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A REVIEW: URBAN FOREST AND CLIMATE CHANGE

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ABSTRACT

Climate change has an impact on forest growth and production both directly and indirectly through changes in temperature, precipitation, weather, and other variables. Also, increased carbon dioxide has an impact on plant development.

Urban forests are affected according to how climate change affects water cycles. Cities can more effectively adapt to the impact of climate change on temperature patterns and weather occurrences due to urban trees. Compared to their surroundings, cities are often warmer. Transitions in temperatures and weather patterns over a long period of time are referred to as climate change. Urban forests are more prone to experience climate change effects like temperature increases in urban areas.

Urban trees and the numerous advantages they provide to city dwellers are at risk due to climate change. Generally, trees that are more tolerant of drought, have evergreen leaves, and are younger tend to grow bigger and quicker than anticipated, whereas trees that are less tolerant of drought, have deciduous leaves, and are older are more likely to show size restrictions.

Key words: Climate change, Resilient, Urban forest

CLIMATE CHANGE

GLOBAL:

According to United Nations Framework Convention on Climate change (UNFCCC) **"Climate change"** means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. The UN Framework Convention on Climate Change (UNFCCC) lays out the fundamental legal framework and guiding principles for international climate change cooperation with the goal of stabilizing atmospheric concentrations of greenhouse gases (GHGs) to prevent "dangerous anthropogenic interference with the climate system."

The Kyoto protocol was adopted on 11 December 1997, Owing to a complex ratification process, it entered into force on 16 February 2005.Currently, and there are 192 parties to the Kyoto protocol. In short, the Kyoto protocol operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries and economies in transitions to limit and reduce greenhouse gases (GHG) emission in accordance with agreed individual targets. The convention itself only asks those countries to adopt policies and measures on mitigation and to report periodically.

The Kyoto protocol is based on the principles and provisions of the convention and follows its annex-based structure. It only binds developed countries, and places a heavier burden on them under the principles of "common but differentiated responsibility and respective capabilities", because it recognizes that they are largely responsible for the current high levels of GHG emissions in the atmosphere.

The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015.

(Samer Fawzy, july,2020) Stated that, As a result of greenhouse gas emissions from both natural and human-made systems, climate change is defined as a shift in the patterns of the climate. If the current emission rates continue, anthropogenic activity-induced global warming would likely increase by 1.5 °C between 2030 and 2052, or around 1.0 °C Over pre-industrial levels. There were 315 natural disasters throughout the world in 2018, most of them had a climatic component. Over 68.5 million people were affected, and there were $131.7 billion in economic damages, of which storms, floods, wildfires, and droughts accounted for roughly 93%. It's pretty disturbing that the economic losses linked to wildfires in 2018 alone are virtually equivalent to all of the losses from wildfires over the previous ten years combined.

The most vulnerable industries to climate change attacks are food, water, health, ecosystems, human habitat, and infrastructure. The Paris Agreement was established in 2015 with the primary goal of limiting the rise in global temperatures to 2 °C by the year 2100 and pursuing efforts to reduce the increase to 1.5 °C. The three primary methods for reducing climate change conventional mitigation, negative emissions, and radiative forcing geoengineering—are covered in this article. Traditional mitigation techniques concentrate on lowering CO_2 emissions from fossil fuels.

Technologies that minimize emissions of carbon dioxide attempt to capture and store atmospheric carbon. In order to stabilize or lower global temperatures, geoengineering methods of radiative forcing modify the earth's radiative energy budget. As it is clear that traditional mitigation measures alone will not be sufficient to reach the Paris Agreement objectives, the use of other pathways seems unavoidable. Biogenic-based sequestration techniques are quite established and may be used right away, but other technologies may still be in the early stages of research.

The overall greenhouse gas emissions in 2018 were 55.3 $GtCO_2e$, according to the emissions gap report created by the United Nations Environment Programme (UNEP) in 2019. Of that amount, 37.5 $GtCO_2$ are ascribed to fossil CO_2 emissions from energy generation and industrial activities. 2018 saw a rise of 2% compared to an average yearly growth of 1.5% over the previous ten years for both total global greenhouse gas emissions and fossil CO_2 emissions.

The increase in energy consumption in 2018 is the primary cause of the growth in fossil CO_2 emissions. Furthermore, emissions resulting from land-use change totaled 3.5 $GtCO_2$ in 2018.

The greenhouse gases defined by the Kyoto protocol are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and the fluorinated gases such as hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) and sulphur hexafluoride (SF_6) (unfccc, n.d.)

(Lea Berrang-Ford, 2010) Climate change will need human systems to adapt. Yet, because to a lack of knowledge on whether and how adaptation is occurring, knowledge of the size of the adaptation problem at a global level is incomplete. Here, we establish a framework for tracking and describing adaptation action and apply it to the peer-reviewed literature in English. Our findings contradict certain well held notions about adaptation while confirming others. (1) Although there has been a lot of study on adaptation, most studies only discuss vulnerability analyses and natural systems (or plans to respond), not adaptation activities. (2) Adaptation actions are rarely driven primarily or only by climate change. (3) Extreme occurrences serve as crucial regional adaptation triggers. In advance adaptation is the most often seen adaptive reaction, especially in wealthy countries. (5) Adaptation activity is more commonly reported in affluent countries, with middle-income countries being underrepresented and reports from a limited number of countries predominating in low-income regions. (6) Reporting on adaptations being created to benefit from climate change or concentrating on women, the elderly, or children is scarce.

Yet, knowledge on the scale of the adaptation difficulty is lacking. Exists an adaption process already? Who, what, and how are adapting? Do adaptation patterns vary among and within nations, regions, and industries? Are adaptations in line with the threats that climate change presents? On these issues, we have pictures. Some instances of adaptation in action are included in IPCC AR4, using a style used by country level climate change assessments.

Definitions from the IPCC AR4 used as a basis for document classification, inclusion/exclusion standards, and sub-categorization. Climate change in this context refers to any alteration in the climate through time, whether brought on by natural variability or human action. In order to mitigate harm or take advantage of advantageous chances, adaptations comprise changes made to human systems in response to present or anticipated climatic stimuli or their consequences. Studies reporting primarily on risk or vulnerability assessments, mitigating factors, general sustainable development, and conceptual or theoretical methods were also omitted. Here, we distinguished between declaring one's intentions to act and really acting on those intentions; (Lea Berrang-Ford, 2010)

Its overarching goal is to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5°C above pre-industrial levels." However, in recent years, world leaders have stressed the need to limit global warming to 1.5°C by the end of this century.

That's because the UN's Intergovernmental Panel on Climate Change indicates that crossing the 1.5°C threshold risks unleashing far more severe climate change impacts, including more frequent and severe droughts, heat waves and rainfall. To limit global warming to 1.5°C, greenhouse gas emissions must peak before 2025 at the latest and decline 43% by 2030.

According to (Olazabal, November 2012) urban planning and policy must be coordinated to address both local and global environmental issues since urbanization is a major contributor to global environmental change. We contend that cities play a significant role in the global sustainability crisis, necessitating an immediate shift in urban behaviors. In order to think about how to deal with change, the notion of resilience in the context of urban dynamics has just lately emerged.

(Leichenko, June 2011) Stated that in the literature on cities and climate change, the concept of resilience is rising in importance.

Terms like "climate resilient," "climate-proofing," and "the resilient city," which are often used, underline the necessity for cities, urban systems, and urban constituents to be able to swiftly recover from shocks and strains connected to the climate.

NATIONAL:

India's average temperature increased by almost 0.7°C between 1901 and 2018. This temperature increase is mostly the result of climate change brought on by greenhouse gases (GHG)-induced warming. Both in terms of human fatalities (2,267 persons) and economic losses (66,182 million US dollars PPP), India was the 7th most impacted country in 2019 by extreme weather events caused by climate change. In reality, 17 out of 20 people in India are now at risk of severe hydrological and meteorological (or "hydromet") disasters including flood, drought, and cyclone as a result of extreme weather events brought on by climate change.

The first global climate risk index with a child-centered perspective is presented in UNICEF's 2021 study, "The Climate Crisis Is a Child Rights Crisis: Introducing the Children's Climate Risk Index" (CCRI). India is placed 26th overall out of 163 nations in the study. This suggests that children in India are among those who are most "at-risk" from the effects of climate change, posing a threat to their safety, education, and health.

According to the same study, 90% of children worldwide breathe contaminated air every day, and air pollution is linked to several of the leading causes of pediatric death, including pneumonia. According to the Status of Global Air report for 2020, Asia (which according to sources includes India) and Africa have the highest age-standardized rates of deaths related to PM2.5 worldwide. India is home to 21 of the world's 30 most polluted cities, putting millions of people at risk for respiratory ailments and other associated conditions. According to a 2018 Lancet report, 1.24 million people in India died from air pollution in 2017. (12.5 per cent of total deaths). (UNICEF, n.d.)

According to (world bank, n.d.) India is one of the Nation's most at risk from climate change. It contains one of the greatest concentrations of economic activity in the whole globe, as well as a sizable population of destitute people who depend heavily on rainfall and the availability of natural resources for their survival. The pressure on India's water, air, soil, and forests is anticipated to reach its peak by 2020.

India's water resources will be one of the main areas where climate change will have a substantial influence on people's livelihoods. Although it is necessary for life, water all too frequently causes destruction through disastrous floods and droughts. These shocks will only get worse as the environment changes.

Climate change is a bitter reality for a growing country like India. This is mostly due to the fact that traditional means of producing energy and resources form the basis of a developing nation's progress. Such nations frequently find themselves in contradictory situations despite significant technological advancements.

The National Action Plan on Climate Change (NAPCC), which outlines national climate change policy, focuses on human development and economic and industrial development.

Levels of smog in cities have decreased because to local measures. Although though India accounts for 17.8% of global population, it is interesting that India is not to blame for temperature increases. Just 3.2% of total emissions are attributable to it (sharma, March-2022)

IMPORTANCE OF URBAN FOREST

There are many various sizes and types of urban woods. Urban parks, street trees, landscaped boulevards, gardens, river and coastal promenades, greenways, river corridors, wetlands, wildlife preserves, tree-shelf belts, and working trees at former industrial sites are a few examples of these. Urban forests provide the green infrastructure on which communities rely by connecting green places in planned ways. From the neighborhood to the metro area to the regional landscape, green infrastructure functions at various sizes. (Forest Service, n.d.)

Urban forests are a substantial and vital element of the urban landscape. Yet, decision-makers continue to lack proper management of these priceless assets due to the few knowledge on the advantages and disadvantages of urban trees and forests currently accessible to them.

The advantages that arise from urban forests are not as great as they may be since urban forest resources are disappearing in many places. Costs are often more than required in many situations.

Urban trees and woods have a long lifespan, thus future demands must be considered while planning. Long-term financial commitments are made in the planting and upkeep of trees, and incorrect planting can raise expenses and diminish returns. (Dwyer, September 1992)

Planning for urban development initiatives should take into account the potential loss of green space amenities. In order to evaluate urban land use, quantifiable data on inhabitants' opinions about urban forests are required. (Tyrväinen, May 2001)

Metropolitan areas cause environmental issues that are observed on all scales, from the domestic to the global. These issues can affect human health negatively, lead to damage towards the economy and other aspects of wellbeing, or impact the ecosystem. (Kuchelmeister, 2000)

In developed nations, many urban foresters interchangeably use the words "urban greening" and "urban forestry" (e.g. Miller, 1997). The most inclusive definitions include all forest areas impacted by urban development as urban forests. Urban forestry, in a more narrow sense, refers to trees and woods in towns and cities, including garden and agricultural trees, street and park trees, remnant forests, and growing woodlands on bare and abandoned land.

Urban regions in developing nations struggle with issues such as poor waste management and pollution control, uncontrolled habitation of sensitive lands, floods, and soil erosion.

Malnutrition is a major issue for those lacking in resources. Only multisource urban forest management is practical in underdeveloped areas. Multifunctional parks, for instance, are a part of slum redevelopment programmes in Durban, South Africa; they are utilized for wastewater treatment, gardening, and storm water catchment as well as sewage treatment.

The sustainability of towns and cities is greatly influenced by trees, which constitute an essential component of the natural life support system. Urban forests provide both obvious (food, energy, lumber, and fodder) and less obvious benefits to suit local needs, which is becoming more recognized as an improvement to urban life. Particularly crucial for urban poor communities is multipurpose urban forestry. (Kuchelmeister, 2000)

Determining the goals for managing vegetation in cities is one of the first steps in creating a solid and complete urban forestry programme. Urban trees may enhance both people's health and the urban environment in a variety of ways. To maximize the net advantages of urban greenery, one must also be aware of a variety of possible costs and, as with all ecosystems, a number of interactions.

The contribution of vegetation to enhancing urban environments and quality of life may be significantly reduced if there is insufficient understanding of the vast variety of advantages, disadvantages, and anticipated results of urban vegetation management strategies, as well as interactions among them.

The physical, biological, and economical environments of a city can all be impacted by changing the type and placement of trees there (i.e., the urban forest structure). It is possible to create and implement management strategies to handle certain issues in cities.

Although the fact that trees can offer a variety of advantages at a single area, not all advantages can always be attained in every circumstance. The main goal of any management plan should be to maximize the combination of advantages that matter most in that specific region (David J. Nowak., et al, 2007)

Information on urban forest structure (species composition, tree size and location, etc.) provides the basis for understanding the urban forest functions that affect urban inhabitants and for improving management to maximize the environmental and social benefits of urban forests.

Urban morphology, which creates the spaces for vegetation, natural factors, which affect the amounts and types of biomass likely to be found within cities, and human management systems, which take into account interurban variations in biomass configurations according to land use distributions, all work together to determine the structure of urban forests.

Urban forest structure refers to the three-dimensional spatial organization of vegetation in urban settings (species composition, tree size and health, quantity and placement of trees, etc.). Information on this structure serves as a foundation for understanding how urban forests affect city dwellers (e.g., by modifying air temperature, lowering stress levels in people, reducing air pollution, enhancing a sense of community, etc.), as well as for improving management to maximize the environmental and social advantages of urban forests. (David J. Nowak,1994)

Our cities' heart may be seen through the windows of our urban and communal trees. They are a reflection of the ideals, way of life, and aspirations of both present and former citizens. Understanding a city's vegetative resource will help us determine how much and where private and governmental institutions will invest going forward. (Sudha, February 2000)

The kind and intensity of human influence on urban vegetation has a significant impact. The combination of native and imported plants in urbanized areas is determined by elements from the natural and cultural domains interacting.

Determining the variables that influence the organization and composition of species assemblages in urban environments would be a significant issue for urban ecology. Our capacity to protect ecological variety in all types of human-modified ecosystems would be significantly improved by such an understanding. (Sudha, February 2000)

IS URBAN FOREST RESILIENT TO CLIMATE CHANGE?

It is generally acknowledged that trees provide a variety of ecological services in urban settings. The extent of their participation, however, is directly correlated with their physiological state and ability to survive in our towns and cities. Water deficits are a primary physiological constraint affecting the performance of urban trees due to root loss during transplanting, restricted soil volume, disturbance of soil hydrological processes, and impermeable surfaces. (Sjöman.,et al, 2015)

Cities all across the globe are focusing more on resilience as a policy objective as they work to recover from both acute and chronic pressures. In addition to offering several advantages to city dwellers and boosting the resilience of the wider social-ecological system, trees and forests are essential elements of the urban ecosystem. The concept of understanding ecosystem services (and shortcomings) in connection to system vulnerabilities may be explored via the lens of resilience theory. The notion of resilience was first discovered in the discipline of natural science. (Huff., et al, 2020)

A healthy urban forest is resistant to short-term stresses including insect and pest infestations, cold weather, drought, and specific human effects.

An unsustainable forest has a diminishing population, a high proportion of sick trees, and a high rate of turnover, all of which lead to fluctuating tree counts and a loss of ecological, social, economic, and aesthetic advantages.

It's really challenging to allocate money for urban forest management because rapid changes in the tree population, as those that happened when Dutch elm disease killed significant numbers of street trees because of monocultures, can lead to unexpectedly high costs within a short period of time. (McPherson, July 1998)

In addition to assisting with climate adaptation, green infrastructure initiatives also aid in achieving sustainability and resilience goals across a variety of outcomes. The advantages of green infrastructure for climate adaptation often relate to its capacity to lessen the effects of severe temperature or precipitation. (Foster., et al, February 2011)

Better storm-water runoff management, decreased incidents of combined storm and sewer overflows (CSOs), water capture and conservation, flood prevention, storm surge protection, defense against sea-level rise, accommodation of natural hazards (e.g., relocating out of floodplains), decreased ambient temperatures, and reduced urban heat island (UHI) effects are all advantages. (Foster., et al, February 2011)

Urban areas will have to deal with managing extremes in precipitation and temperature, increased storm frequency and severity, and sea-level rise over the next century, according to climate change predictions. The issues that metropolitan regions are currently struggling with may be already signaling—or at the very least mimicking—the onset of climate change consequences and their propensity to get worse. (Foster., et al, February 2011)

The sensitivity of urban forests to climate change has also been disregarded in professional practise and in the choices that must be made to mitigate this vulnerability. The majority of research on urban forests and climate change focuses on choosing the right tree species, planting high-quality tree stock, and placing trees where they are most likely to grow (i.e., in habitats with ideal soil volume and quality, optimal irrigation, and damage mitigation).

A successful adaptation to climate change in urban forestry, however, depends on a variety of social processes, including coordination and communication between decision-makers, funding, staffing, regulatory frameworks, and community support, among others, because decisions about urban forests are linked to city planning. (Barona)

Increasing urban resilience is a top goal for decision-makers throughout the world as cities start to feel the consequences of climate change. The IPCC defines adaptive capacity as "the ability or capability of a system to adjust successfully to climatic variability and change" and notes that it is a crucial component of urban resilience.

Urban trees in the city may perform a variety of tasks, including adaptation to climate change, and should be taken into account when planning for resilience.

A research conducted by (Natário, January 2017) In order to improve the effectiveness of urban forest design and management, numerous solutions have been proposed. In this study, I suggest, among others:

1. Combat pests and diseases that attack urban afforestation
2. Correct selection of trees for each specific area (the right tree for the right place)
3. Biodiversity of tree plantation
4. Public and private afforestation projects and initiatives
5. Participation planning
6. Create a forest agency
7. Proper training for city maintenance services
8. More scientific data linking urban forest to resilience (carbon sequestration data from an urban forest)
9. planting techniques that reduce the need for supplementary watering, reduce maintenance requirements, isolate roots from potentially polluted urban soils, and that facilitate transplantation

It is widely accepted that urban forests may be used to reduce climate change. Although the benefits of trees to the environment are generally recognized, studies of urban forests as a system or even their contribution to improving cities' ability for adaptation to the present climate change challenge are seldom taken into account. (Natário, January 2017)

For urban afforestation initiatives and efforts to be really successful, it is crucial that both public and private programmes and initiatives take models, management strategies, and planning frameworks into consideration. (Natário, January 2017)

In rapidly urbanizing areas, natural vegetation becomes fragmented, making conservation planning challenging, particularly as climate change accelerates fire risk. (Pendal., et al, 2022)

Numerous advantages that the urban forest offers individuals might help those live healthier and happier lives. Yet, because to the concentrated amplification of temperatures by certain elements of the built environment, a fast warming globe faces severe problems for preserving the existing tree canopy. The public's image of trees as "green infrastructure" and how much urban forest help attempts to increase regional climate change resistance further complicate the situation. (Vivek Shandas, June 2021)

Sustaining everyone's quality of life is crucial in an era where cities are growing and more people are residing in them. One important factor in this is urban woods. To preserve human health and well-being in metropolitan environments, productive ecosystems are crucial. (Sina Rogozinski, 2011)

Urban ecosystems like urban forests, however, can be put in peril by issues including escalating urbanization, a changing climate, and soil, air, and water pollution. It is thought that one way to retain the ecosystem services offered by urban forests is to have or create resilient urban forests.

While some are crucial for human health, they could in the future become necessary for human life in metropolitan settings. Droughts are a serious threat to life in urban areas, especially for young trees, as a result of climate change and urbanization.
Complex adaptive system dynamics and the ability to adjust to change both depend on resilience. It focuses on how slow and rapid changes interact and how well something or someone can adapt to dynamic change. After a disruption, it may often be regarded as having the capacity to revert to its original condition. (Sina Rogozinski, 2011)
Living in cities is impacted by the harsher climate and poor air quality that are a part of the urban environment. People are particularly vulnerable to climate change because heat islands and impermeable surfaces intensify catastrophic weather occurrences. Since they offer ecosystem services that get better as trees get bigger, urban trees are crucial instruments for cities' adaptation to climate change and mitigation. (Liu., et al, july,2021)

IMPORTANCE OF TREES IN CITIES:

By releasing oxygen into the air and absorbing carbon dioxide, trees lessen the "Greenhouse" impact. A mature tree generates 10 people's worth of oxygen every year. Trees may reduce noise pollution and act as an effective sound barrier. According to recent study, trees also aid to lessen the stress of contemporary living.
However, because they are a vital component of the ecosystem, trees also aid animals and biodiversity in addition to the environment and the scenery. The habitats that trees provide for native ground flora like bluebells as well as animals, including bats, red squirrels and invertebrates, include older or veteran trees, groupings of trees and forests.

Making Trafford a beautiful place to live, work, learn, and unwind may be achieved in large part via the planting of trees as well as the maintenance and preservation of older trees.
By supplying oxygen, enhancing air quality, reducing climate change, saving water, maintaining soil, and fostering animals, trees benefit their surroundings. Trees absorb carbon dioxide during photosynthesis and turn it into the oxygen we breathe. One acre of forest may absorb six tons of carbon dioxide and emit four tones of oxygen, per the U.S. Department of Agriculture. This is enough to cover 18 people's annual requirements. By eliminating dust and absorbing other pollutants including carbon monoxide, sulphur dioxide, and nitrogen dioxide, trees, bushes, and turf also act as air filters. Rain washes harmful particles to the ground after trees catch them.
Trees are crucial to the eco-systems in which they live, both above and below ground. Long-reaching roots prevent soil erosion by holding it in place. Trees collect and hold rainwater, reducing runoff and post-storm sediment deposition. As a result, floods, chemical movement into streams, and ground water recharge are all prevented. Leaves that have fallen form wonderful compost that improves soil.

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