Reduction in Urban Air Pollution During COVID – 19 Lockdown Can Be Control by Implementation of Sustainable Urban Planning Strategies

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Abstract- People start feeling healthier as urban environment is now clearer than before. Everyone wants to stay safe, stay healthy and stay happy as well. Reduction in air pollution makes people to healthy and happy as well. COVID-19 pandemic is a matter of human health and safety. At the same time as people have to change their regular manners and patterns to control the virus impact, there have been seen some temporary positive effects on the environment as reduction in air pollutant found during the lockdown period.

Afterward COVID-19 lockdown people advised for social distancing, being hygiene, work from home as long as possible, e-learning (study via internet) and some other work which can be done from home via e-services to maintain social distancing. It is the time to implement Sustainable Urban Planning Strategies, which can help in controlling the urban environment with current issues.

Indexed Terms- Urban environment, Air pollution, COVID-19 pandemic, human health, social distancing, work from home, e-services, Sustainable Urban Planning Stretegies.

I. INTRODUCTION

Urban Air pollution has been a matter of concern for many years. Air is an essential element for living environment. When it makes for cause of discomfort, disease, or death to humans, damage other living organisms or damage the natural environment or built environment, it is known as Air pollution.

Due to COVID – 19 pandemics, millions of people have been asked to quarantine and whole countries have been locked down to reduce the spread of the coronavirus [1]. Around the world, events are being cancelled and travel plans dropped. Number of universities, schools and workplaces have closed, and workers are advice to do work from home. This pandemic is shutting down industrial activity on enormous level [2]. But as people have changed their everyday patterns to avoid the virus, there have been some positive effects on the air environment.

Satellites found reduction in air pollutant, but that doesn't mean the air is free of all pollution, it's a temporary reduction. In spite of this reductions in industrial, transportation, and business activity, the coronavirus epidemic had reduced levels of atmospheric nitrogen dioxide (NO_2) and carbon dioxide (CO_2) [3].

But it will gradually return to its former shape as travel policies, industries and business activities are being done as before [4]. According to the World Health Organization millions of people die due to air pollution every year [1]. To control urban air pollution in current scenario implementation on various Sustainable Urban Planning strategies are required. It is gradually recognized that implementation of strategies to reduce urban air pollution can have significant health benefits and make our environment healthier and more liveable.

II. AIR POLLUTION

A substance in the air that can be unpleasant to humans and the environment is known as an air pollutant. Air pollution arise from when gases, dust particles, fumes or odour are introduced into the atmosphere during a way that creates it poisonous to humans, animals and plants. Air pollution affects the health of humans and other living beings. It creates smog and acid rain,

causes cancer and respiratory diseases, reduces the ozone layer atmosphere and contributes to global warming [5]. Air pollution influences urban climate in a various way. Among these is a decrease in visibility. A low surface visibility due to air pollutants is now a common occurrence in many urban areas [6].

2.1 Causes of Air Pollution

Sources of air pollution refer to the several locations, activities or factors which are responsible for the releasing of pollutants into the atmosphere [5].

- The burning of fossil fuels – Sulphur dioxide emitted from the combustion of fossil fuels like coal, petroleum, and other factory combustibles are one the major cause of air pollution. Carbon Monoxide and Nitrogen Oxides emitting from vehicles including trucks, jeeps, cars, trains, and air-planes causes an immense amount of pollution in Urban Environment.
- Agricultural activities – The use of insecticides, pesticides, and fertilizers in agricultural activities has grown quite a lot. They emit harmful chemicals into urban air.
- Factories and Industries – Industries like manufacturing discharge carbon monoxide, hydrocarbons, organic compounds, and chemicals in a large amount into the air thus depleting the quality of air.
- Mining operations – In mining minerals below the earth are extracted using large equipment. In the process dust and chemicals are discharged in the air producing massive air pollution, which declining health conditions of workers and nearby residents as well.
- Indoor air pollution – Household cleaning products and painting supplies produce poisonous chemicals in the air and make happen air pollution. Suspended particulate matter (SPM) usually caused by dust, combustion, etc [7].

2.2 Effects of Air Pollution on Urban Environment

Air pollution is a major risk to health. By reducing urban pollution levels, the suffering of disease from stroke, heart disease, lung cancer, and both chronic and acute respiratory diseases, including asthma can be reduced [8].

- Respiratory and heart problems – Several million are known to have died due to the direct or indirect effects of Air pollution. Several respiratory and heart conditions along with Cancer, threats to the body. Children in areas, unprotected to air pollutants are commonly suffer from pneumonia and asthma.
- Global warming – With increase in temperature, sea levels worldwide and melting of ice from colder regions and icebergs, displacement, and loss of habitat have previously announced a forthcoming disaster if actions for preservation and regulation are not commenced soon.
- Acid rain – Harmful gases like nitrogen oxides and sulphur oxides are emitted into the atmosphere during the burning of fossil fuels. When it rains, the water droplets mix with these air pollutants, becomes acidic and then falls on the ground in the form of acid rain.
- Eutrophication – Eutrophication is a state where a great amount of nitrogen present in some pollutants causes developed on the sea's surface and turns itself into algae and adversely affects fish, plants, and animal species.
- Effect on wildlife – Chemicals present in the air can force wildlife species to move to a new place and change their habitat. The toxic pollutants deposit over the water surface and can also affect sea animals.
- Depletion of the ozone layer – Ozone layer is protecting humans from harmful ultraviolet (UV) rays. It is depleting due to the presence of chlorofluorocarbons, hydrochlorofluoro-carbons in the atmosphere. As the ozone layer will go thin, it will emit harmful rays back on earth and can cause eye and skin-related problems [7].

III. COVID-19 LOCKDOWN AND AIR POLLUTION

Activity pattern changes because of COVID-19 lockdown, much of the world has experienced a new routine like fewer cars on the road and more time spent at home. In spite of these changes, Global Carbon Project, NASA's Aura satellite and ESA's Copernicus Sentinel-5P collecting key observations, on how the planet is responding to this changing behaviour due to restrictions in place from COVID-19 [9].

3.1 Carbon Dioxide (CO_2) –

Global Carbon Project shows the report from combination of energy, activity and policy data available up to the end of April 2020 is used to estimate the changes in daily emissions during the confinement from the COVID-19 pandemic and compared this change in emissions to the mean daily emissions for the latest available year (2019 for the globe) to provide a quantitative measure of relative change compared to pre-COVID conditions. Changes in activities give result in changes in reduction in Carbon dioxide.
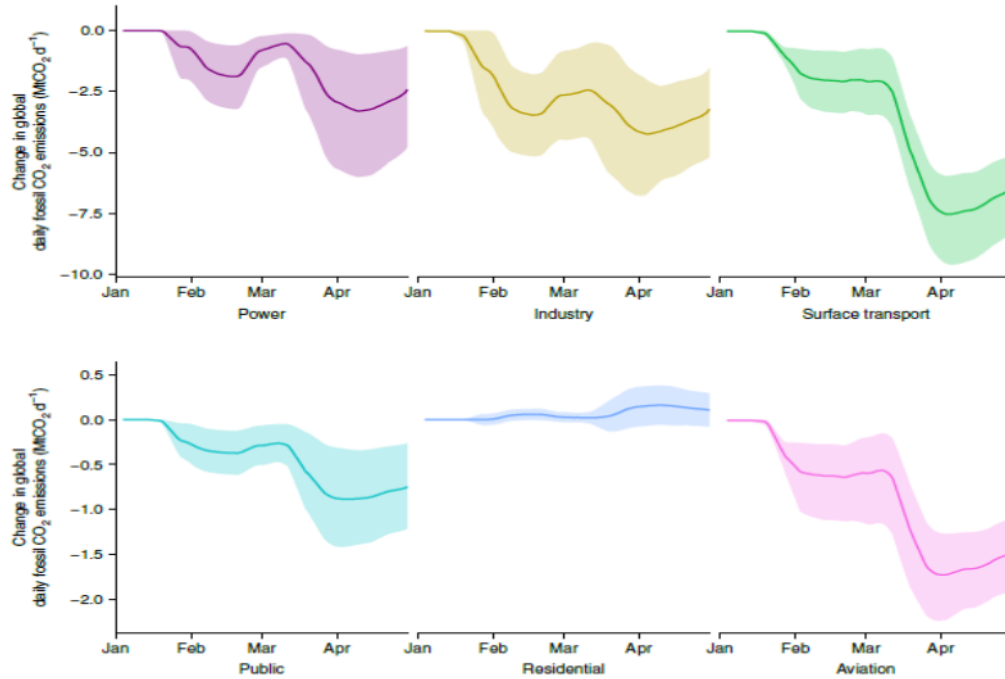

Figure 1 Change in global daily fossil CO_2 emissions by sector (MtCO$_2$ d^{-1}). (Source – Global Carbon Project)

The data represent changes in activity, to cover the six sectors are relative to typical activity levels prior to the COVID-19 pandemic, rather than direct changes in CO_2 emissions.

Activity	Changes in daily activities in percentage
Aviation sector	–75% (–60 to –90%)
Surface transport sector	–50% (–40 to –65%)
Industry sector	–35% (–25 to –45%)
public buildings and commerce sector	–33% (–15 to –50%)
Power sector	–15% (–5 to –25%)
Residential sector	+5% (0 to +10%)

Table 1 Change in global daily fossil CO_2 emissions by sector relative to annual mean daily emissions from those sectors in 2019. (Source – Global Carbon Project)
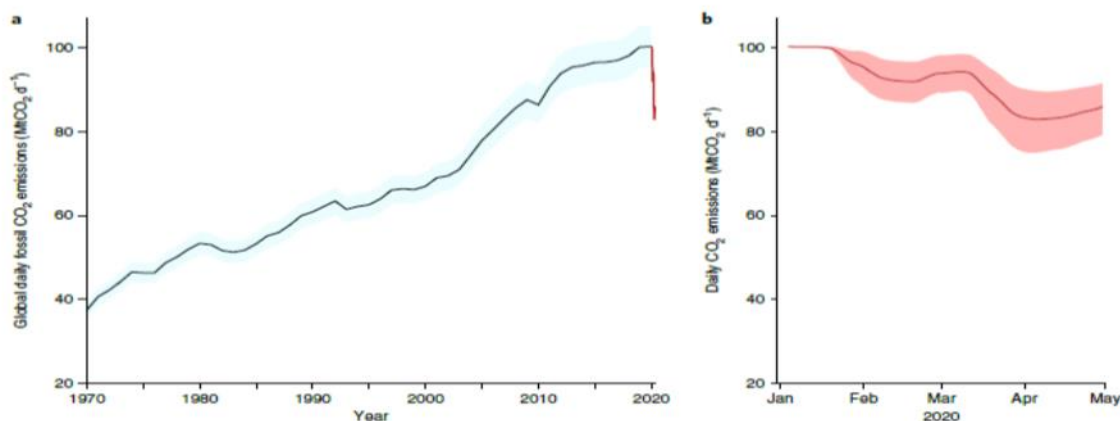
Figure 2 Global daily fossil CO2 emissions (Source – Global Carbon Project)

Fig 2a, shows the Annual mean daily emissions in the period 1970–2019 in black line and the red line shows the daily emissions up to end of April 2020 estimated. Fig 2b, shows Daily CO_2 emissions in 2020 (red line) [10].

3.2 Nitrogen dioxide (NO_2) –

Air pollutant Nitrogen dioxide emissions are strongly related to factory output and vehicles operating on the road. As both come to a halt during this COVID-19 pandemic, the changes in NO_2 level in environment is visible from space [11].
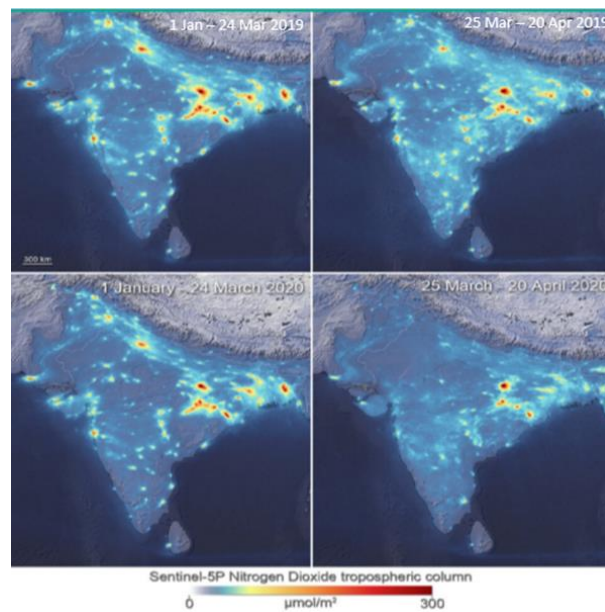
NASA's Aura satellite and ESA's Copernicus Sentinel-5P satellite are providing fundamental information about changes in atmospheric pollutant nitrogen dioxide in year 2020 during COVID-19 Lockdown period with respect to last years in some countries like India, China, United State and Europe [12].

3.2.1 India –

Lockdowns forced to standstill the spread of the coronavirus have been recently related with cleaner air quality. India observing levels fall by around 40–50% due to quarantine at national level. Only essential services including water, electricity and health services continuing active and all non-essential shops, markets and places of worship were closed.

Copernicus Sentinel-5P satellite produced new satellite maps which show averaged nitrogen dioxide concentrations over India from 1 January to 24 March
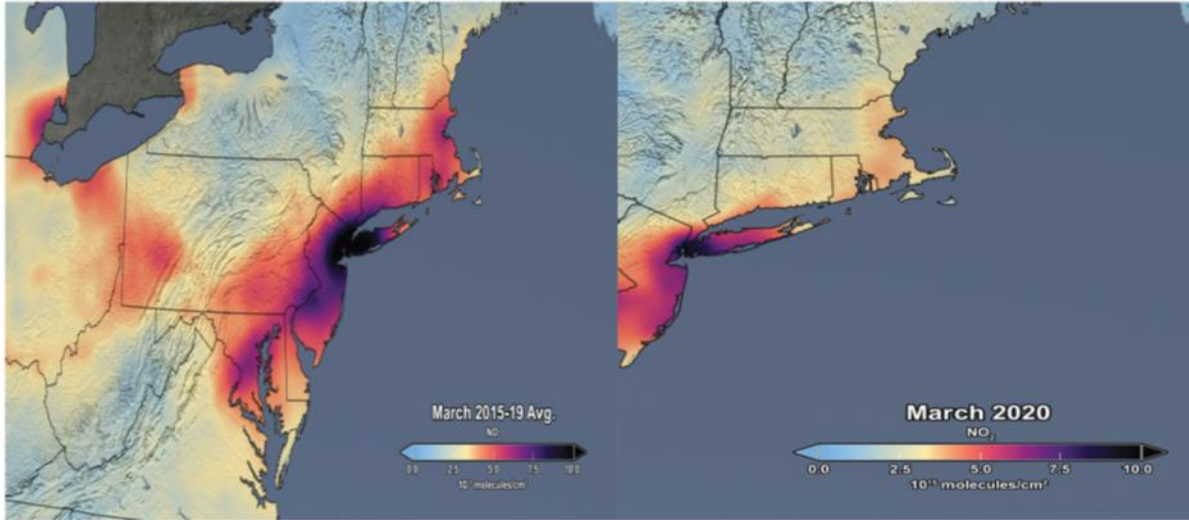
2020 and 25 March (the first day of the lockdown) to 20 April 2020 as compared to the same time frame as last year [13].

Figure 3 Changes in Nitrogen dioxide (NO_2) emissions in India (Source – Sentinel-5P Satellite image)

3.2.2 United State –

Ozone Monitoring Instrument (OMI) on NASA's Aura satellite measurements have found considerable decreases in urban air pollution of the Northeast United State. These current improvements in air quality have come at the cost of widespread lockdown and shelter-in spread of COVID-19.
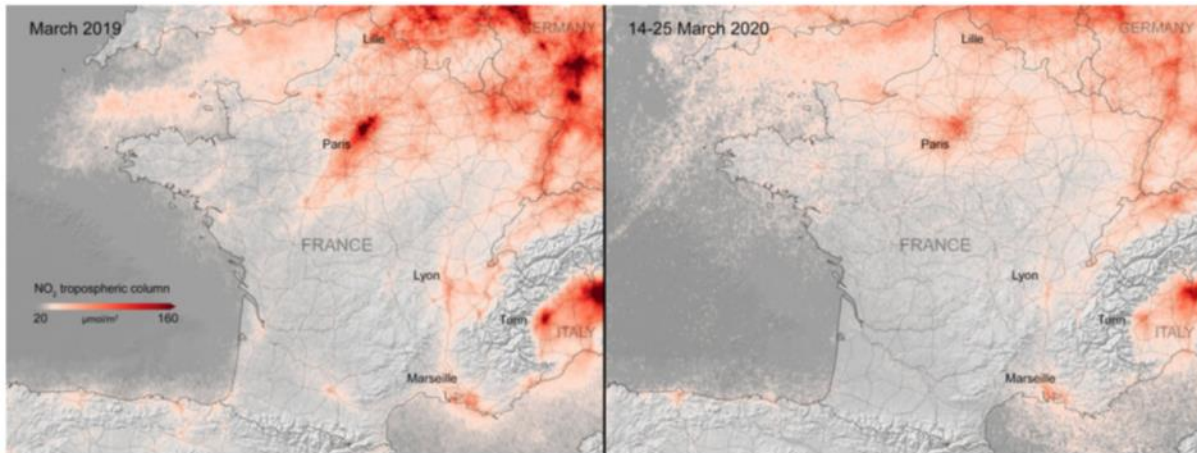
Figure 4 Changes in Nitrogen dioxide (NO_2) emissions in United State. The left image shows the average concentration in March of 2015-19, while the right image shows the average concentration measured in March of this year (Source - NASA's Aura satellite image)

The data represent that the nitrogen dioxide levels in March 2020 are about 30% lower than when compared to the March mean of 2015-19 on average across the region [14].

3.2.3 Europe –
Royal Netherlands Meteorological Institute's Scientists have been using data from Copernicus Sentinel-5P satellite to monitor both weather and pollution over Europe and has revealed a considerable drop in nitrogen dioxide concentrations, agreeing with the strict quarantine measures. The new images evidently show an effective reduction of nitrogen dioxide concentrations over major cities across Europe – specifically Milan in Italy, Paris in France and Madrid in Spain.

Figure 5 Changes in Nitrogen dioxide (NO_2) emissions in France, Euriope (Source – Sentinel-5P Satellite image)
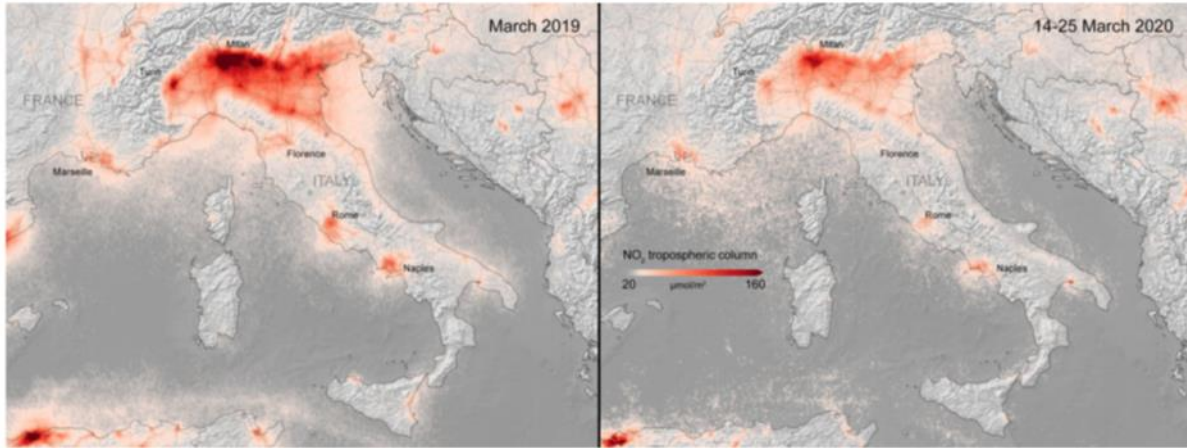
Figure 6 Changes in Nitrogen dioxide (NO_2) emissions in Italy, Europe (Source – Sentinel-5P Satellite image)

The satellite images show nitrogen dioxide concentrations from 14 to 25 March 2020 as compared to the monthly average of concentrations from 2019 [15].

3.2.4 China –

Chinese authorities had shut down transportation going into and out of Wuhan and local businesses also, in order to reduce the spread of the COVID-19 by January 23, 2020.

In initial analysis, NASA scientists compared NO_2 values detected by OMI in 2020 with the average amounts detected at this time of year from 2005-2019. In 2020, NO_2 values in eastern and central China were significantly (from 10 to 30 percent) lower than what is normally observed for this time period.

The data were collected by the Ozone Monitoring Instrument (OMI) on NASA's Aura satellite and the Tropospheric Monitoring Instrument (TROPOMI) on ESA's Sentinel-5 satellite has been making similar results.
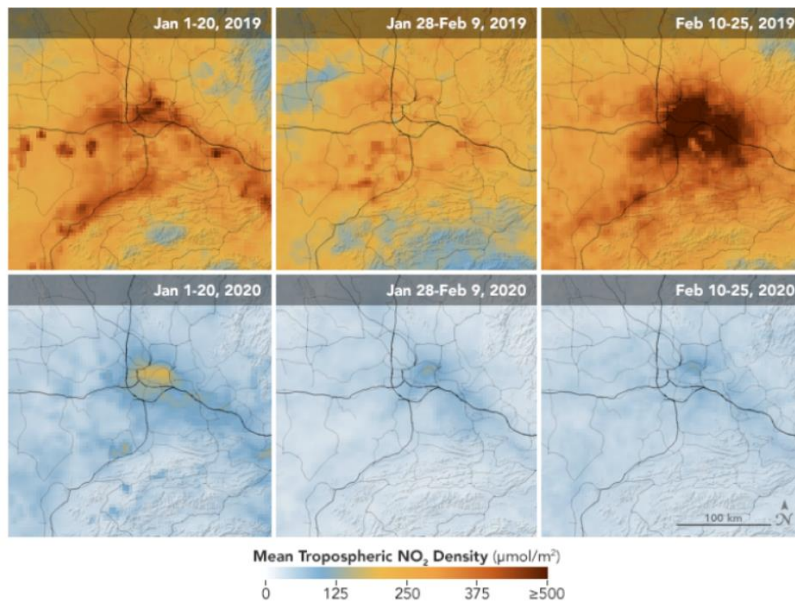
Figure 7 Changes in Nitrogen dioxide (NO_2) emissions in China (Source – NASA's Aura satellite and Sentinel-5P Satellite image)

Nitrogen dioxide (NO_2) emissions changes in year 2020 in comparison of past years' emission data of various countries [16] –

Country	Changes in Nitrogen dioxide emission from past years in percentage
India	40–50%
United State	30%
Italy, Europe	40%
China	10-30%

Table 2 Change in Nitrogen dioxide (NO_2) emissions. (Source – NASA's Aura satellite and Sentinel-5P Satellite reports)

IV. SUSTAINABLE URBAN PLANNING STRETEGIES FOR REDUCTION IN URBAN AIR POLLUTION

Most sources of urban pollution are well beyond the limit of persons and requires concentrated action by local, national and regional level policy-makers working in sector of urban planning [8].

The Urban Local Bodies require to provide solutions and be ensured on the usage of these policies and recommendations, as there is no second chance against the COVID19 pandemic [17]. Solution efforts on urban air pollution are always a big problem. This is why prevention interventions are always a better way of controlling air pollution [5]. These prevention methods can be achieved by some Sustainable urban Planning strategies-

4.1 Transit Oriented Development –
The integration of land use with transport systems is called "Transit Oriented Development", which is focused around a transit node and eases of access to the transit facility thereby inducing people to prefer to. The policy which helps in reducing Urban Air Pollution afterward COVID-19 lockdown as follow:
- Network & Connectivity – Separate high traffic volumes over multiple parallel streets rather than collecting traffic on few major arterial roads. Design a fine network of streets that make available choice of routes for all modes, reducing distances between places as well as journey times.

- Pedestrian access – Provide the shortest direct route to pedestrians and non-motorised modes to station and between building blocks as well.
- Streetscape Design – Pedestrian and bicycle friendly designated space for all activities reducing urban air pollution and maintaining social distancing as well. Planned Street and landscaping helps in prevention of urban heat island effects from wide and open streets.
- Function/Activities at nodes of public transport – Promote multi-functional developments around nodes that are otherwise deserted within evening or in the dark. Plan a mix of different types of users and inhabitants to create a lively and safe place.

4.2 Smart City Planning –
A smart city uses information, communication and technology to improve its liveability, workability and sustainability. A smart city provides e-services, by key functions of Information collection, communicating, and analysing, which helps to maintain social distancing.
- Automatic Parking System – The smart transportation refers to the integration of information and communication technologies with transport infrastructure to improve economic performance, safety, mobility and time saving of the citizens.
- e-Services – Various e-services can be offered in a modern smart city as follow:

e-Services of a Smart city	
e-Government	Public complaints, showing administrative procedure, bringing transparency in governance
e-democracy	Performing dialogue, consultation, polling and voting of issues of city
e-Business	Supports business installation
e-health and Telecare	Distant support and services to elderly, civilians with diseases, disabled
e-learning	Distant learning opportunities, training material to the students.

e-Security	Supports public safety via amber-alert notifications, school monitoring and natural hazard management
Environmental services	Information about recycling, guide households and enterprises in waste/energy/water management
Intelligent Transportation	Offers tools for traffic monitoring, measurement and optimization.
Communication services	Broadband connectivity, digital TV

Table 3 e-services of a smart city. (Source – URDPFI guideline volumn-1)

4.3 Green City Planning –
Green cities are promoting economic growth and development of urbans that reduce negative environmental impacts. Key Benefits of Green city as follow:-

• Effective Land Use – Green cities promote in effect land use and encouraging compact mixed-use developments.

• Habitat Prevention and Restoration – These cities prevent damage to the natural landscape, efficiency of agricultural land, biodiversity and natural habitat. These green spaces improve the quality of urban air environment and canopy reduces noise level as well.

• Efficient Transportation Management – Green city increases opportunities for non-motorised movement, bicycling, pedestrian friendly network, reduction in the number of automobile trips.

• Effective Use of Resources – Green city includes strategies like reduce-recycle-reuse which takes into account waste reduction initiatives by planning. Eco- friendly transportation services should be preferred which runs on CNG, bio-fuels, solar battery etc. Thus, Non-Motorised Transport (NMT) and Intelligent Transport System (ITS) should be encouraged.

• Amenities within walk-able distances – It reduce dependency on automobiles.

Services / Amenities	Distance
Rail Station	within 1/2-mile (800-meter)
Bus Stop	within 1/4-mile (400-meter)
ATM, Parking, Convenience shopping, religious facilities, crèche etc.	within 600-800 meters
School, Medical Clinic, Community hall with sports facilities, Restaurant etc.	within 1.6 - 2 km.

Table 4 Amenities within walkable distance. (Source – URDPFI guideline volumn-1)

4.4 Sustainable Planning –
Sustainable development creates a balance between the social and economic development of human habitat alongside the safety of environment, equity employed, basic services, shelter, social infrastructure and transportation. Some of these parameters, which can be considered in Planning and Development, are:

• Regional Planning – Regional development to control expanding unplanned and un-organized growth beside Master Plans/Development Plans along with integration of land use and transport resulting in sustainable development.

• Redevelopment / re-densification – Approaches shall be developed for Re-development / re-densification of existing urban habitat. Mixed land use, integrated and shared social space and multiple transport options are often considered and implemented to decrease trip generation and make efficient transport system.

• Open Spaces – Promoting vegetation/Green Belt in urban areas to reduce urban heat island effects. [18]

CONCLUSIONS

Air pollution causes a major threat to health and urban climate. The mixed impacts of ambient (outdoor) and household air pollution cause about seven million premature deaths every year, mostly as a cause of increased mortality from stroke, heart disease, chronic obstructive pulmonary disease, lung cancer and acute respiratory infections etc. Global warming, acid rain, eutrophication of water bodies, changing in habitat of

wild-animals, Depletion of the ozone layer are also be affected by increase in urban air pollution.

COVID-19 pandemic is related to human health and it is main concern to secure people from the pandemic. Offices, industries, business sector, education sector and transportation activities were reduced due to COVID-19 lockdown. People are forced to live at home and this changed their day to day behaviours and patterns to prevent from the virus. Scientists found reduction in air pollutants (specially in NO_2 & CO_2) as industrial, transportation, and business activities have reduced. But these change can be return to as before when all the activities were resume as before. Therefore strong Stretegies are required to control air pollution at urban level.

Sustainable Urban Planning Stretegies with individual efforts can reduce and control the effects of air pollutants on respiratory health. Reducing the levels of air pollutants will have a significant effect on health. Furthermore, implementation of sustainable Urban Planning Stretegies can encourage or mandate Urban Planning policies that reduce emissions from various sectors and create sustainable and liveable urban environment.

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