Remittances Review
August 2024,
Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)
Received: 07 July 2024, Accepted: 20 July 2024
DOI: https://doi.org/10.33282/rr.vx9i4.5

Comparing Carbon Emission of Planned and Unplanned Areas of Lahore

Rummana Khan sherwani[1*], Dr Abdul Waheed[2], Faiqa Khan[3], Ammar Iqbal[4], Sardar Safeer Sarwer[5]

1. *PhD Scholar, SCEE, Urban and Regional Planning department, National University of Sciences and technology, Assistant professor, University of Management and Technology, Lahore rummanakhan@nit.nust.edu.pk,*
2. *Associate professor, SCEE, Urban and Regional planning department, National University of Sciences and technology, Pakistan drwaheed@nit.nust.edu.pk.*
3. *Lecturer, Department of Architecture and Planning, University of Management and Technology, Lahore, Punjab, Pakistan faiqa.khan@umt.edu.pk,*
4. *Assistant Manager Urban Planning in Asian Consulting Engineers Pvt Lahore ammariqbal045@gmail.com,*
5. *Town Planner Urban Community Housing Pvt limited plnr.safeer.sssk@gmail.com,*

Abstract:

One of the most significant worldwide challenges now affecting humanity is climate change. It is becoming increasingly evident that everyone, every community, and every organization has a role to play in lessening the effects of carbon emission that contribute to the global warming as the Earth's temperature rises at an unprecedented rate. As a result, the climate of the planet is getting more complex. The warmest season is summer and coldest is winter. Glaciers are melting due to climate change, the primary reason for floods worldwide. This is because we do not know how much carbon we are producing in provision of comfort in our houses. The main contributors to carbon emissions are energy production and its use, transportation, and industrial operations. The threat of climate change amplifies the need for prompt, decisive action to cut carbon emissions and save the planet's future. Cities especially the residential sector, have a vital role in promoting sustainability and battling climate change, critical sources of global carbon emissions. In this research, carbon emissions of planned and unplanned areas are compared to check the difference, which will examine how house and neighborhood design and provision of open spaces according to planning standards has an impact on amount of carbon emission in the houses and neighborhoods. We used a combination of quantitative and qualitative methods. Statistical methods help quantify carbon dioxide emissions and assess the impact of best practices, while qualitative measures provide information on public opinion and barriers to implementation. Stratified random sampling was done for collecting data of 800 sample size in Lahore. Eco-friendly materials help to store carbon in biomass, trap CO_2 from the atmosphere through photosynthesis, and lessen the effects of urban heat islands. Because it aims to totally eradicate carbon monoxide, the idea of zero carbon emission has evolved to solve this issue, improving the environment for both present and future generations. This study intends to investigate the viability and potential of urban carbon emission reduction as a solution. In doing so, we strive to limit societal climate change and eventually produce no carbon emissions. By supplying solar panels, green infrastructure in three sizes (small, medium, and large), climate finance, sustainable initiatives and the plants we utilize to lessen our carbon footprint, the solution also lowers the environmental impact to bring global sustainability.

KEY WORDS:

Climate Change, Carbon Emission, Green House gases, Air Pollution, Planned areas, Unplanned areas, Renewable energy resources, Green roof

Introduction:

In recent years, the environmental impacts of carbon emissions and the importance of global development have been widely recognized. With a range of environmental advantages like air purification, water filtering, and carbon sequestration, green infrastructure is a viable approach for reducing the harmful effects of carbon emissions. According to Global Carbon Project (2019-20) world is producing average 5.29 tons of carbon from electronics and household activities daily, producing 1930.9 tons per year (1751683.014 kg). The primary cause of climate change is carbon emissions, which seriously negatively affect the natural world and human culture. Recent decades have seen a sharp growth in carbon emissions, contributing to major global warming, rising sea levels, an uptick in natural disasters, and climate change. Research will focus mainly on the challenges and prospects of implementing zero-carbon policies in cities and the effects of these policies on the ecological, economic, social, and environmental quality of cities.

Research may examine how green infrastructure may affect carbon emissions over the long term. The advantages of organic products might become apparent for a while, and studies might not have a lasting impact. Research will focus particular on the challenges and prospects of implementing zero-carbon policies in cities and the effects of these policies on the ecological, economic, social, and environmental quality of cities.

Research may examine how green infrastructure may affect carbon emissions over the long term. The advantages of organic products might not become apparent for years, and studies might not have a lasting impact. Limitations brought on by specific elements. The analysis is unable to account for particular variables that may have an impact on emissions, such as changes in the energy supply, the state of the economy, or technological advancements. Researchers must recognize these limitations and offer suggestions for future studies to address them. Planned and unplanned areas of Lahore were marked. List of Katchi Abadies from the directorate of Katchi Abadi Lahore was collected and marked with the help of ARC GIS 10.2 software and the map was developed. Primary data was collected with the 384 sample households each from planned and unplanned areas through questionnaires. Data was entered in EXCEL. CO_2, SO_2 and NO_2 emissions were calculated in planned and unplanned areas. Oxygen calculation was done which emits from different types of plants and impacts nitrogen dioxide and Sulphur dioxide. Conclusion and recommendation provide an ample insight into the recommended calculations.

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

Conceptual Frame Work

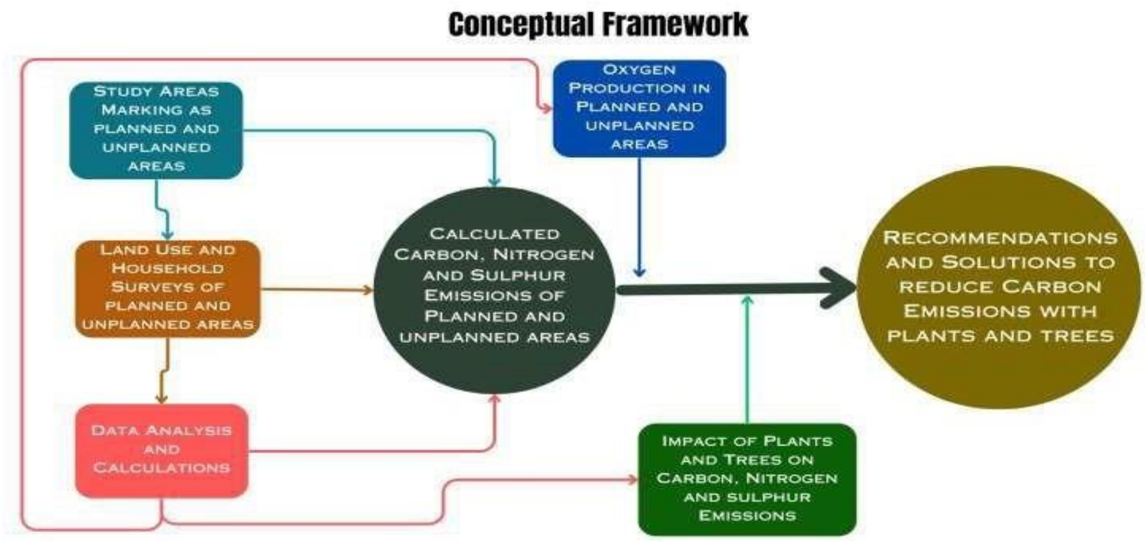


Figure 01: Conceptual Framework

The conceptual framework describes the process of work done from primary survey of planned and unplanned Case study areas. Data analysis of the surveyed areas was performed and GHG emission calculation was done. Recommendations and solutions on the basis of calculations provide sustainable solutions.

Literature Map

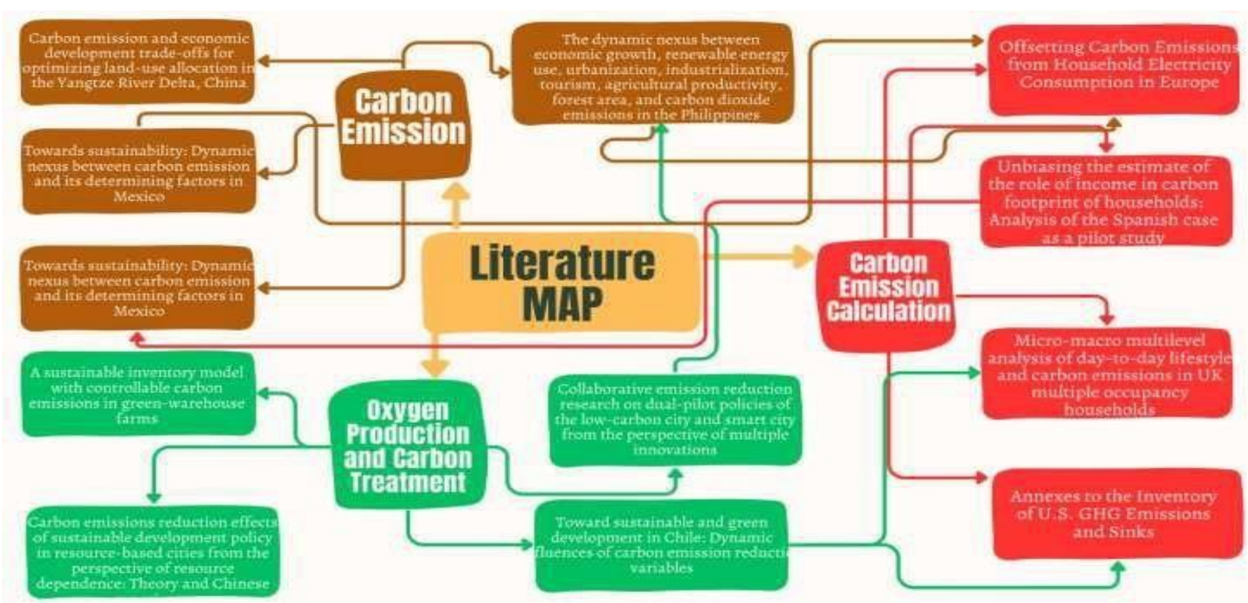


Figure 02: Literature Map

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

Literature Review

The findings suggest that malmat can play a significant role in flue gas production, particularly in China's western and northern regions. To investigate the greenhouse gas reductions of various forestry practices and to comprehend the connection between forests and greenhouse gas emissions, more research is necessary which is in practices. (Z. Li et al., 2021)

Careful monitoring of the effect of nitrogen dioxide (NO_2) on gas stoves for clean cooking. The work is important because it adds to the knowledge of indoor air pollution, a serious public health problem, especially in developing countries where traditional biomass production is the main focus. The study also shows how household habits, including frequent cooking, can affect exposure to nitrogen dioxide. This study has important implications for public health policy, especially in developing countries with problematic indoor air pollution. Encouraging gas stoves and other clean cooking methods is an effective way to reduce the adverse health effects of indoor air pollution. Respiratory infections and other related health conditions can be reduced by reducing exposure to nitrogen dioxide and improving the overall well-being of affected individuals (Kephart et al., 2021). This strategy can promote sustainable agriculture by assisting agricultural warehouses in lowering their carbon footprint and increasing sales (Md Mashud et al., 2021).

Overall, the study offers insightful information on how the external CO_2 compensation pricing and the CO_2 factor of electricity affect the energy system design of zero-emission neighborhoods. The findings underscore the need for supportive policies and regulations to encourage the establishment of zero-emission neighborhoods, which has significant implications for policymakers and urban planners. This study also emphasizes the significance of good leadership and stakeholder engagement in supporting sustainable development (Zhang et al., 2021). The report also highlights the importance of considering the social and economic effects of energy and carbon reduction initiatives (Pinel et al., 2021). The author examines the effects of green energy technology investments, technological innovation, and trade globalization on green energy supply and environmental sustainability using panel data from 1980 to 2018 and a fixed-effects regression model. The study discovers that trade globalization, technological innovation, and investments in green energy technologies have a considerable positive impact on the availability of green energy and environmental sustainability in the G7 countries. The study also shows that country-specific factors like economic development, energy structure, and environmental legislation have an impact on the relationship between these parameters and the availability of green energy and environmental sustainability and meet environmental sustainability targets in the G7 countries, governments should concentrate on supporting green energy technology investments, technological innovation, and trade globalization (Xiao et al., 2022). The study used data from 1980 to 2016 and discovered that carbon emissions are positively impacted by GDP, energy consumption, and urbanization but negatively impacted by population and trade openness. The study adds to the knowledge of the relationship between sustainability, environmental deterioration, and economic growth (Raihan & Tuspekova, 2022b). The study offers insightful information on the intricate connections between Kazakhstan's economic development, energy consumption, urbanization, agricultural output, wooded area, and carbon emissions. The conclusions have significant policy consequences and emphasize the need for a thorough, well-rounded strategy to combat climate change (Raihan & Tuspekova, 2022a). The study also highlights the importance of considering all lifecycle carbon emissions linked to building materials and construction methods (Allan et al., 2022).

This study looks at how solar energy, namely solar photovoltaic (PV) technology, can help society become zero energy. The authors give a general review of solar PV technology today and discuss its possibilities for producing renewable energy in cities. It is crucial to consider the social and economic effects of new energy technologies in energy-scarce settings (Hachem-Vermette, 2022). Despite these drawbacks, this publication contributes significantly to the literature on sustainability and offers insightful data to researchers and policymakers working to advance sustainability and lower carbon emissions in low-carbon intelligent cities (Xiufan & Decheng, 2023). Additionally, it informs practitioners and policymakers so they may comprehend the intricate connection between corporate governance and commercial performance (Oyewo, 2023). The presence and availability of public transport are associated with reduced carbon emissions as people increasingly choose environmentally friendly modes of transport. Communities with good electricity infrastructure and well-implemented environmental policies also have lower carbon footprints (Liu et al., 2023).

The article is nicely written and suitable for scholars and decision-makers interested in Saudi Arabia's sustainable development and carbon reduction (Almatar, 2023). The authors examine the intricate relationships between economic growth, the use of renewable energy, urbanization, industrialization, tourism, agricultural productivity, forest cover, and carbon dioxide emissions using a range of statistical methodologies. This method offers a detailed perspective on how these variables interact and can help guide policymaking in the Philippines and elsewhere. The authors acknowledge that some of the data used in the study may have errors or flaws, which may affect the results, in addition to not accounting for the potential impact of other environmental factors, such as water use and waste management, on carbon dioxide emissions (Raihan, 2023a). Overall, the material in this study helps understand Chile's environmental performance, energy use, economic growth, and reduction of carbon emissions. The results underline the necessity for a careful balance between economic expansion and environmental preservation to maintain sustainable and environmental friendly growth (Raihan, 2023b). The dynamic effects of carbon emission reduction variables on environmental friendly and sustainable development in Chile are examined in this study. The authors investigate the effects of Chile's carbon emission reduction measures on economic growth, energy use, and environmental performance using periodic data from 1980 to 2015. The findings show the necessity for a careful balance between economic development and environmental preservation to maintain a sustainable and environmentally friendly development (Li, 2023). The decision-makers were significantly affected by this research, which also offered a market-based strategy that could be used in urban settings. The research also emphasized the need for a thorough and integrated strategy for sustainable development and climate change mitigation (Backe et al., 2023).

Impact of Plants and Trees on Carbon, Nitrogen and Sulphur Emission

Table 1 shows the amount of carbon emission in planned and unplanned areas. The planned areas generate more carbon than unplanned areas. This is due to more use of electronics and the area of houses. However, the effect of this emission is reduced due to the large green areas in planned areas. According to studies, plants and green infrastructure reduce the effects of carbon emission, especially in the daytime; plants produce O_2, which reacts with CO and generates CO_2, which is important to complete the breathing cycle of life in the atmosphere. According to our analysis, on average, the planned areas on average, 90% have plants, most of

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

which are big trees. Trees mostly generate equal oxygen regardless of size. Almost every size of tree and plant is available with their oxygen-generating capability. These plants reduce the carbon emission effects. But in unplanned areas, only an average of 10% has plants and trees in the house, and most of these plants are small and indoors, which produce low amounts of oxygen that do not impact carbon emission; therefore, the carbon emission of unplanned areas is more harmful than the planned areas.

Table 1 Plants and Trees Detail

Name	**Type**	**Soil**	**Season**	**Type**	**Height for Production**	**Oxygen Production tons/Year**
Sukh-Chain	Outdoor	Fertile and Hard	All Seasons	Shade Tree	7’	3
Sheesham	Outdoor	Fertile and Hard	All Seasons	Shade Tree	6’	2.9
Neem	Outdoor	Hard and Fertile	All Seasons	Shade Tree	7’	3
Boston Fern	Indoor	Fertile	All Seasons	Plant	2’-3’	4
Snack Plant	Indoor	Fertile	All Seasons	Plant	2’-3’	4
Peace Lily	Indoor	Fertile	All Seasons	Plant	3’	4
Areca Palm	Indoor Outdoor	Fertile	All Seasons	Plant	3’	4

The carbon monoxide is the dangerous gas for health, which released by electronics and fuel consumption, $1/2O_2$ from plants react with 2CO and generate $2CO_2$.

$$2CO + 1/2O_2 \longrightarrow 2CO_2$$

This CO_2 again used by plants to prepare energy for their survival and they break this most stable bond in photosynthesis and release oxygen in the air.

$$CO_2 + 2H_2O \xrightarrow[\text{Green Plants}]{\text{Light}} (CH_2O) + O_2 + H_2O$$

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

The nitrogen monoxide is the dangerous gas for health, which released by fuel and LPG consumption, $1/2O_2$ from plants react with 2NO and generate $2NO_2$.

$$2NO + 1/2O_2 \longrightarrow 2NO_2$$

This NO_2 again used by plants to prepare energy for their survival and they break this bond in photosynthesis and release oxygen in the air, store nitrogen in their roots.

$$NO_2 + 2H_2O \xrightarrow[\text{Green Plants}]{\text{Light}} (NH_2O) + O_2 + H_2O$$

The Sulphur monoxide is the dangerous gas for health, which is released by fuel and LPG consumption, $1/2O_2$ from plants react with 2SO and generate $2SO_2$.

$$2SO + 1/2O_2 \longrightarrow 2SO_2$$

This SO_2 again used by plants to fulfill their sulphury needs to act against insects and harmful bacteria for their survival and they break this most stable bond in photosynthesis and release oxygen in the air.

$$SO_2 + 2H_2O \xrightarrow[\text{Green Plants}]{\text{Light}} (H_2SO) + O_2 + H_2O$$

Research Methodology

The study used a combination of qualitative and quantitative research approaches. Qualitative research includes the analysis of carbon data and green products. In this quantitative study, information on carbon emissions in urban slums and the effects of various forms of green infrastructure was gathered. The data was statistically analyzed using MS Excel, SPSS, and GIS to make stress maps for trends and linkages. Solvin's formula was used to determine the sample size in Lahore city, which is 384. Three neighborhoods for the planned area and three Katchi Abadie were selected as a case study. One hundred thirty households (130) from each locality were surveyed, and 130 questionnaires were filled. Overall, almost 800 households were surveyed. Primary data was collected by doing a household survey.

Initial data entry was performed in Excel, which was used to make graphs. GPS was used to mark the locations of surveyed households. The collected data was transferred to Arc Map in Arc GIS 10.2 to make stress maps of CO_2, Sulphur, and nitrogen emissions.

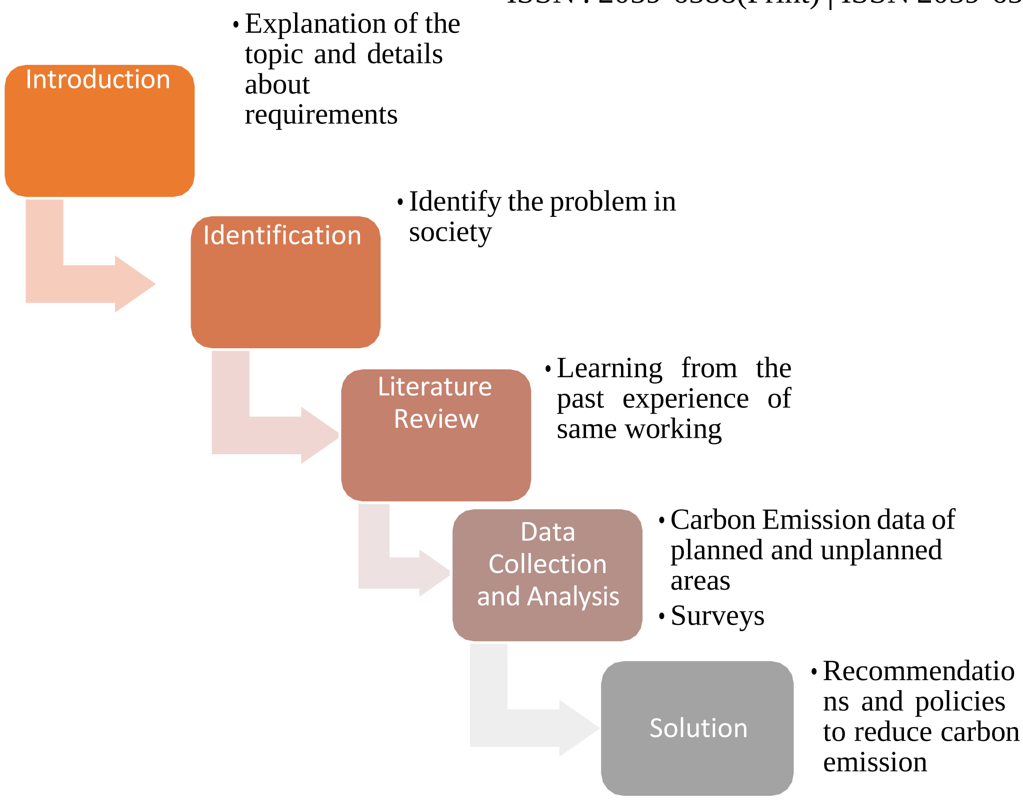


Figure 03: Research Map

Initial data entry was performed in Excel which was used for making graphs. GPS were used for marking locations of surveyed households. The marked locations were transferred to arc map. Data was also transferred to Arc GIS 10.2 for making stress maps of the CO2, Sulphur and Nitrogen emissions.

Remittances Review
August 2024,
Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

Data Collection from Planned and Unplanned Areas:

Planned Areas

Location Map:

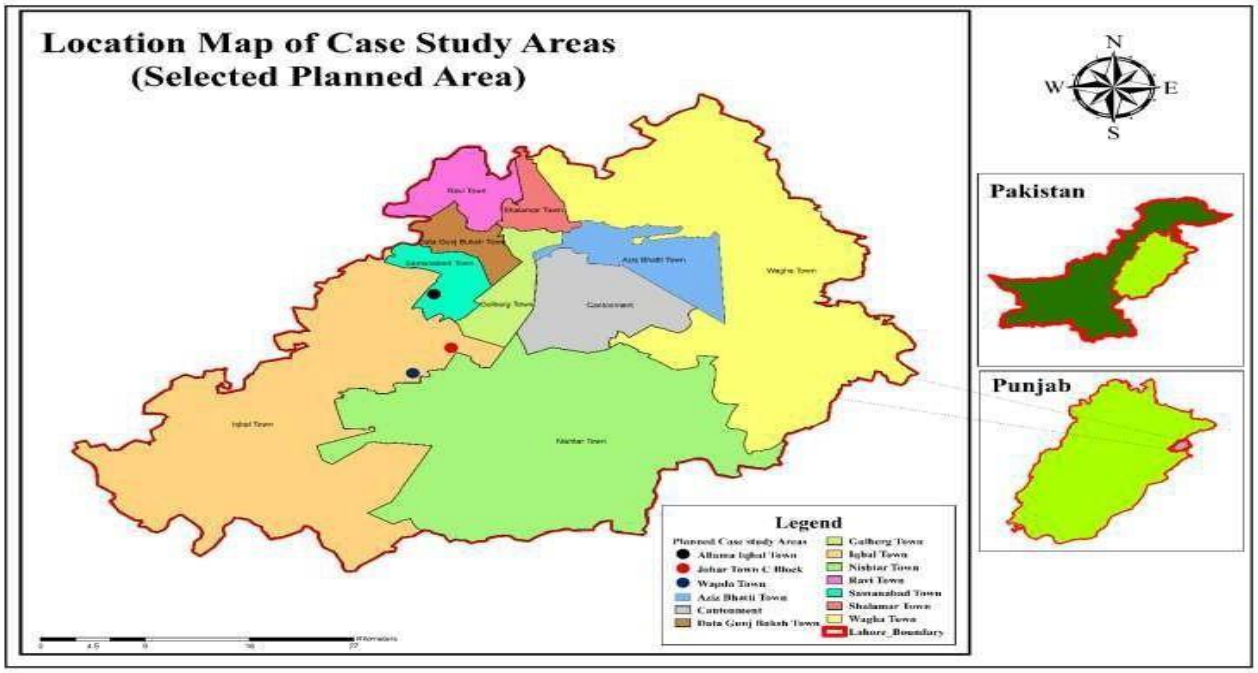


Figure 04: Planned areas location map

The map shows the selected planned areas for our study according to the town of Lahore division.

WAPDA Town

WAPDA Town was developed in 1978 by the Water and Power Development Authority (WAPDA) for its employees. However, it was later opened to the general public. The society is spread over an area of 12,000 Kanals (2,400 acres) and has a population of over 100,000 people. WAPDA Town is located on the main boulevard. This area has a number of shops, restaurants, and banks. There is also a large market called WAPDA Town Market. WAPDA Town is a popular residential area for upper-middle-class and upper-class families. It is a relatively expensive area with a good standard of living. The area is also well-connected to the rest of Lahore by road and public transport. WAPDA town is an advance area of Lahore with a mixed community. There is a mix of upper class and middle class in the area.

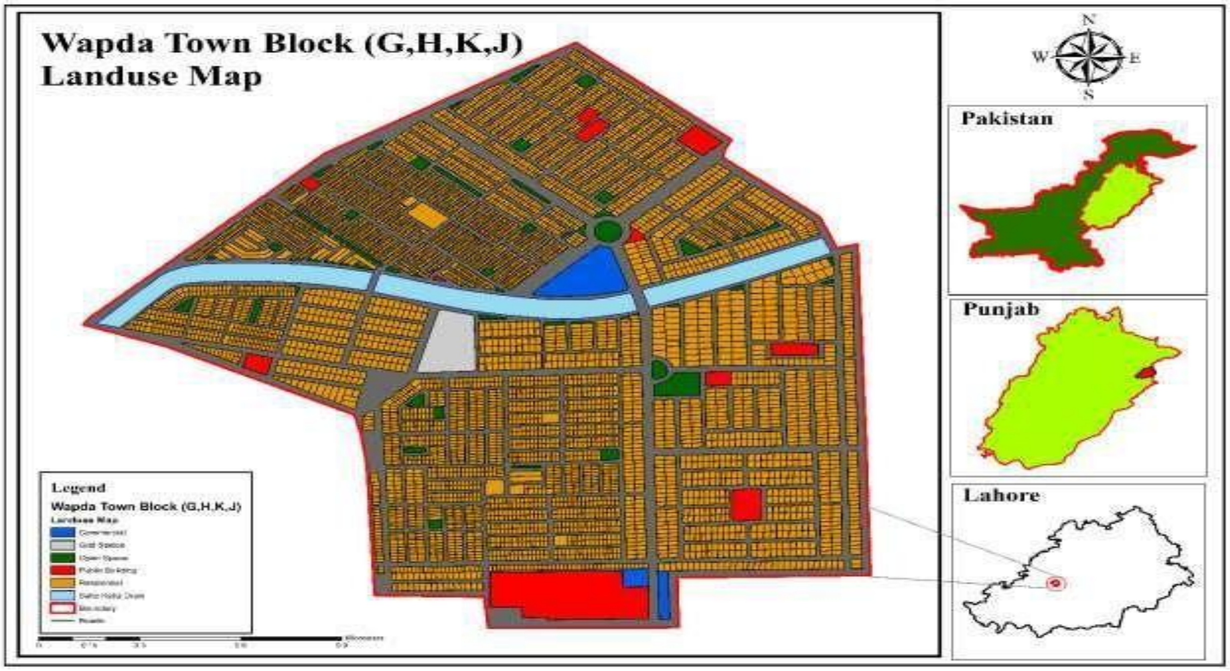


Figure 05: WAPDA Town (Bock G, H, K, J) Land use Map

JOHAR Town (Block, C)

JOHAR Town is a residential neighborhood and union council (UC 114) located in Tehsil of Lahore, Punjab, Pakistan. It is named after Mohammad Ali JOHAR, one of several prominent leaders of the Pakistan Movement. JOHAR Town was developed in the early 1970s by the Lahore Development Authority (LDA). It is a well-planned town with a good road network, a number of schools, collages, hospitals, and mosques and a number of parks and playgrounds. The main commercial area of JOHAR town is located on the main boulevard. This area has a number of shops, restaurants and banks. There is also a large market called Emporium Mall. JOHAR town is a popular residential area for middle – class families. It is a relatively affordable area with a good standard of living. The area is also well-connected to the rest of Lahore by road and public transport.

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

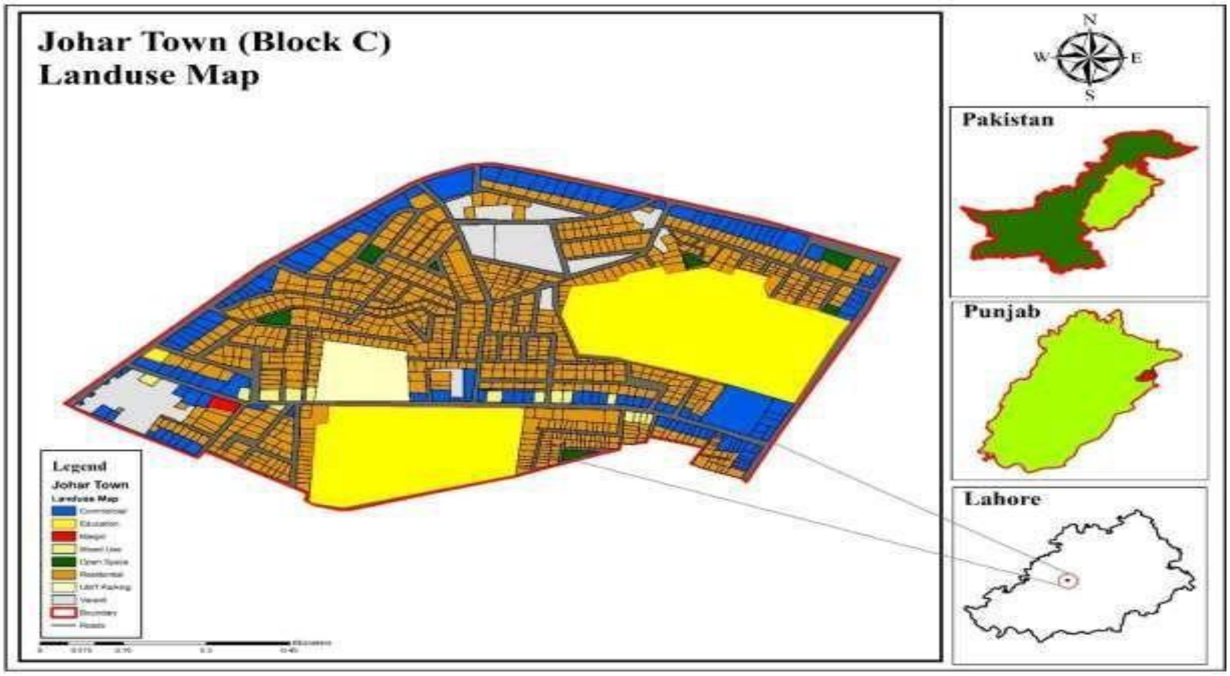


Figure 06: JOHAR Town (Block C) Land use Map

Allama Iqbal Town (Ravi Block and Umer Block)

Allama Iqbal town is a commercial and residential locality in the south-western Lahore, Punjab, Pakistan. It is named after Allama Muhammad Iqbal, the national poet of Pakistan. It is one of the largest towns in Lahore, with ab population of over 1 million people. Allama Iqbal town was developed in the late 1970s and early 1980s. It is a well- planned town with a good road network, a number of schools, collages, hospitals, and a number of parks and playgrounds. The main commercial area of Allama Iqbal town is located on the main boulevard. This area has a number of shops, restaurants, and banks. There is also a large market called Moon market. Allama Iqbal town is a popular residential area for middle class families. It is a relatively affordable area with a good standard of living. The area is also well-connected to the rest of Lahore by road and public transport.

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

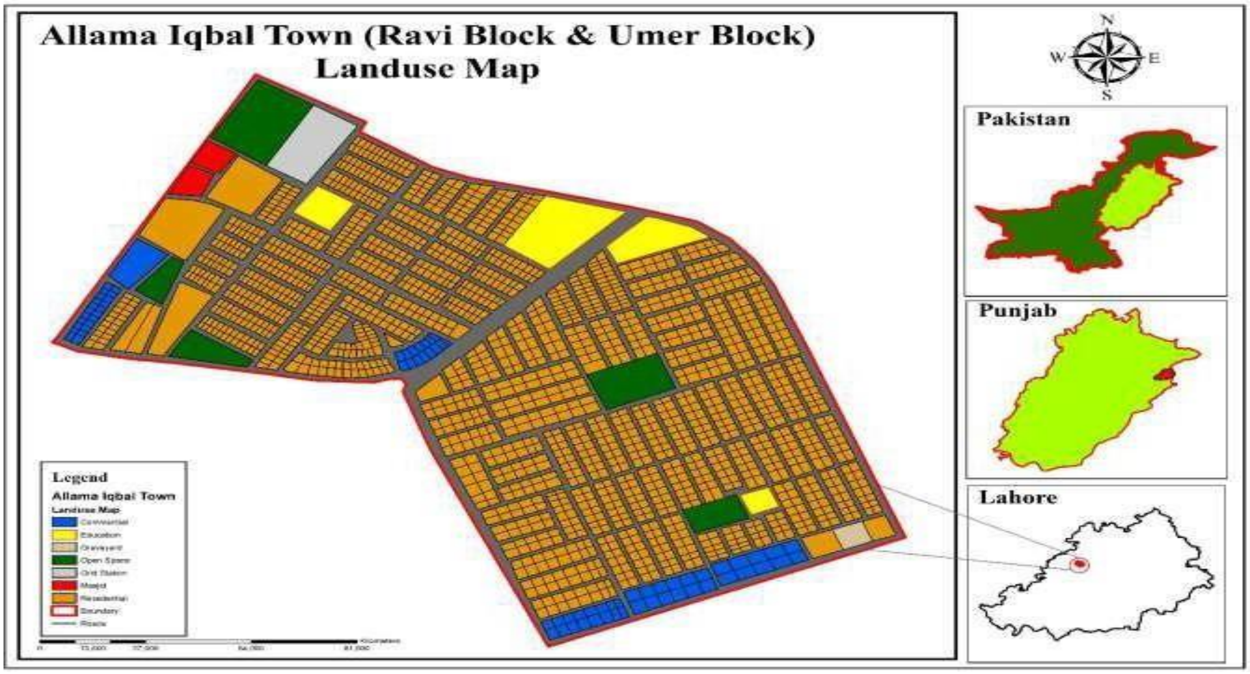


Figure 07: Allama Iqbal Town (Ravi Block and Umer Block) Land use Map

Unplanned Areas

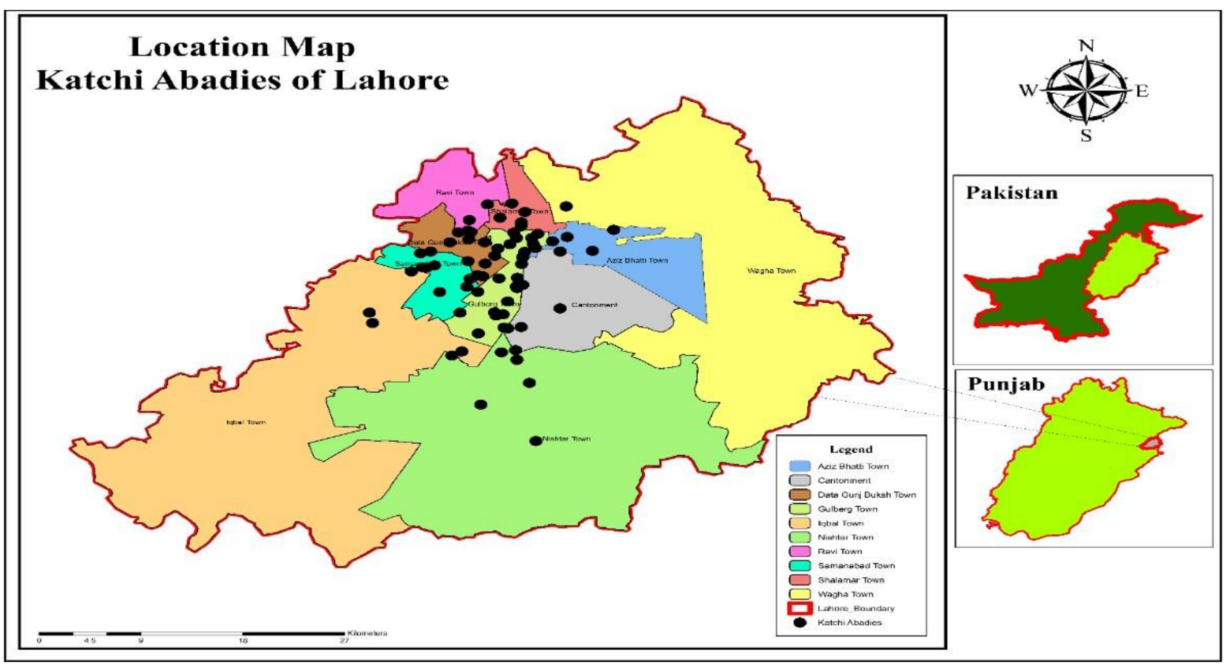


Figure 08: Katchi Abadies Map showing the locations of different Katchi Abadies in the division of towns in Lahore.

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

Selected Areas for Study:

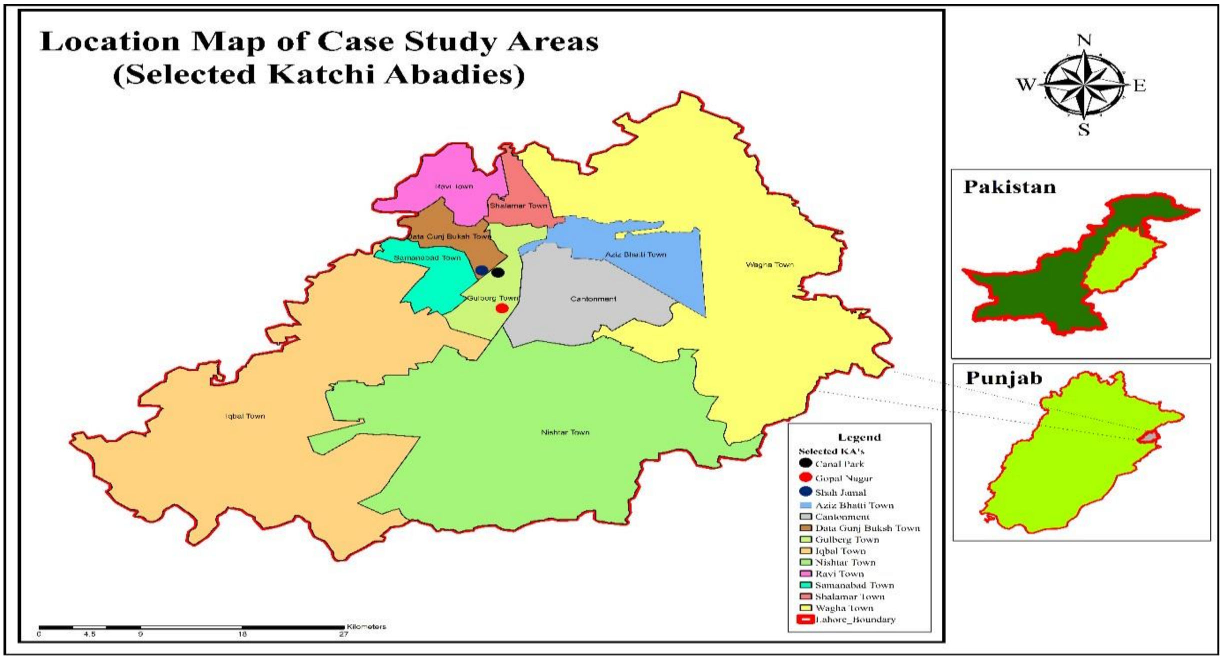


Figure 09: shows the maps of the selected towns for data collection for the present study.

The selected Katchi Abadies, doesn't have appropriate commercial area, open spaces and public buildings which are necessary for a sustainable living. The roads are narrow and substandard. There is no arrangement for solid waste management and rest of public amenities are missing. Houses are built up not according to building bye laws and planning standards. People with low Socioeconomic standards, due to their weak economic levels are forced to live in these areas.

Results and Discussions:

Carbon Emission

This graph shows the area-wise carbon emission comparison of planned and unplanned areas.

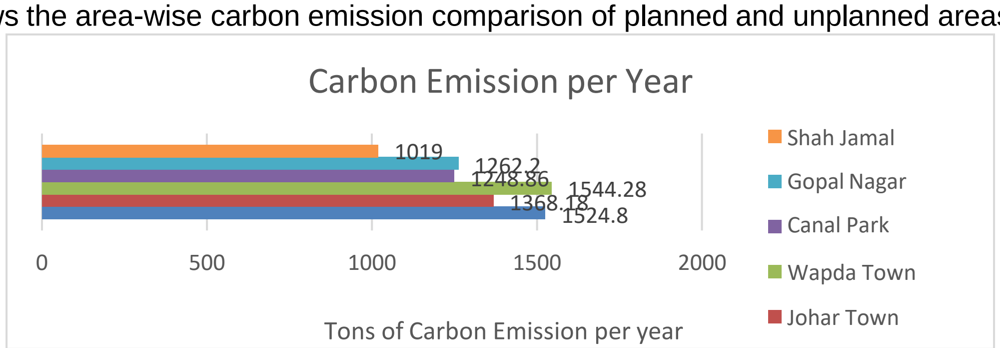


Figure10: Carbon Emission per year Map

Nitrogen and Sulphur Emission Calculation

Table 2: Nitrogen and Sulphur Emission Work done

Article	Work Done	Reference
Actual Sulfur Dioxide Emissions from Fuel Burning Using Material Balance	Calculated nitrogen and Sulphur from household activities in Spanish cities	(*Sulpher Calculations. Pdf*, n.d.)
Nitrogen dioxide exposures from LPG stoves in a cleaner-cooking intervention trial	Calculated nitrogen and Sulphur emission worldwide from burning	(Kephart et al., 2021)

For the carbon emission calculation, we used a general formula which used globally to calculate the carbon emission from electronics for the houses. In this formula we use equation:

Nitrogen Emission = Total Consumed liters of fuel x K
(K=1.34 Kg NO)
For calculation of Nitrogen from LPG we use:

Nitrogen Emission = Total Consumed Kg of LPG x K
(K = 1.8 kg NO)
For calculation of Sulphur from Fuel we use:

Sulphur Emission = Total consumed liters of fuel x K
(K = 0.97 Kg SO)
Sulphur Emission = Total consumed Kg of LPG x K

(K = 0.03 Kg SO)

By using above formulas, we calculated the emissions of all areas Sulphur and Nitrogen and combined all the results in a table.

Table 3: Nitrogen and Sulphur Emission per year of Planned areas and Unplanned Areas in Lahore

	Planned Areas			**Unplanned Areas**		
Areas	WAPDA Town	JOHAR Town	Allama Iqbal Town	Shah Jamal	Gopal Nagar	Canal Park
Nitrogen (ton/year)	223.4	211.8	212.6	132.3	154.2	149.4
Sulphur (ton/year)	115.7	110.4	111.4	62.3	70.2	65.7

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

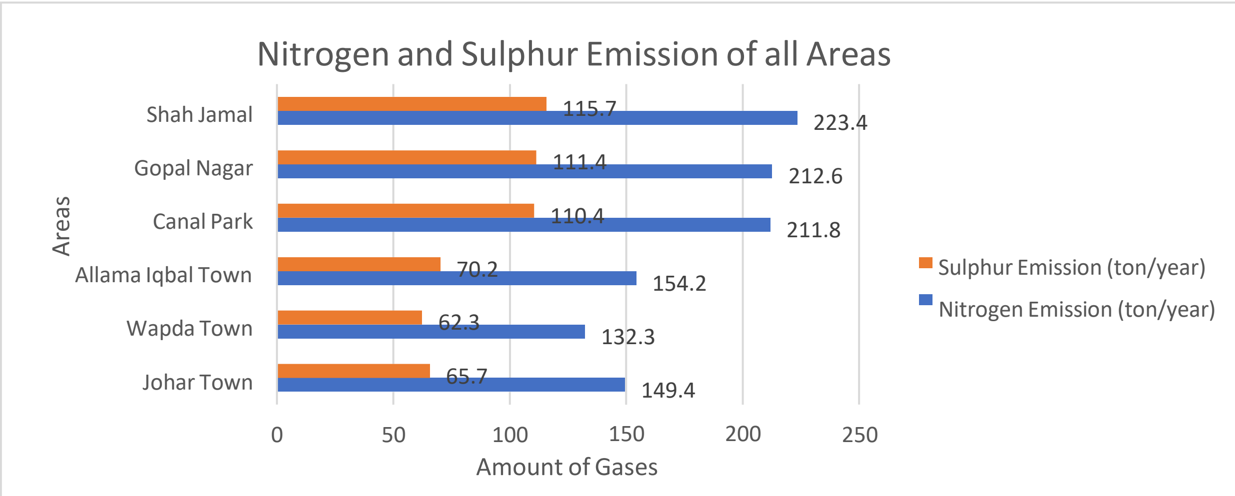


Figure 11: Nitrogen and Sulphur emission Graph

This graph shows the overall emissions of nitrogen and Sulphur from all planned and unplanned areas of Lahore. On the basis of available plants, we can have compared impact of carbon emission in both planned and unplanned areas:

Table 4: Oxygen Production per Year in Planned Areas and Unplanned Areas of Lahore

Planned Areas	**Oxygen Production (US Tons/year)**	**Unplanned Areas**	**Oxygen Production (US tons/year)**
WAPDA Town	356.6	Shah Jamal	54.49
JOHAR Town	257.5	Gopal Nagar	77.69
Allama Iqbal Town	251.7	Canal Park	51.34
Total	**865.1**	**Total**	**183.52**

Above calculation showed that planned areas have more plants and trees which produce collectively 865.1 tons of oxygen per year, which reduce effect of carbon emission on the environment. On other hand unplanned areas are only producing 183.53 tons.

Now if we calculate the impact, production of carbon in planned areas is 4437.26 tons and these areas are producing 865.1 ton of oxygen which reduce 19.2% of total emission of carbon. On other hands unplanned areas producing 3529.2 tons of carbon and producing only 183.5 tons of oxygen, which reduce only 5% impact of carbon in environment

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

Oxygen Production

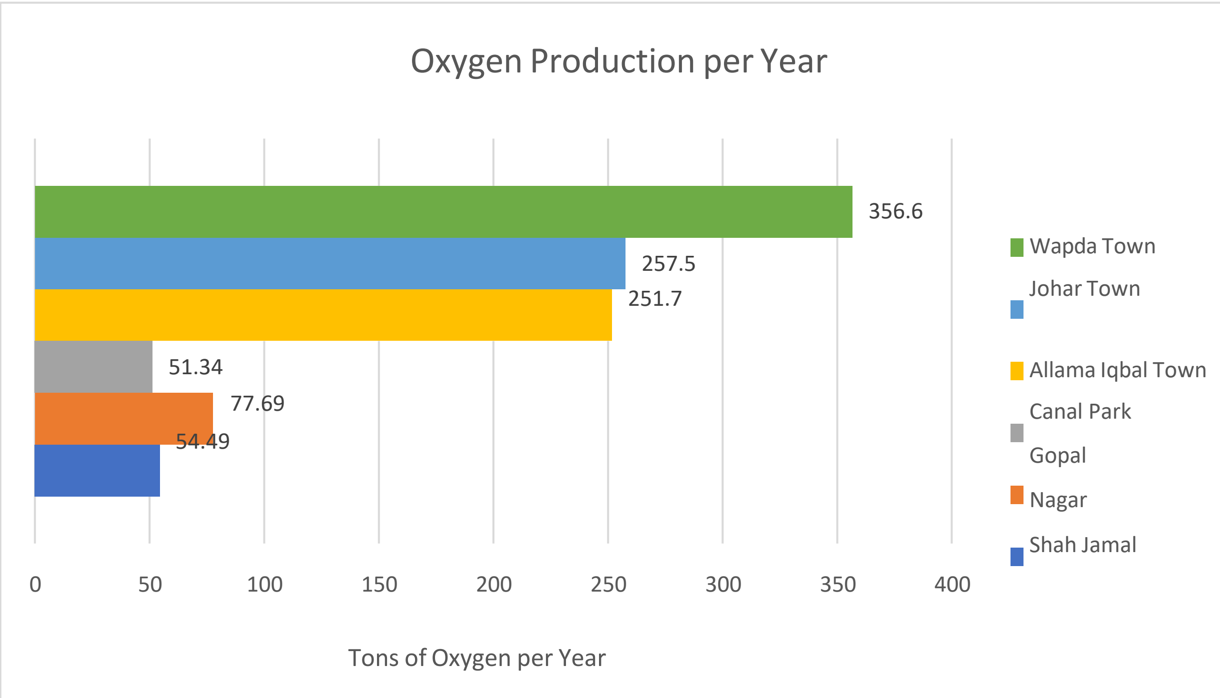


Figure 12: Oxygen Production Ton/Year

This graph shows the area wise oxygen production comparison of both planned and unplanned areas.

Shah Jamal

Shah Jamal is producing 1019 tons of CO in a year and producing 54.49 ton of Oxygen which has a huge gap and as we know we need ½ mole of oxygen to convert Carbon monoxide in Carbon dioxide. Now we have only 54.49 mole of oxygen which can only react with 109 moles of this CO and will convert it but, other 915 moles will affect the environment of area.

Gopal Nagar

Gopal Nagar is producing 77.69 tons of Oxygen and the carbon emission is 1248.86 tons per year. Now in this case again oxygen is only enough for 155 moles of CO, and other amount of Carbon will affect the climate of area.

Canal Park:

Canal Park is producing 51.34 tons of Oxygen and the carbon emission is 1262.20 tons per year. Now in this case again oxygen is only enough for 103 moles of CO, and other amount of Carbon will affect the climate of area.

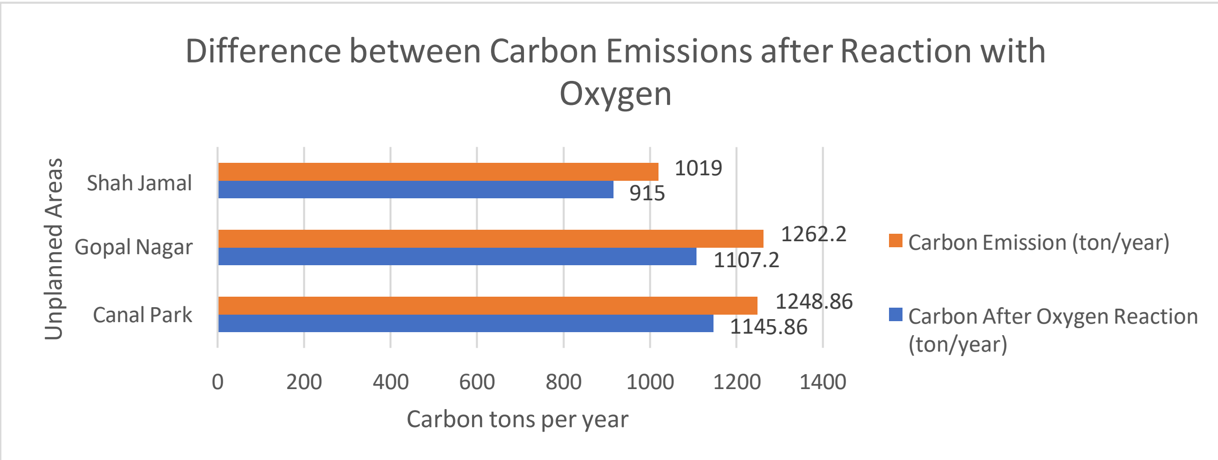


Figure 13: Effect on Carbon Emission after Plants incorporation in Unplanned Areas

Table 5: Carbon, Nitrogen and oxygen Production per year of Tons in Planned and Unplanned Areas of Lahore

	Planned Areas			Unplanned Areas		
Areas	**WAPDA Town**	**JOHAR Town**	**Allama Iqbal Town**	**Shah Jamal**	**Gopal Nagar**	**Canal Park**
Carbon (ton/year)	1544.28	1368.18	1524.8	1019	1262.2	1248.86
Nitrogen (ton/year)	223.4	211.8	212.6	132.3	154.2	149.4
Sulphur (ton/year)	115.7	110.4	111.4	62.3	70.2	65.7
Oxygen (ton/year)	356.6	257.5	251.7	54.49	51.34	77.69

WAPDA Town

WAPDA Town is producing 356.6 tons of Oxygen and the carbon emission is 1544.28 tons per year. Now in this case again oxygen is only enough for 713 moles of CO, and other amount of Carbon will affect the climate of area.

JOHAR Town

WAPDA Town is producing 257.5 tons of Oxygen and the carbon emission is 1368.18 tons per year. Now in this case again oxygen is only enough for 515 moles of CO, and other amount of Carbon will affect the climate of area.

Allama Iqbal Town

Allama Iqbal Town is producing 251.7 tons of Oxygen and the carbon emission is 1524.80 tons per year. Now in this case again oxygen is only enough for 503 moles of CO, and other amount of Carbon will affect the climate of area.

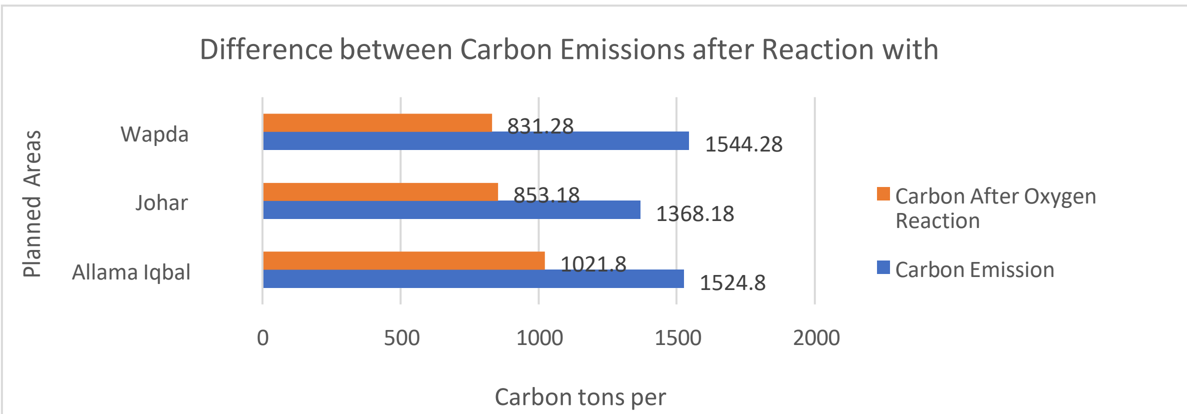


Figure 14: Effect on Carbon Emission after Plants incorporation in planned Areas

This graph shows the difference in values of carbon emission after the oxygen reaction with it.

Comparison of Emissions from all Areas

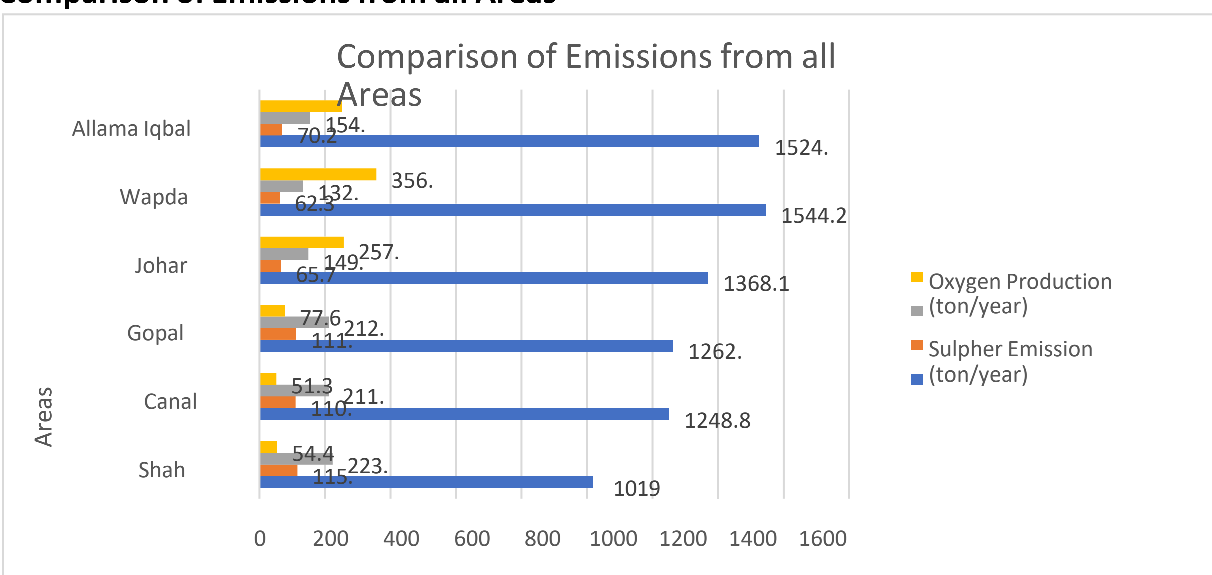


Figure 15: Effect on Emission Before Plants incorporation in Case Study Areas

Recommendations:

Effect of Energy Efficient Materials in Construction

Table 6: List of Materials Use for Carbon Control

Name	Use	Function	Carbon Reduction	Availability
Solar Plates	Electricity Production	Can fulfill energy requirement	1ton per Year	Available in Pakistan
Solar lights	Lights	Charge through solar and can use in gardens for night lightening	1ton per year	Rarely Available in Pakistan
Precast Slabs Concrete	Construction Material	Slabs have airy pours in them which reduce carbon effect on surroundings	2 tons per year	Available in Pakistan
Rigid Form	Avoid Heat	Reduce urban heat island effect	2 tons per year	Available in Pakistan

In planned areas average of 51% used energy efficient material to reduce heat in houses and this amount impact amount of carbon emission in those areas as after reduction from plants we have collectively 2705 (1021+ 853+831) tons of carbon emission. This amount will more reduce if 200 houses have rigid form used in construction it will reduce 400 tons of carbon as 1 house with rigid form reduce 2 tons of carbon. Then this amount will reduce to 2305 tons, which is almost 50% of total amount of carbon which these areas are producing.

On other hand, in unplanned areas average of 2% have used this material and it will not impact any big reduction in amount of carbon in these areas.

The third factor is the house design and living standards, in unplanned areas houses has fewer open areas and more people are living their but in planned areas houses have more open spaces which provide passive design and reduce usage of lights and other electronics in the day time. Which reduce amount of carbon emission. The poor house design force people to use more electronics for comfort.

Climate Finance and sustainable initiatives

There is a need to work on climate finance and sustainable living initiatives like working on international climate finance access, (GEF), (GCF) and (CIFs). In order to get second party opinion sustainable finance framework is required through ministry of finance. UNDP, FAO, MOCC are working to improve GCF access and has achieved high climate co-benefits in World bank projects. Thorough working on Funding initiatives which provides SECP national guidelines for Green-bond issuance, Nature performance bonds (NPB) for nature conservation projects, Carbon pricing Instruments (CPI) under CIACA provide facilitation to explore domestic carbon pricing and market development, needs to enhance its effectiveness. Blue carbon initiative

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)
ensures mangrove forests with potential increase in revenue from carbon credits could reach up to 500 million dollars. Public private partnership (PPP) encourages private sector involvement in climate initiatives for direct access to climate finance access through national and private banks for monitoring and reporting on true compliance for national inventory and Paris agreement for a national adaptation monitory and evaluation system.

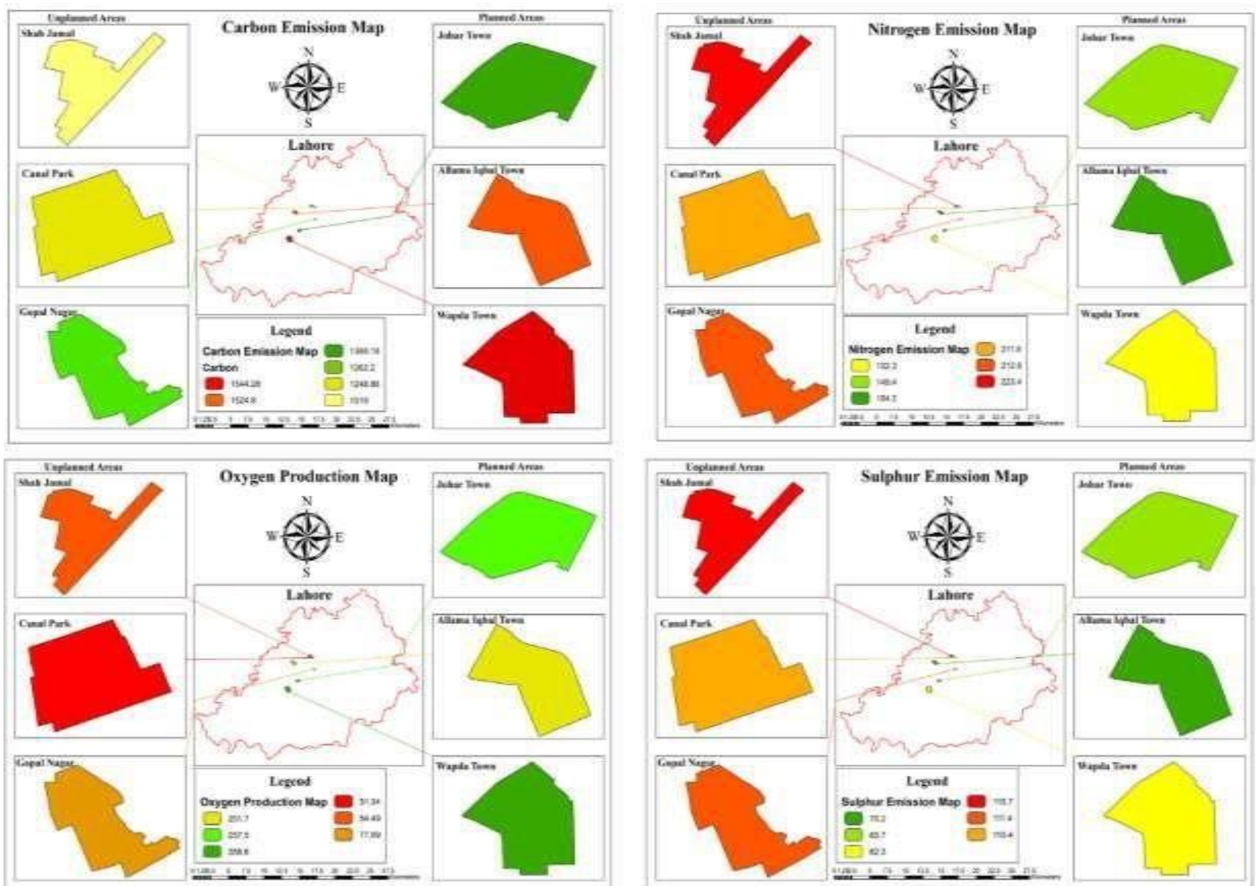


Figure 16: Combined Effect on Emission Before and after Plants incorporation in Case Study Areas

Increase Plants and Trees:

Unplanned Areas

The availability of required number of plants and trees can equalize carbon emission with oxygen production, which will create sustainability for a long time in the areas. As on above discussion we saw in unplanned areas:

Total carbon emission = 3529.2 tons/year
Total Oxygen Production = 183.52 tons/year
If we calculate the gap:
= 3529.2-183.52

=3345.68 tons
This shows we need more plants to generate equilibrium in oxygen and carbon production and

as per above data we need 1000 small plants which can produce 4000 tons of Oxygen in a year. With height of 2' and these plants are indoor plants and can easily place on any side of house.

1000 plants = 3 Areas

1 area = 335 plants

As per our sample size per house plants
1 area = 130 houses
1 house = 335/130
1 house = 3 plants
Space required:
1 plant = 3' width

Total Space require for these plants => 3 plants = 3 x 3 = 9'

Planned Areas

The availability of plants and tree low the impact of carbon emission for this in planned areas we all need some more plants and trees as

Total carbon emission = 4437.26tons/year
Total Oxygen Production = 865.1 tons/year
If we calculate the gap:
= 4437.26-865.1

= 3572.16 tons

With the addition of oxygen from energy efficient materials
Energy efficient material oxygen = 400 tons
Remaining Carbon = 3572.16 – 400 => 3172.16

This shows we need more plants to generate equilibrium in oxygen and carbon production and as per above data we need 900 small plants which can produce 3600 tons of Oxygen in a year. With height of 2' and these plants are indoor plants and can easily place on any side of house.

900 plants = 3 Areas

1 area = 300 plants

As per our sample size per house plants
1 area = 130 houses
1 house = 335/130
1 house = 2 plants
Space required:
1 plant = 3' width

Total Space require for these plants => 2 plants = 3 x 2 = 6'

Passive design of houses

House design matter a lot when we talk about comfortable environment. To maintain this comfort level, people use different electronics like, bulb, AC/Heaters and Fans etc. with a better design

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

we can reduce usage of all these electronics as if we provide heighted roofs with large windows, it will provide more air and light, then there will no need of bulbs in morning and also fans and air conditioners will not use. This design will provide better ventilation in house therefore use of exhaust fan will also reduce. In winter these large windows can provide more sunlight and will keep house warm, this will reduce use of heater.

Energy Efficient Materials in Construction:

In construction of houses, we can use energy efficient material which do not reflect the heat and sunlight, when the materials reflect the sunlight, it increases temperature and react with CO_2 and cause global warming. The material which absorbs the light and then reduce it with low temperature can reduce global warming and create a better atmosphere for living.

Awareness of Carbon Emission

In our society mostly people do not know about the carbon emission and its impact on us and environment. Therefore, they do not participate to reduce it. With an awareness campaign we can educate people with the seriousness of this issue and also, we can provide them information about energy efficient materials and appliances to reduce carbon emission.

Compulsory Open Spaces in by Laws:

Defense Housing Authority (DHA)

Table 7: DHA Land Use Rules

Plot Size	Front	Rear	Side-1	Side-2
2 Kanal	20 feet – 9”	8 feet – 4½ “	5 feet – 4½”	5 feet – 4½”
1 Kanal	15 feet – 9”	5 feet – 4½ “	5 feet – 4½”	5 feet – 4½”
10 Marla	10 feet – 9”	5 feet – 4½ “	5 feet – 4½”	
8 Marla	8’	4’	4’	
7 Marla	7’	3’	3’	
5 Marla	5’	3’	3’	

Remittances Review
August 2024,
Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

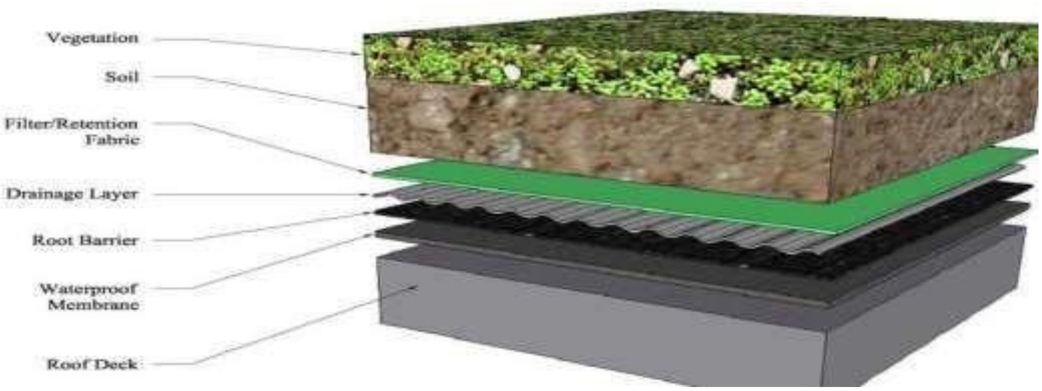
Lahore Development Authority (LDA)

Table 8: LDA Land use and Building Control Rules

Plot Size	Front	Rear	Side-1	Side-2
Less than 5-	5 ft (1.52 m)	5 ft (1.52 m)	-	-
Marla 5 Marla's & above but less than 10 marlas	5 ft (1.52 m)	5 ft (1.52 m)	-	-
10 Marlas to 30 Marlas	10 ft (3.05 m)	7-ft (2.13 m)	5 ft (1.52 m)	
Above 30 Marlas but less than 2-kanals	10 ft (3.05 m)	7-ft (2.13 m)	5 ft (1.52 m)	5 ft (1.52 m)
2-kanals& above	20-ft (6.1m)	10 ft (3.05m)	10-ft. (3.05)	10-ft. (3.05)

Rooftop Garden:

For the rooftop gardens we need a proper procedure and also materials to in cooperate it in houses for this the required procedure and cross section of material is:



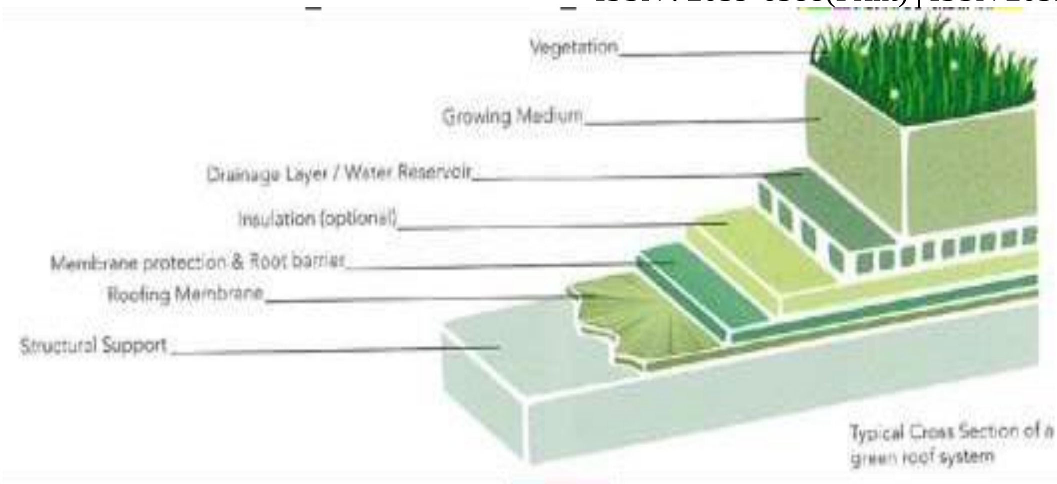
Source: Google Image Section of Green Roof Setting

Table 9: Land Division Calculation

Name	Covered Area	Planter Space	Solar Space	Open Space	Total Size of Plot
5 Marla	349.232 sqft	351.297 sqft	328.888 sqft	221.757 sqft	1127.5 sqft
10 Marla	438.016 sqft	519.782 sqft	456.203 sqft	836.511 sqft	2255 sqft
1 Kanal	1642.923 sqft	823.341 sqft	863.356 sqft	1151.409 sqft	4510 sqft
2 Kanal	1435.453 sqft	1232.44 sqft	1388.961 sqft	3370.25 sqft	9020 sqft

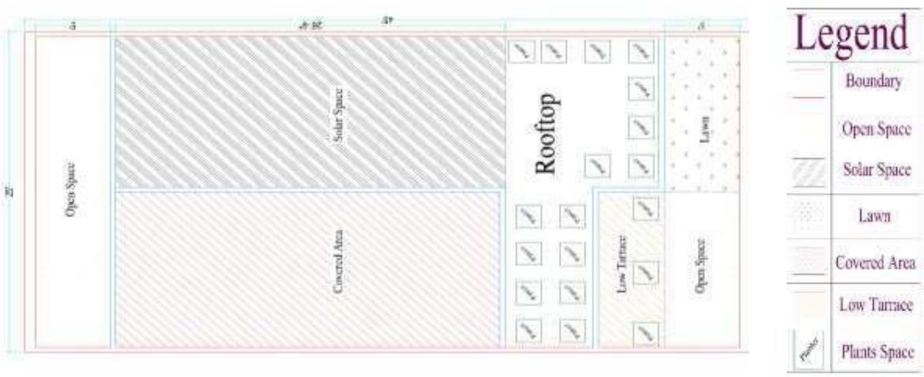
Source: Google Image Section of Green Roof Setting

Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

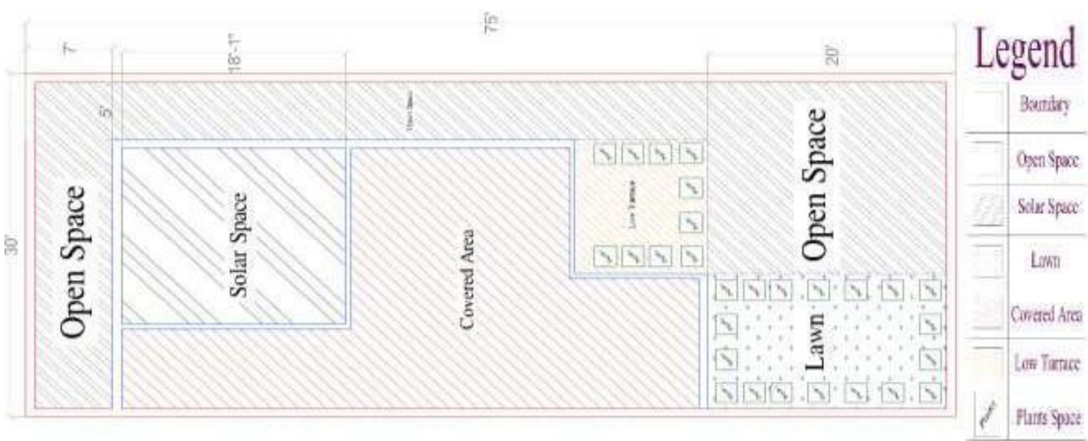


Source: Google Image Section of Green Roof Setting

House Design: 5 Marla:

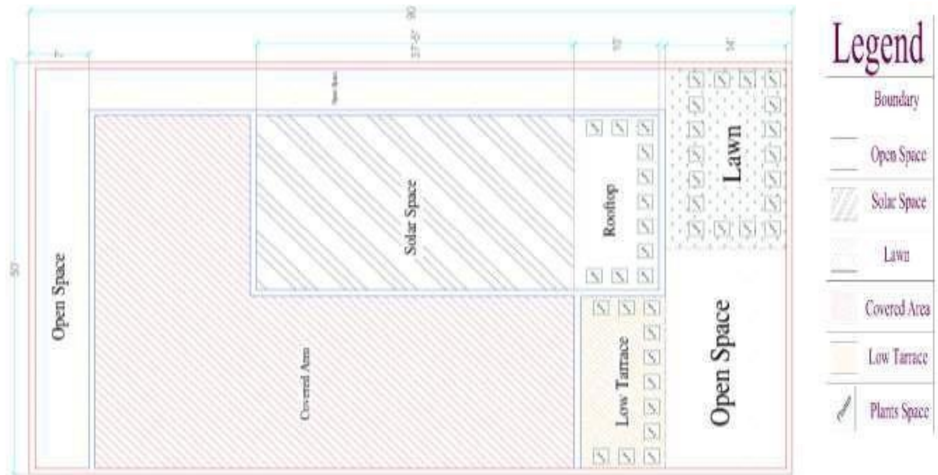


10 Marla:

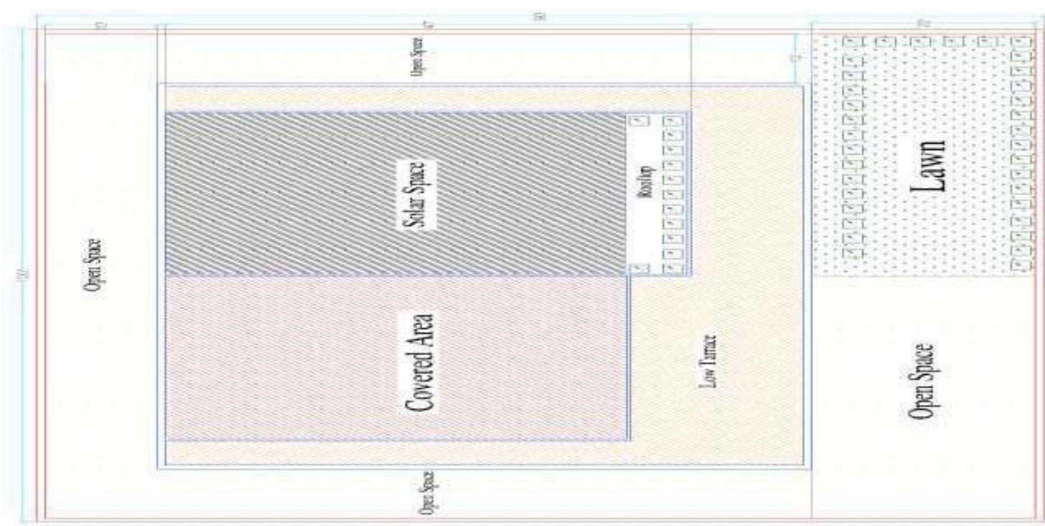


Volume: 9, No: 4, pp. 80-106
ISSN : 2059-6588(Print) | ISSN 2059-6596(Online)

1 Kanal:



2 Kanal:



References

Allan, J., Eggimann, S., Wagner, M., Ho, Y. N., Züger, M., Schneider, U., & Orehounig, K. (2022). Operational and embodied emissions associated with urban neighbourhood densification strategies. *Energy and Buildings*, *276*, 112482. https://doi.org/10.1016/j.enbuild.2022.112482

Almatar, K. M. (2023). Towards sustainable green mobility in the future of Saudi Arabia cities: Implication for reducing carbon emissions and increasing renewable energy capacity. *Heliyon*, *9*(3), e13977. https://doi.org/10.1016/j.heliyon.2023.e13977

Backe, S., Pinel, D., Askeland, M., Lindberg, K. B., Korpås, M., & Tomasgard, A. (2023). Exploring the link between the EU emissions trading system and net-zero emission neighborhoods. *Energy and Buildings*, *281*, 112731. https://doi.org/10.1016/j.enbuild.2022.112731

Carbon Calculation.pdf. (n.d.).

Chen, J., Dan, B., & Shi, J. (2020). A variable neighborhood search approach for the multi-compartment vehicle routing problem with time windows considering carbon emission. *Journal of Cleaner Production*, *277*, 123932. https://doi.org/10.1016/j.jclepro.2020.123932

De Arce, R., & Mahía, R. (2023). Unbiasing the estimate of the role of income in carbon footprint of households: Analysis of the Spanish case as a pilot study. *Heliyon*, *9*(6), e16394. https://doi.org/10.1016/j.heliyon.2023.e16394

Gordic, D., Nikolic, J., Vukasinovic, V., Josijevic, M., & Aleksic, A. D. (2023). Offsetting carbon emissions from household electricity consumption in Europe. *Renewable and Sustainable Energy Reviews*, *175*, 113154. https://doi.org/10.1016/j.rser.2023.113154

Hachem-Vermette, C. (2022). Role of solar energy in achieving net zero energy neighborhoods. *Solar Energy Advances*, *2*, 100018. https://doi.org/10.1016/j.seja.2022.100018

Kephart, J. L., Fandiño-Del-Rio, M., Williams, K. N., Malpartida, G., Lee, A., Steenland, K., Naeher, L. P., Gonzales, G. F., Chiang, M., Checkley, W., & Koehler, K. (2021). Nitrogen dioxide exposures from LPG stoves in a cleaner-cooking intervention trial. *Environment International*, *146*, 106196. https://doi.org/10.1016/j.envint.2020.106196

Li, W. (2023). Carbon emission and economic development trade-offs for optimizing land-use allocation in the Yangtze River Delta, China. *Ecological Indicators*.

Li, Z., Mighri, Z., Sarwar, S., & Wei, C. (2021). Effects of Forestry on Carbon Emissions in China: Evidence From a Dynamic Spatial Durbin Model. *Frontiers in Environmental Science*, *9*, 760675. https://doi.org/10.3389/fenvs.2021.760675

Liu, T., Shryane, N., & Elliot, M. (2023). Micro-macro multilevel analysis of day-to-day lifestyle and carbon emissions in UK multiple occupancy households. *Sustainable Production and Consumption*, *39*, 13–29. https://doi.org/10.1016/j.spc.2023.04.023

Md Mashud, A. H., Pervin, M., Mishra, U., Daryanto, Y., Tseng, M.-L., & Lim, M. K. (2021). A sustainable inventory model with controllable carbon emissions in green-warehouse farms. *Journal of Cleaner Production*, *298*, 126777. https://doi.org/10.1016/j.jclepro.2021.126777

Oyewo, B. (2023). Corporate governance and carbon emissions performance: International evidence on curvilinear relationships. *Journal of Environmental Management*, *334*, 117474. https://doi.org/10.1016/j.jenvman.2023.117474

Pinel, D., Korpås, M., & B. Lindberg, K. (2021). Impact of the CO 2 factor of electricity and the external CO 2 compensation price on zero emission neighborhoods' energy system design. *Building and Environment*, *187*, 107418. https://doi.org/10.1016/j.buildenv.2020.107418

Raihan, A. (2023a). The dynamic nexus between economic growth, renewable energy use, urbanization, industrialization, tourism, agricultural productivity, forest area, and carbon dioxide emissions in the Philippines. *Energy Nexus*, *9*, 100180. https://doi.org/10.1016/j.nexus.2023.100180

Raihan, A. (2023b). Toward sustainable and green development in Chile: Dynamic influences of carbon emission reduction variables. *Innovation and Green Development*, *2*(2), 100038. https://doi.org/10.1016/j.igd.2023.100038

Raihan, A., & Tuspekova, A. (2022a). Dynamic impacts of economic growth, energy use, urbanization, agricultural productivity, and forested area on carbon emissions: New insights from Kazakhstan. *World Development Sustainability*, *1*, 100019. https://doi.org/10.1016/j.wds.2022.100019

Raihan, A., & Tuspekova, A. (2022b). Toward a sustainable environment: Nexus between economic growth, renewable energy use, forested area, and carbon emissions in Malaysia. *Resources, Conservation & Recycling Advances*, *15*, 200096. https://doi.org/10.1016/j.rcradv.2022.200096

Sulpher Calculations.pdf. (n.d.).Xiao, R., Tan, G., Huang, B., Li, J., & Luo, Y. (2022). Pathways to sustainable development: Regional integration and carbon emissions in China. *Energy Reports*, *8*, 5137–5145. https://doi.org/10.1016/j.egyr.2022.03.206

Xiufan, Z., & Decheng, F. (2023). Collaborative emission reduction research on dual-pilot policies of the low-carbon city and smart city from the perspective of multiple innovations. *Urban Climate*, *47*, 101364. https://doi.org/10.1016/j.uclim.2022.101364

Zhang, H., Peng, J., Yu, D., You, L., & Wang, R. (2021). Carbon Emission Governance Zones at the County Level to Promote Sustainable Development. *Land*, *10*(2), 197. https://doi.org/10.3390/land10020197

Zheng, H., & Ge, L. (2022). Carbon emissions reduction effects of sustainable development policy in resource-based cities from the perspective of resource dependence: Theory and Chinese experience. *Resources Policy*, *78*, 102799. https://doi.org/10.1016/j.resourpol.2022.102799