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DETERMINING THE SEQUESTRATION POTENTIAL OF HOME-GROWN VEGETATION WITHIN AN URBAN RESIDENTIAL PLOT

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ABSTRACT

Urban Households – the buildings with their inhabitants are one of the major sources of carbon emission leading to climate change. There is an urgent need to mitigate this problem. Initiatives generally followed are restricting energy use and reducing energy-intensive activities and materials. However, the best way of mitigating CO2 emitted by the building is to sequester it through plants grown inside the premises. This paper intends to study the scope of sequestration of CO2 by plantation grown within the plot of a multi-storied and multi-tenement residential buildings in the urban area of Newtown, beside Kolkata, in India, in comparison to quantity of CO2 emitted from the operation phase of the building's life cycle. The aim of the study is to find how much of the CO2 emitted by the building can be sequestered by growing plants inside the same plot of the building. CO2 emission is quantified from activities like – electricity usage, fuel (LPG) for cooking, fuel (Petrol) usage for vehicle idling time inside the building premises, respiration and potable water production and the total emission is compared to scope of sequestration by plantation inside the plot. Quantitative analysis of CO2 emitted by a multi-tenement multi-storied residential building and CO2 sequestered by plantation grown within the premises show that plantation in only 4% of the plot area, as per stipulation by local municipal authority, can sequester only 4% of the CO2 emitted by the building. However, assuming a scenario with increased plantation, which is practical and achievable, this proportion of sequestration can be increased to as high as 40%.

Keywords: Household Carbon Footprint, CO2 Emission, Urban Residential Buildings, Climate Change, Carbon Sequestration, Home Garden

1. INTRODUCTION

Urbanization: Over the last few decades, the world has seen phenomenal increase in urbanization. Since 2010, total global building constructed area has seen a magnum growth of over 31% and in 2024 this figure is reaching about 250 billion square meters globally, out of which residential sector constitutes approximately 80% United Nations Environmental Programme. (2024). In India this urbanization has been primarily propelled by the economic growth due to focus on economic liberalization, reforms in financial sector and the process of decentralization since the 1990s Sadashivam & Thakur (2016). Percentagewise, in 1950, 17.09% of the total population in India were living in urban areas, which increased to 34.9% in 2020 and is projected to be 52.8 % in 2050 Nations (2018). Kolkata, the location for this research work, is also looking at a population growth of 7329000 in 1970 to 17584000 in 2030 and it will remain amongst the most densely populated urban agglomerates of the world in near future. Nations (2018).

GHGs & building sector: The major concern of today's world is that of Green House Gases or GHGs, which are emitted primarily because of excessive energy consumption. International Energy Agency (IEA) says 60% of the world's energy is consumed by urbanized areas and more than 70% of the world's carbon emissions are caused by them Fei Zheng (2023). The building sector is found to be one of the biggest consumers of energy and emitter of GHG gases. Worldwide energy demand scenario shows that the building sector energy demand has grown by over one per cent annually between 2010 and 2022 United Nations Environmental Programme. (2024).

Mitigation efforts in residential building sector: Excessive GHG emission is causing extreme climate change events and has become a thing of concern to the world. The 'Paris Agreement' adopted within the United Nations Framework Convention on Climate Change (UNFCC), asks all the participating countries to limit global average temperature rise this century to well below 2 Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 Celsius United Nations. (2015). Considering emission from buildings, various ways of mitigating CO2 emission have been identified - like restricting energy use and reducing energy-intensive activities and materials, shifting to electric vehicles (EV) because that is the only way to stop burning automobile fuel Champions et al. (2023), choosing alternative cooking fuel as cooking involves good amount of emission Gould & Urpelainen (2018), Lim et al. (2012), searching for technological development in urban Potable Water Production (PWP) Gui et al. (2024), Akash & Choudhury (2024), Biswajit (2020), Biswajit (2020), Gui et al. (2024).

Carbon Dioxide (CO2) constitutes an important part of anthropogenic GHG – accounting for approximately 77% of the global total CO2 equivalent GHG emission Ramachandra & Bharath (2015), Change (2008). On the other hand, considering building life cycle theory the maximum emission comes from the 'Operation Stage' – ranging from approximately 70 to 85% of the total lifecycle emission. Yan & Chen (2018), Adalberth (2000), Mei Shang (2021), Ramesh et al. (2012), Fei Zheng (2023). Hence the need for mitigation of CO2 emission from building operation phase becomes of utmost importance.

The elevated carbon dioxide (CO2) concentration in the atmosphere can be reduced by storing carbon or CO2 in any other medium. By carbon sequestration this carbon from the atmosphere can be removed and stored in biological or geological mediums Kumar (2006). Plants being the only source of carbon sequestration, can be given some importance in the building development so that it can sequester, if not the whole, a part of the CO2 that the building emits. This paper makes comparative study of CO2 emitted by the building in operation phase and CO2 sequestered by plants grown within the campus. Home gardens Kumar (2006) and indoor plants Torpy et al. (2014), beside contributing to the exterior and interior visual aesthetics of residential houses, also play a very important role in purification of the indoor air quality as well as the air quality of the premises and the air-quality of the world at a bigger scale. This sequestration of CO2 by home-garden and indoor plants, however small it's contribution may be, can act as a mechanism of CO2 reduction at source.

This paper intends to undertake a comparative study of CO2 emitted by the residential building in the operation stage and CO2 sequestered by plants grown in the premises of the building. The objective of the study is to propose a system for the urban administrators, town and urban planners, architects and designers and also the urban dwellers to follow, which will contribute, to whatever extent, towards mitigation of emission through plantation grown within the plot of the building. Existing building standards, rules and regulations in terms of open green areas and vegetation and plantation inside the plot need a serious overhaul and proper study for the benefit of the future.

2. BACKGROUND

Research Field and Boundaries: With the intention of doing a study that will be more precise and keeping several limitations in mind, the research boundaries are set as - 1) it studies buildings in urban agglomerates only, 2) it studies only residential buildings, 3) it assesses only the 'operation phase' of the building, 4) the character of the buildings this research focuses on are only multi-storied and multi-tenanted, 5) this paper studies emission of only Carbon Dioxide (CO2)

Research gap – Existing research papers have mostly tried to reduce the CO2 emission from buildings by working on alternate materials for building construction, finding more sustainable materials with low embodied energy or materials that effectively reduce energy consumption during operation stage by reducing heat consumption or by intervention at the design planning stage taking climatological factors into consideration for effective control of heat or light or ventilation. But sadly, we have never thanked the plants properly and made serious studies of their capabilities and contribution. Its high time we give some good research effort to do the same. Considering this fact, this research finds itself in the midst of a sea of scope to contribute to our goal of mitigation of emission control.

Study Area - Newtown (Rajarhat-NewTown), the planned satellite city of Kolkata City in the Indian state of West Bengal Figure 1 is chosen as the site for this study. It is adjacent to Kolkata & Bidhan Nagar (also known as Saltlake) - the other planned satellite city of Kolkata. The Kolkata City, Bidhan Nagar and Newtown all are included in Kolkata Metropolitan Area. Started in 1990, Newtown is administered by NKDA (NewTown Kolkata Development Authority). Geographically the area of Kolkata, Bidhan Nagar and Newtown sits on the lower Gangetic Delta of eastern India. Latitude and longitude of Newtown are precisely 22.64° North and 88.48° East respectively, with an average elevation varying from approximately 3.0 meters to 10.0 meters. Kolkata is an old unplanned city, developing since the 17th century whereas Bidhan Nagar and Newtown are new planned cities, construction of Bidhan Nagar starting in 1962 and Newtown starting in late 1990s. This research paper selects Newtown as the site of research study as it has strong scope of development in the urban and housing sector with proper sustainability approach Table 1.

Figure 1

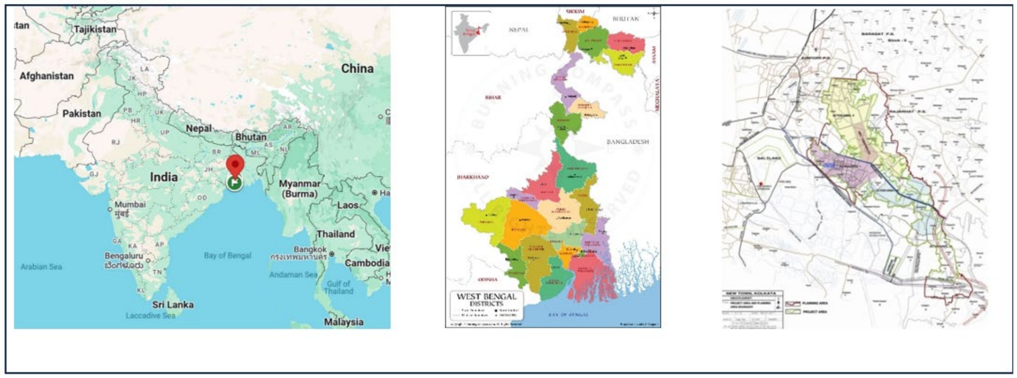

Figure 1 Map of Kolkata, Bidhan Nagar and Newtown

Source Google Maps / NewTown Development Authority, West Bengal

Table 1

Table 1 Status of Development in Different Sectors of New Town

Location	Action area-I	Action area-II	Action area-III	CBD
Area in hectares	677	1310	783	183
Progress of infrastructure development	All most complete	More than 50% work completed	Work in progress	Work in progress

Source Biswas & Das (2017).

- **Pollution control guidelines and rules:** The "Ministry of Urban Development (MoUD)" launched the "Atal Mission for Rejuvenation and Transformation (AMRUT)" in 2015. The Department of Municipal Affairs, Government of West Bengal, which administers the Newtown area, launched the AMRUT in 2016. In an effort to lower emissions and other pollutants, the government of West Bengal and India has taken aggressive measures to enhance the amount of green space in urban areas. The authority has laid down various rules and regulations of which the following are quite relevant to our present study –
    1) To reach a green cover of 15% in the urban areas by 5 yrs from its inception
    2) To make mandatory rules for all new housing schemes to have 15% green cover – this provision is to be considered during the time of sanction from urban local bodies.
    3) To encourage the involvement of citizens, communities, and private sectors in the creation and maintenance of urban green space
    4) To carry out tree census periodically
    5) To make obligatory the role of citizens to support tree preservation and to encourage plantation through incentives.
    6) To create nurseries to support plantation
    7) Terrace garden to be permitted to improve green space
    8) Attempt to be made to cover every building with tree lines around it

The Newtown Kolkata Development Authority (NKDA) building rule suggests building owners of plots less than 1500 sqm. to leave 4% area of the site as open green space as a step to counter carbon footprint.

3. LITERATURE REVIEW

It is provoking that not much research and investigation has been conducted on sequestration by plant species in tropical areas Toochi (2018). Some research work has been done considering Indian local trees, forestry, and agricultural lands. However, there is almost no literature on sequestration by urban home gardens or indoor gardens. The analysis faces significant challenges due to the absence of reliable inventories and inconsistencies in estimating the carbon sequestration capacity of residential gardens. Kumar (2006). There is definitely a huge research gap in this field of carbon sequestration by local (West Bengal) urban home-grown small-size plants. Carbon Sequestration, as per all papers, totally depends on number of plants, volume or leaf area, the weight of plants, or physical conditions like water supply and light availability. With almost no relevant information on Carbon sequestration rates of small-size local plants, it becomes prudent enough to fall back on one or two research papers that are more appropriate and applicable considering all parameters. Out of all research papers studied, the papers by Torpi et al. Torpy et al. (2014)studying carbon sequestration by indoor plants is worth mentioning as it is the only paper that, though based on foreign conditions, gives us information about indoor plants and also small plants. The author specifies that is very difficult to assess the rate of sequestration by plants as it depends upon the species type, physical conditions inside the house, and most importantly the lighting conditions. However keeping aside the foreign conditions of the research study, dealing with mostly different species of trees not appropriate to tropical conditions, this research work still draws the sequestration rate factor for quantification of CO2 consumed by indoor plants based on this paper Torpy et al. (2014) only. The paper mentions that sequestration rate for indoor plants ranges from 47.9 mgCO2/plant/hr to 168 mgCO2/plant/hr, depending upon varying light conditions and different species. To deal with this huge range, this paper considers an average of this range, i.e. 107.95 mgCO2/plant/hr = 0.001 TonneCO2/plant/year (average of47.9 mg CO2/plant/hr and 168 mg CO2/plant/hr) as the sequestration rate for any indoor plant. The other research paper where from analytical information can be used for this research work is the paper by CRISIL CRISIL Foundation. (2021)). This research, though not dealing with entirely small home-grown plants, was based on entirely outdoor trees and plants in urban Indian context. There is information on small and mid-size outdoor trees and plants that are of Indian origin and are grown in urban areas with tropical hot and humid climates. A reference guideline for quantification of CO2 sequestration by plants in Indian urban scenario can be drawn from CRISIL research work. The findings of the research work can be analysed to deduce the average CO2 sequestration by plants in Indian urban context as 8646.29 MT CO2 by 33,368 trees over a span of 15 years or 0.019 TonneCO2/per plant/year. Information from existing literature studies that is found to be useful for CO2sequestration quantification in this research work are presented in Table 2

Table 2

Table 2 Sequestration Information Obtained from Literature Review

CO2 Sequestration rate	Source	Rate/ coefficient/factor
CO2 Sequestration rate by indoor plants	Torpy et al. (2014)	0.001 Tonne CO2/plant/year

CO_2 Sequestration rate by plants (as per leaf area)	Torpy et al. (2014)	is 657mg CO_2/m2 leaf area/ hr,
5 sqm. of green wall contains	Torpy et al. (2014)	57 sqm. of leaf area
CO_2 sequestered by outdoor plants and small trees	CRISIL Foundation. (2021)	0.019 Tonn CO_2e/per plant/year

4. METHODOLOGY

4.1. METHODOLOGY FOR QUANTIFICATION OF SEQUESTRATION

The methodology adopted for quantification of total amount of CO_2 that can be sequestered by plants inside the premises of a multi-storied multi-tenement urban residential building has been based completely on inputs from existing research studies. The plants that can be found inside the premises is divided into two groups – 1) out-door plants that can be grown in the open spaces around the building and terraces and 2) indoor plants that can be grown inside the building that is inside the flat areas or common areas, including window ledges. For calculation of CO_2 sequestration by outdoor small and medium ranged plants, data from CRISIL ((CERE)) experiments were adhered to – '33,368 trees and plants will sequester 8646.29 MT CO_2 over a span of 15 years', which gives an average rate of 0.017 MT CO_2/plant/year = 0.019 TonneCO_2/plant/year. For calculation of sequestration rate of indoor plants, data from research work of Profiling indoor plants for the amelioration of high CO_2 concentrations by F.R. Torpy, P. Irga, M.D. Burchett (F.R., P, & M.D.) were used - CO_2 sequestration level ranged from 47.9 to 168 mg CO_2/plant/hr for indoor plants, which means an average rate of 107.95 mg CO_2/plant/hr = 945642 mgCO_2/plant/year = 0.945 KgCO_2/plant/year = 0.001 TonneCO_2/plant/year.

Green walls becoming popular these days, the scope of sequestration of CO_2 by green walls was also considered. For this quantification, data from Profiling indoor plants for the amelioration of high CO_2 concentrations F.R. Torpy, P. Irga, M.D. Burchett F.R. et al. (2014) was used. This research paper gives two very useful information regarding plant growth and sequestration of CO_2 by green walls – 1) 5m2 of green wall contains - 57m2 of leaf area and 2) highest sequestration rate is 657 mgCO_2/m2 leaf area/ hr. This paper considers the first information as it is placed by the authors F.R. Torpy, P. Irga, M.D. Burchett - 5m2 of green wall contains - 57m2 of leaf area or 1sqm of green wall have 11.4 sqm of leaf area. However, the second information says that this is the highest rate of sequestration by plants. So, for a more reasonable research work, a much lesser value of 460 mgCO_2/m2 leaf area/hr (70% of the actual value) = 0.004 TonneCO_2/ m2/ year is considered as the average rate of sequestration by green walls.

The number of plants that can be grown in a residential premises, inside the building or outside, is very difficult to ascertain. General reconnaissance survey and literature study showed that there is a general apathy towards growing trees and plants inside the premises in urban India and in Kolkata. Reasons are numerous - like maintenance problems, damp and leakage problems in roof slabs when plants are grown in the terrace, mosquito and pest problems, lack of enthusiasm and support to take the responsibility of maintenance of plants, etc. With this scenario prevailing, this research paper considers two scenarios –

1) **Scenario 1:** In scenario 1, it is assumed that the residential building restricts plantation area to only what is mandatory as per the NKDA municipal rules. So the plantation area is only 4% of the plot area, which

is the minimum open to sky and not paved so called 'green area' requirement as a municipal rule.

2) **Scenario 2:** In scenario 2, it is assumed that the plot has an enhanced plantation area, which comprises of the same 4% of the plot area as green space (open to sky and not paved) as per municipal rules and some more plantation in the paved or unpaved covered areas in the plot around the building and also some terrace garden. There is also some green vertical walls which can be accommodated anywhere in the open areas around the building or in the terrace along stair-head room or overhead reservoir. Added to these, there are indoor plants in individual flats or common areas like stairs or lift lobby.

CO2 sequestration scope was calculated for both scenarios and compared to the total CO2 emission by the building during its operation stage.

5. SAMPLE SURVEY

For sample survey a whole building, in Newtown, was chosen. The plot area 271.73 sqm. The ground covered area is 149.446 sqm. which is approximately 55% of the plot area, which is as per NKDA building rules the maximum ground coverage for residential plots less than 1500 sqm. The ground open space is 122.284 sq, which is about 45% of the plot area. Green open spaces (not paved) was introduced by NKDA to improve environmental aspects of urban areas like storm water management, heat-island, greeneries, etc. It is fixed at minimum 4% of the plot area. The green open space in this plot is 10.88 sqm, which is exactly the minimum area required (4%). The plot area, ground coverage, open spaces and other dimensions of open spaces of the plot like front open space, rear open space and side open spaces are mentioned in the Table 3 The front open space is 2.0 m, rear open space is 2.10 m, the side open spaces are 2.470 m and 1.3 m. Table 3 and Figure 2

Table 3

Table 3 Particulars of Whole Building Studied in Newtown

	Areas & Dimensions			**As per stipulated NKDA Building Rules**
	Measurements as per site		**% coverage as per Site**	
	Quantity	Units		
Plot Area	271.73	sqm		
Covered Area	149.446	sqm	55.00%	Maximum Ground Coverage for Residential Plots below 1500 sqm= 55%
Open Area	122.284	sqm	45.00%	45%
Green Area	10.88	sqm	4.00%	4%
Open Paved Area	111.404	sqm	41.00%	No Rules
Front Open Space	2.000	meters		1.2 M for residential buildings up to 15.1 m height
Rear Open Space	2.100	meters		2.0 M for Residential Plots upto 300 sqm and building height 15.1 M
Side Open Space (1)	2.470	meters		0.8 meters for plot area less that 300 sqm and building height less that 15.1 meters

Side Open Space(2)	1.300	meters	2.4 meters building height less that 15.1 meters

Figure 2

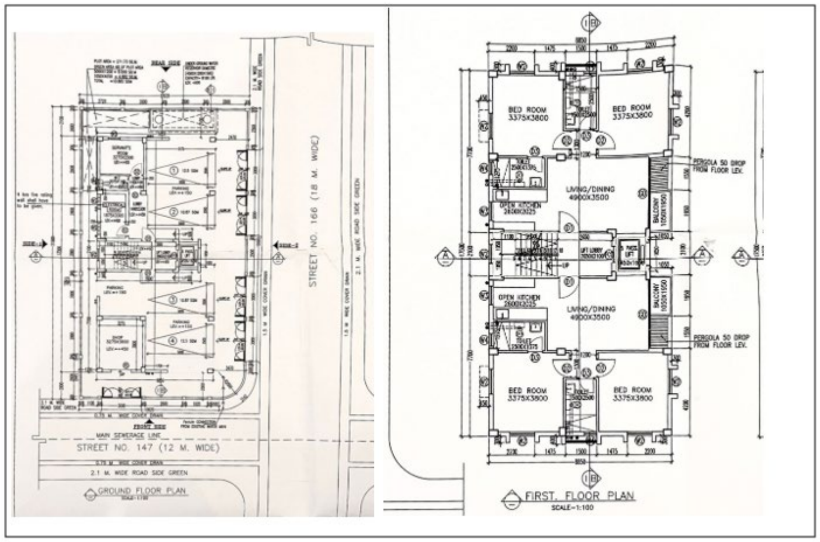

Figure 2 Ground Floor Plan & Typical Plan for 1st, 2nd and 3rd Floors

6. ANALYSIS AND RESULTS

Quantification results of CO2 emission: For quantification of CO2 emission from a urban multistoried multi-tenement residential building, first various causes or sources of CO2 emission were studied. This process was totally based on existing research papers. The activities or sources of CO2 emission identified by this paper are as follows - 1) Electricity consumption, 2) fuel consumption for cooking, 3) fuel consumption for vehicles, 4) respiration, 5) potable water consumption. Electricity is consumed by residents of all residential buildings. This source does not have any emission impact in the vicinity of the building, i.e. CO2 is not emitted inside the premises or from the building. However, all the emissions take place at the generation plant. Since the building consumes the energy, it is solely responsible for the 'indirect emission' that is taking place at another place. So, electricity is considered as a form of indirect energy and is taken into account for study of CO2 emission from buildings. CO2 emission from respiration by human beings and pets of a urban residential building has not been considered by most of the existing research papers- considering CO2 emitted from respiration as a part of natural CO2 cycle where Carbon Dioxide gets converted into carbohydrate by plants by the process of photosynthesis, that carbohydrate after being consumed by human beings liberated into the atmosphere as free CO2 by the process of metabolism and again that CO2 is consumed by the plant by the process of photosynthesis. However, this research paper takes into account CO2 from respiration as a part of emission as it is also considering CO2 sequestration by plants grown in the premises of the residential buildings. Cooking is one activity that is an intrinsic part of human life and something where use of energy is essential. It involves burning fuel like LPG, natural gas, fire wood, etc. or use of electricity. According to the fifth National Family Survey 2019-2021 (NFHS-5) Ministry of Health and Family Welfare, Government of India. (2021) carried out by the Ministry of Health and Family Welfare, 89.7 percent of Urban Household use clean fuel for cooking. Sample survey undertaken in this research study showed that today almost all urban residential household in multi-storied and multi-tenement buildings use LPG as the only option for cooking fuel. This research paper, citing this reason, identifies LPG as the only source of CO2 emission from cooking fuel in an urban multi-storied and multi-tenement residential building in the operation phase and ignores all other fuel for cooking. Vehicles are definitely a source of urban CO2 emission. This research paper, in it's study of emission from only urban multi-storied and multi-tenement residential building in it's operation phase, does not consider emission due to movement of vehicles outside the premises of the building, but concentrates solely on movement inside the premises. Since diesel as a fuel for vehicles is in the process of being banned in India, it is also not considered for study. Only petrol as a fuel for vehicles is studied by this research paper. General studies and also sample survey proved that residents hardly own or keep vehicles other than 2 wheelers (motorcycles) and four wheelers (cars). This paper, hence, studies only 2 wheelers (motorcycles) and four wheelers (cars) which are parked inside the premises. This research paper identifies idling time of vehicles, two wheelers (motorcycles) and four wheelers (cars), and with petrol as fuel and movement only inside the premises as the source of emission of CO2 in a urban multi-storied and multi-tenement residential building in the operation phase. Use of potable water is indispensable in an urban life and considering high-quality potable water distribution in an urban area, huge amount of energy is spent on abstraction and treatment, distribution, consumption, and waste-water treatment. This research paper identifies Potable Water Distribution (PWP) as a source when considering CO2 emission from urban multi-storied and multi-tenement residential buildings.

The quantification process was based on Sample Survey and application of most relevant consumption coefficients and emission factors. Survey data from the multi-storied, multi-tenement whole building in Newtown, mentioned previously, were tabulated the total emission from building came to 14.404 TonneCO2/annum. This paper considered all flats (6 nos.) and all common areas of the building. The total emission from electricity was 6.080 TonneCO2/annum, 4.525 TonneCO2/annum from respiration, 1.738 TonneCO2/annum from cooking fuel, 1.183 from water consumption and 0.879 TonneCO2/annum from fuel consumption due to automobile idling time. The percentage distribution of emission from different sources were approximately 42.21 % from electricity, 31.42% from respiration, 12.07% from cooking fuel, 8.21% from water consumption and 6.10% from automobile idling time fuel consumption.

6.1. ANALYSIS FOR CO2 EMISSION – SEQUESTRATION BALANCE

Primary objective of this research paper being quantification of CO2 CO2 emission during operation stage of a multi-storied multi-tenement urban residential building and the sequestration potential of plants grown inside the premises, there arises the need to compare the CO2 emitted by such a building and the CO2 that can be sequestered by plants inside the premises. For this study the multi-storied multi-tenement urban residential building surveyed and analysed in this paper is taken for consideration. The total CO2 emission from this residential building (considering the whole building with six number flats and common areas), as quantified previously, is 14.182 TonneCO2/annum. This plot has an area of 271.182 sqm. Out of this, the covered area (covered by building) is 149.446 sqm. (55% of plot area) and the open area (open to sky) is 122.284 sqm. (45%). Terrace area is 149.446 sqm. Green open area not paved is 10.88 sqm. (4% of plot area as per building rules). The side open spaces are 2.47 m and 1.3 m and the front open space and rear open spaces are 2.0 m and 2.1 m respectively.

Quantification of sequestration considering plants in only 4% green space for plants as per existing building rules: Considering there is only 10.88 sqm. green area (minimum 4% of plot area as per NKDA building rules), and there are only mid-size plants, each on an average covering 0.6m x 0.6 m = 0.36 sqm approximately, there can be approximately 30 number such plants in the site. Considering them as outdoor plants with CO2 sequestration rate as 0.019 TonneCO2/plant/year, the annual total CO2 sequestration from the building comes to 0.57 TonneCO2/annum. Considering that there are no other plants in the site, this quantity of CO2 sequestered when compared to the total annual CO2 emitted by the building (14.182 TonneCO2/annum) becomes too negligible. The amount of CO2 sequestered by plants grown inside the site comes to only 4% of the total annual CO2 emission.

Quantification of sequestration considering an ideal, favourable and practical condition

Reconnaissance survey in Kolkata and Newtown showed that there are many multi-storied multi-tenement urban residential buildings where there are, other than love for plants, a higher degree of awareness and appreciation for benefits of keeping plants inside the site. There are many premises which grow plants and trees more than what is typically prescribed by the law. As a hypothetical case this paper considers the same plot, being studied in Newtown, with increased number of plants than what can be accommodated in the minimum 4% area allotted for green space. Assuming a scenario which is achievable and practical, the paper considers –

1) 30 mid-size outdoor plants each on an average covering 0.6m x 0.6 m = 0.36 sqm approximately grown in this area of 10.88 sqm (mandatory green space as per municipal rules - 4% of plot area)
2) 50 more mid-size outdoor plants, potted, placed in open spaces (paved or unpaved) around the building
3) 100 mid-size outdoor plants, potted and grown in the terrace of the building, which is eaqual to … sqm. As per this calculation green area is covering ..% of the terrace area.
4) A green wall area of 50 sqm anywhere in the plot (boundary walls, attic room, lift machine room, over-head water tanks, etc.)
5) 90 number indoor plants (15 number plants in each of the 6 flats)

Considering this scenario, the quantification of CO2 sequestration is as follows –

1) CO2 sequestration from 30 + 50 = 80 mid-size outdoor plants

= 80 x 0.019 TonneCO2/plant/year

= 1.52 TonneCO2/annum

2) CO2 sequestration by 100 number plants at terrace

= 100 x 0.019 TonneCO2/plant/year

= 1.9 TonneCO2/annum

50 sqm of green wall = 50 x 11.4 sqm of leaf area

= 570 sqm of leaf area

3) CO2 sequestration by 50 sqm of green wall

= 570 sqm x 0.004 TonneC02/ sqm of leaf area/year

= 2.28 Tonne CO2/year needs checking

4) CO_2 sequestration by 90 number indoor plants are

= 90 x 0.001 TonneCO_2/year

= 0.09 Tonne/year

Total CO_2 sequestration = (1.52 + 1.9 + 2.28 + 0.09) TonneCO_2/annum

= 5.79 TonneCO_2/annum

With the assumptions and calculations mentioned above, the total CO_2 sequestration by plantation inside the building premises surveyed and studied in Newtown, comes to 5.79 TonneCO_2/annum. Considering the total CO_2 emission from this building is 14.182 TonneCO_2/annum, a sequestration of 5.79 TonneCO_2/annum or approximately 40.83% is plausible and can be achieved.

7. CONCLUSION

With respect to emissions and Climate Change scenario at present in the world, the future is generally depicted as a matter of tremendous concern and calls for responsible response from everyone in this society. Urban buildings, taken collectively, being one of the biggest contributors of this emission, the urban residents, along with planners, architects, designers, policy makers and also researchers need to whole-heartedly contribute to this process of mitigation. The building must do something to bring about a change in emission scenario – it must show some responsibility. The urban residential building must reduce CO_2 mission to the maximum extent and plantation within the premises should be encouraged to the maximum. There should be an all-out effort to maintain balance between CO_2 emitted by the building and CO_2 absorbed by plants grown inside the premises. The mandatory green open space of 4% as stipulated by the municipal authority (NKDA) of Newtown is not good enough - it can only sequester about 4% of the CO_2 being emitted by the building in the same plot. In this situation and increased number of plantation involving green open space not paved or paved, terrace garden, indoor plants and vertical gardens are to be encouraged. Calculation in this paper show that with an enhanced plantation scenario a sequestration as much as 40% of the total CO_2 emitted by the building can be achieved.

CONFLICT OF INTERESTS

None.

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None.

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