero carbon, nature conservation, food and energy, self-sufficiency, economic well-being and development. Carbon dioxide occupies major share in greenhouse gases and it is acted as an equivalent indicator. Carbon neutrality is achieving net zero greenhouse gas emissions by balancing the measured amount of carbon released into atmosphere due to human activities with an equal amount sequestrated in carbon sinks.

It is not generally appreciated that the atmospheric temperature increases caused by rising carbon dioxide concentrations are not expected to decrease significantly even if carbon emissions were to completely breakoff. It is due to the human activities that the atmospheric concentrations of key greenhouse gases has increased. The objective of the United Nations Framework Convention on Climate Change (UNFCCC) is to achieve stabilization of Greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the ambience. The physical climate changes are due to the anthropogenic carbon dioxide which are already in the atmosphere today are expected to be largely inevitable. The human activities since the beginning of the Industrial Revolution (around 1750) have produced a 45% increase in the atmospheric concentration of carbon dioxide, from 280 ppm (1750) to 415 ppm (2019). The increase in CO_2 has occurred despite the uptake of more than a half of the emissions by various natural "sinks" involved in the carbon cycle. A large majority of anthropogenic carbon dioxide emissions come from fossil fuel combustion, principally coal, oil, and natural gas, with additional contributions coming from forest fires, deforestation, changes in land use, soil erosion and agriculture.

The transportation sector produces the largest share in the emission of greenhouse gases. These emissions from transportation primarily come from burning fossil fuel for vehicles such as cars, trucks, ships, aero planes etc...

Electricity production produces the second largest share in the emission of greenhouse gases. These emissions primarily come from burning fossil fuels for energy, as well as from certain chemical reactions. Emissions of greenhouse gases from businesses and homes arise primarily from fossil fuels which are burned for heat generation, the use of products that contain these gases, and the waste handling. Greenhouse gas emissions from agriculture come from livestock such as cattle, paddy cultivation etc... It is essential to restrict atmospheric concentrations of GHGs released from various human developmental and life style activities using biological or natural processes. It is recognized that addressing climate change is not as simple as switching to

renewable energy or offsetting GHG emissions. Preferably, to address the problem new development activities are to be introduced.

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1.1 Carbon Footprint and Carbon Credits

A carbon footprint is historically defined as the total emissions caused by an individual, event, organization, or product, which is expressed as carbon dioxide equivalent. The greenhouse gases (GHGs), which includes carbon dioxide, can be emitted through deforestation or land clearance and the production and consumption of food, fuels, manufactured goods.

In most cases, the total carbon footprint cannot be calculated exactly because of inadequate knowledge of and data about the complex interactions between contributing processes, including the natural processes that can store or release carbon dioxide. By keeping this in mind a definition can be stated for carbon footprint as, it is a measure of the total amount of carbon dioxide (CO_2) and methane (CH_4) emissions from a definite population, organization or activity, by considering all the relevant sources, sinks and storage within the boundary of the population, organization or activity of interest. It is calculated as carbon dioxide equivalent using the global warming potential (GWP100).

The concept name of the carbon footprint originates from ecological footprint, 1990s. This approach compares how much people demands compared to what the planet can produce. This helps to assess the number of ”earths” that is required if everyone on the planet consumes resources at an equal level as the person calculating their footprint. The carbon Footprint forms a part of the ecological footprint. Carbon footprints are more concentrated than ecological footprints as they measure the emissions of gases that can cause climate change into the atmosphere.

A carbon credit is a generic term for any tradable certificate or permit representing the right to emit one tonne of carbon dioxide or the equivalent amount of a different greenhouse gas (tCO_2e).

Carbon credits and carbon markets forms the component of national and international attempts to deminish the growth in concentrations of greenhouse gases (GHGs). One carbon credit is equal to one tonne of carbon dioxide, or carbon dioxide equivalent gases. Carbon trading forms an application of an emissions trading approach. Greenhouse gas emissions are found and then markets are used to assign the emissions among the group of regulated sources. The goal of carbon footprint and carbon credits is to allow the market systems to drive industrial and commercial processes for the low emissions or less carbon intensive approaches than those used when there is no cost to emitting carbon dioxide and other GHGs into the atmosphere. As the GHG mitigation projects generate credits, this can be used to finance carbon reduction schemes between trading partners and around the world.

1.2 Carbon Sequestration

The term “carbon sequestration” is used to characterize both natural and deliberate processes by which CO_2 is either removed from the atmosphere or diverted from emission sources and stored in the carbon sinks. This is termed as oceanic sequestration, terrestrial sequestration (vegetation, soils, and sediments), and geologic sequestration.

1.3 Main Objective

The project aims to propose sector wise strategies to develop Malappuram district in Kerala state as a carbon neutral district by carrying out a carbon emission analysis in the sectors of transportation, energy, and waste and sequestration capacity of present vegetation.

1.4 Specific Objective

1. To carry out a carbon emission analysis in the of transportation sector, energy sector, waste sector and agriculture and other land use sector.
2. To estimate the sequestration capacity of present vegetation in the study area.
3. To propose an action plan for the next 10 years to make the study area carbon neutral.

2. METHODOLOGY

This chapter explains the methodology used to the estimate total GHG emissions in CO_2 equivalents and carbon sequestration by different vegetation cover in the Malappuram District. Developing a detailed methodology for Malappuram was a challenging task since the study area covers a large variety of land use patterns.

2.1 Identification of Study Area

Kerala is very peculiar as it comes to geology and biodiversity. Even the district of Malappuram exhibits very distinctive characteristics at different parts. In this study, Malappuram district is selected as study area as it is the most populous district of Kerala, which is home to around 13% of the total population of the state.

2.2 Identification of Emission Factor

The initial step for a greenhouse gas inventory is to identify the categories for the inventory so that resources can be classified accordingly. Where an inventory already exists, the key categories can be identified from the recent estimates. For a new inventory, the compilers have two choices. Firstly, they can make a preliminary qualitative assessment based on local knowledge and expertise about large emission sources and inventories in countries with similar national circumstances. Or, secondly, they can make preliminary Tier 1 evaluation to assist in identifying key categories. For the current study the sectors identified for carbon emission analysis are

Transportation.

Energy.

Solid waste.

Agriculture, forestry and other land use.

Methodology used for calculating GHG emissions is based on the linear equation.

Total emissions = Activity data * Emission Factor

2.3 Data Collection

2.3.1 Transportation sector

The emission from the transportation sector was estimated based on both primary and secondary data on vehicles from motor vehicle department and previous reports. This sector is further sub divided into different modes of transportation based on the availability of data.

2.3.2 Energy sector

The emission from energy sector was measured based on primary data obtained from KSEB 110KV Substation. The total equivalent emission from energy sector is calculated as per IPCC guidelines. Estimating CO_2 emission from the use of electricity involves multiplying data on megawatt/hours (MWh) of electricity used by the emission factor (kg CO_2 /MWh) for electricity which will depend on the technology and type of fuel used to generate electricity. The total emissions were calculated and projected to 2032 using the growth factors provided in Economic review 2018, government of Kerala.

2.3.3 Solid waste sector

The total waste produced in an area depends on the population of the area. So the population of the district is projected to 2032 and the total waste generated is calculated by multiplying it with the per capita rate of waste generation. Emission factors for volume of waste generated is also calculated and the carbon equivalency is estimated as per the standards.

2.4 Estimating the Sequestered Carbon

Methodology used for estimating the carbon sequestrated is based on the linear equation.

Total sequestration = Sector Data ∗ Sequestration Factor

In order to calculate region-specific carbon sequestration it is important to find the type and number of each tree which is found locally. Therefore, a general survey was conducted in the agricultural office and approximate area and type of species were found out. To account for sequestration from other places, areas which may work as a carbon sink were chosen randomly.

Total carbon was estimated for trees in the forests and plantations within the study area. On an assumption that the same rate of sequestration will be prevailed for the next ten years, the sequestered carbon in 2032 is estimated.

2.4 Assessing the Carbon Data and Recommendations

The total carbon emission obtained from different sectors and total sequestration are projected to 2032. This gives us a clear picture on excess carbon that must be catered. Knowing the sequestration rate of various tree species, it is possible to put forward a planned vegetation which can account for the excess carbon, a major outcome of this project.

3. EMISSIONS FROM DIFFERENT SECTORS

The emissions from different sectors such as transportation, energy, waste, and agriculture and other land use were calculated under different assumptions, data collected from different government sectors and from previous surveys.

Table 1: Total Emissions from Different Sectors

Sectors	Emissions in CO_2 Eq tonnes
Transportation	75,34,864.001
Energy	1,01,859.1119
Waste	1,208.47498
Agriculture and other land use	1,88,141.2426
Total	78,26,072.838

4. CARBON SEQUESTRATION

The total carbon sequestered is calculated by considering the present vegetation and soil characteristics. Due to inadequate availability of data we considered the present vegetation in terms of total forest area and

calculated the sequestration capacity accordingly. The sequestration capacity of soil is calculated by considering the average organic carbon content in the soil. And thus the total carbon sequestration capacity of Malappuram district is shown in the below table.

Table 2: Total Carbon Sequestered

Sector	Sequestration in CO_2 Eq tonnes
Soil	39,114.12663
Forest	1,90,287.28
Total	2,29,401.4066

5. RESULTS AND RECOMMENDATIONS

The carbon emissions and sequestration is then balanced to find out the excess carbon. And this excess carbon is to be removed in the upcoming years to attain carbon neutrality. This can be achieved by adopting different measures. The excess carbon formed is given in the table below.

Table 3: Carbon Balance

Total emissions from different sectors	Total Sequestration capacity
78,26,072.838	2,29,401.4066
Excess of CO_2 Eq	**75,96,671.431**

5.1 Recommendations

Planting trees with good sequestration capacity is highly recommended. Apart from that, various measures are to be taken to reduce the emissions from the source. Along with the steps mentioned to cater the deficit carbon, proper awareness programs like campaigns, seminars and workshops can be conducted in school levels and on community basis.

Public transits like Metro is recommended so that the commercial spaces are set in its premises thus reducing the personal trips. Provide bicycle tracks in order to promote cycling. Roads also must be maintained good for efficient fuel usage. Public transportation can reduce the need for many separate personal trips by private vehicles in dense urban areas, replacing many separate emissions from personal trips. E-vehicles can reduce carbon emissions (however they are accountable for the emissions caused while charging, which is negotiable). Promote the use of vehicles with fuel efficient engines will considerable reduce the emissions form vehicles.

Use lights like LED which are energy efficient. They can reduce electricity consumptions Replace old appliances with energy efficient ones. Because the old appliances consume more power to operate. Majority of the new appliances are energy efficient. Promote the use of sustainable energy sources.

Having a planned waste disposal scheme will reduce the emissions from open dumping of waste. The city needs a proper town planning considering the land use patterns in order for an efficient waste management.

In order to maintain the carbon neutrality of the study area, measures has to be taken as given above. It is to be noted that if the carbon emissions increase and sufficient sequestration is not available, the rate of rise in temperature would be go beyond control. This very idea shows the importance of having a quick and efficient mean demanded from us to cut no more trees and to plant a lot more trees. The need for the reduction of the emissions from source is also very important.

6. CONCLUSION

This chapter is the conclusion to the project which includes findings and summing up of all the works done and future scope of this project. Due to inadequate availability of data on no. of vehicles from government sectors, it was done purely based on recent surveys. There were many limitations as this project considers an entire district. We tried our best to keep the sources genuine and latest.

6.1 Findings

1. Carbon emissions in the sectors of transportation, energy and solid wastes were studied. The results gave good insights on the need of a sustainable approach to keep the city carbon neutral.

2. Transportation sector contributes the most to the total carbon emissions (75, 34,864.001 tCO_2e (projected emission)). We were not able to obtain sufficient data from RTO office so we took the data regarding no. of vehicles and the average distance travelled by each category of vehicles from recent surveys. Adequate measures to reduce their rate must be taken.

3. The consumption of electricity in Malappuram district is taken from KSEB Manjeri and Malappuram substation. By comparing with transportation sector emissions from energy sector is less.

4. Emissions from waste sector was purely based on calculation using exponential growth formula.

5. Data on Agriculture, forestry and other land use were taken from agricultural office Malappuram.

No. of cattles, buffaloes and goats and area of paddy fields were considered in this sector.

6. The sequestration capacity of existing vegetation has to be maintained and new trees must be planted. There can be sudden fall in those rates if a massive deforestation is made. Man- made forests and vegetation alone can keep the city carbon neutral.

7. Planting more trees with appreciable rate of sequestration is also a good solution to the rising carbon emissions as they are listed in the above chapters.

6.2 Future Scope

There can be variations in both emission and sequestration sectors. Timely inventory and monitoring can really help in keeping the city carbon neutral. There are other unaccounted emissions and sequestrations. Future study considering those areas has a real scope and can make skill full environmental engineers.

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