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Sustainability and Challenges of Climate Change Mitigation through Urban Reforestation - A Review

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Abstract

The realities of Climate change and its untold implications on the livelihood of man are no longer new worldwide. In attempts to subdue the negative implications of Climate change scenario globally, several measures have being suggested and being put in place. One of such measures is urban reforestation especially in the developing nations where forest resources have extremely and uncontrollably exploited. Most of cities in developing nations are almost devoid of regularly maintained trees for whatever purpose. Thus, the enormous roles which urban tree performs are lacked in most cities. In order to subdue excessive heat in cities arising from exposure of urban land areas urban reforestation exercise needs to be embarked upon. The investigation was carried out through desk studies and review of relevant publications to examine what it entails to have a sustainable reforestation programme in cities. The study revealed that several factors need to be taken into consideration if sustainable urban reforestation will be achieved, especially in developing countries. These factors include urban soil nutrients status investigation, appropriate tree type study, public perception about the tree types, relevant legal instrument to achieve successful reforestation exercise in cities among others were found to be salient to this exercise. Urban reforestation has enormous potentials to subdue Climate change consequences, including urban renewal if adequate provision is made for its sustainability, especially in developing countries. To ensure this is realized it is recommended that relevant ministry/agency could be put in charge for the maintaining, cutting and replanting of urban tree and all that are involved in urban tree sustainability.

Key Words: sustainability, climate change, urban tree, climate change mitigation, reforestation

Introduction

The increasing variability in the global climate and the associated risks coupled with its mitigation are on the top priority of the global community in view of its consequential effects on the sustainability of man on the earth. Stern (2006) in buttressing this assertion stated that accelerated Climate change and increasing climate variability present serious global risks that demand urgent global response. It was on the basis of this observation that the United Nations and other stakeholders, international, national and local, have been involved in series of conferences aiming at discovering ways of mitigating it. For instance series of Conferences on Climate change have been organized by the United Nations since 1995 when the first conference was held in Berlin, Germany. The last three Conferences have been held between 2nd and 13th December, 2019 in Chile; between 2nd and 15th December, 2018 in Katowice, Poland and between 6th and 17th November in Bonn, Germany. The 2020 version is scheduled to hold from 9th

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Stockholm Environmental Institute (SEI) (2014) and Guha-Sapir et al. (2013) had revealed that the results of recent research has estimated the average annual damages from disasters triggered by climatological, hydrological and meteorological hazards in 2002-2011 at US$163 billion, US$24 billion and US$52 billion respectively. Of all these damages done, Guha-Sapir (2014) further exposed that 47.9% occurred in Asia, 38.6% in Americas, 9% in Europe, 3.7% in Oceania and less than 0.8% in Africa. It was further stressed that the global variations in economic losses which revealed that it was highest in developed countries, while fatality rates and economic losses in terms of Gross Domestic Product (GDP) are higher in developing countries.

However, climate-related disasters have also become a rallying point in the international climate negotiations to move for more ambitious climate action, Thus, this investigation into Climate change impacts and its mitigation is Thus, timely and policy relevant issue respectively in the developing nations.

In her own view, Nwakwoala (2015) stated that since human lives are directly linked to the climate, it is therefore of no gain saying that human activities are changing the climate. He further lamented that there has been a continuous rise in global temperature in the last 130 years, which has huge consequences on a wide range of climate-related factors. He highlighted Climate change impacts to include ice caps melting due to rise in temperature, rise in sea levels among others. Thus, as man experiences impacts of Climate change which will not be favourable to human existence, it is imperative that we begin to make choices that will reduce greenhouse gas emission (GHG), which, according to Uwakwoala, stated the best way to achieve is get younger generations educated through educational systems and other avenues of public enlightenment. Law et al. (2018) in corroborating this view stated that GHG reduction needs to be pursued vigorously to avoid surpassing a 2°C increase in temperature since pre-industrial times. Alterations in forest management can contribute to increasing the land sink and decreasing emissions by keeping carbon in high biomass forests, extending harvest cycles, reforestation, and afforestation. It was further asserted that forests are carbon-ready and do not require new technologies or infrastructure for immediate mitigation Climate change.

Hohne et al. (2014) in their view expressed that industrialised countries started to increase CO_2 emissions from energy use much earlier while developing countries contributions to the emissions are majorly through land use changes and forestry as well as of methane (CH4) and the nitrous oxides (N_2O) were substantial before their emissions from energy use.

Munishi et al. (2008) attributed the changes in global climate to the increasing concentration of CO_2 in the atmosphere. With the increasing concern about the rise in the atmospheric CO_2 and its implications on on global climate, terrestrial ecosystem management has been looked upon as a potential way of mitigating carbon emission (Munishi and Shear 2004). Land use changes and forest management activities have historically been and are currently net sources of C (as CO_2 gas) to the atmosphere (Brown et al. 1996). However, forest management has a great potential for emission mitigation by withdrawing C from the atmosphere and accumulating it in vegetation biomass and soil (Munishi 2001; Munishi and Shear 2004). Land use changes and forestry were identified as the most important sources and sinks of anthropogenic greenhouse gases in Tanzania (Omujimi 1994; Kabisch et al. 2016; Xu et al. 2016) though here are no quatitative data to show which changes create net sources or net sinks.

Berrang et al. (1985) and Gonçalves et al. (2019) revealed that healthy trees and forests provide communities with a host of climate-related benefits. Active planning, management and care of the urban forest can improve its resilience to Climate change and help cities and communities better adapt. In the same vein, Intergovernmental Panel on Climate Change (IPCC) (2014) revealed that the maintenance of urban green spaces is also one of the approaches suggested for the management of Climate change risk through adaptation, in particular through the reduction of vulnerability and exposure through development, planning and practices that include "low-regret" measures, i.e. those that produce benefits even in the absence of Climate change and with which the adaptation costs are relatively low compared to the benefits of the action. Konijnendijk et al. (2006) defined urban forest as “the art, science and technology of managing trees and forest resources in and around urban community ecosystems for the physiological,

sociological, economic, and aesthetic benefits trees provide society". The urban forest has been described as "the sum of all woody and associated vegetation in and around dense human settlements, ranging from small communities in rural settings to metropolitan areas" (Miller 1997). Konijnendijk (2011) and Putz et al. (2015) revealed that urban forests accordingly comprise different elements, such as urban woodlands, parks, civic squares, green corridors and single trees. They form part of the urban and peri-urban green infrastructure (GI) that is usually shaped and managed, by professionals from different disciplines and public authorities. In another sense, GI is being used in contemporary times, especially among the Europeans and Americans. Benedict and McMahon (2002) defined GI as an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human population. In Kambites and Owen (2006) and Wright (2011), it was submitted that GI is taken to encompass connected networks of multifunctional, predominantly unbuilt, space that supports both ecological and social activities and processes.

Among the benefits of Urban tree include: apartment buildings with high levels of greenery have been shown to have approximately half the number of crimes than those with little or no greenery; also, it has been revealed that residents living in areas without nearby nature reported more aggression and violence than those living with nearby green. moreover, access to nature also provides humans with other benefits such as : (i) Parks and other green spaces provide a space for people to play, walk, joy, bird watch or just to sit quietly. All these activities are good for human physical health in a society that is increasingly sedentary and also good for mental health by providing a place to unwind. In addition, trees reduce noise levels.

Benefits of urban forest

Findings have shown that urban forestry could be a good source of investment (Zhang et al. 2007; United States Environmental Protection Agency [USEPA] 2011; Hansmann et al. 2016; Kabisch et al. 2016; Xu et al. 2016) among others. Other benefits as listed by Huang et al. (1990), Burden (2006), Dwivedi et al. (2009) include the following: reduction in energy costs, shading, evapotranspiration and wind speed reduction provided by trees help conserve energy in buildings, thereby, minimizing urban heat island, trees make homes and neighborhoods more desirable places to live. Urban forests also serve as source of income when properly managed in such a way that the cost of raising and maintaining such parks/forests can be defrayed from the income. However, proper guides, rules and regulations must be put in place to ensure that the other benefits of the tree are not jeopardized. In addition, Akay and Önder (2016) and Frigeri et al. (2017) listed ecological advantages derived from urban forests including absorption of gaseous pollutants (e.g. ozone, nitrogen, oxides, sulfur chlorides) through leave surfaces, interception of particulate matter (e.g. dust, ash, pollen, smoke), capturing of CO_2 and the release of oxygen through photosynthesis and lastly, transpiration of water and shade surfaces, which lowers air temperatures, thereby reducing ozone levels. Furthermore, urban tree are also valued for their roles in carbon sequestration and storage, which is, however, salient to the process of Climate change mitigation. Moore (2006) estimated that about 100,000 Urban tree could sequester about one million tonnes of carbon. The oxygenation significance of Urban tree may not be comparable to that of other sources like ocean and forests as noted by Nowak et al. (2006, 2007), yet this benefit becomes an added advantage for Urban tree investors regardless of the volume. Thus, investing in urban reforestation has the capacity to checkmate the oxygen loss just as it adds to the quality of urban environment in many other ways.

Apart from these, Kane and Kirwan (2009) and Hsieh et al. (2016) also added that trees could have positive impact on water runoff from rainfall which can be a challenge in cities. Most of the methods used for runoff control (such as storm sewers) create a host of problems such as pollution failure to recharge groundwater and loss of wildlife. Leaves and branch surfaces intercept and store rainfall, thereby reducing runoff volumes and delaying the onset of peak flows. Burden (2006) and Donovan (2017) noted the following benefits: that roots create air spaces in soil and thereby increasing the rate at which soil absorbs rainfall and the capacity of soil to store water which reduces runoff; tree canopies reduce soil erosion by diminishing the impacts of raindrops on bare soil; transpiration through tree leaves reduce soil moisture, increasing the soil's capacity to store

rainfall. When runoff is reduced, the number of pollutants entering groundwater, rivers and lakes decreases.

Characteristics of urban centres in developing nations

Urban centres are defined as centres with various economic activities, provision of basic facilities and services, and physical development (Harvey 2000). In his own view, Mabogunje (1974) defines urban centre on the basis of the ability of their residents to shoulder certain responsibilities such a supporting community services. Cohen (2004) and Aluko (2010) stated that urban centres could be defined in term of population sizes in different countries. For instance, urban centre in Japan is described as settlement with at least 30,000 people, in the United States, it is 50,000, in Greece, 10,000, in Australia, 1,000 while in Denmark, it is 250 people. In Benin Republic, an urban centre is a settlement with a minimum of 10,000 while 2000 inhabitants are required for a settlement to be categorized as urban in Angola, Argentina and Ethiopia (Cohen 2004). By the head count of 1952 in Nigeria, a settlement is classified as urban with a minimum inhabitants of 5,000 while in 1963, urban centre was put at 20,000 at least (Oyeleye 2013).

Evidences have shown that urban growth in most developing nations was attributed to rural-urban drift Egunjobi et al. (2002). Though, the population growth rate in Nigeria is declining from 5.7% in 1985 to current rate of 4.0%, this rate is still higher than Nigeria's overall population growth rate which is 2.6% (Onokerhoraye and Omuta 1994). This situation, however, has serious implication on the socio-economic and infrastructural development. Oyeleye (2013) and Agbelade et al. (2016) had revealed that rural-urban migration in Nigeria has been on the increase over years. For instance, between 1985 and 1990, according to Oyeleye, over 3 million people migrated from rural areas to urban centres while over 5 million migrated between 2001 and 2005. This trend is not likely to be halted in the years to come, especially in view of the deplorable condition and abandonment of the rural areas in terms of infrastructural development (Cohen 2006). Cohen (2004) and the US Department of Economic and Social Affairs (2015) revealed that in an increasingly urban world, almost half of the world's population and over three-quarters of the population of higher income countries lie in urban areas. Cohen stated that there were just 16 cities in the world that contained at least a million of people at the start of the 20th century, which are mostly found in advanced industrial economies. However, today, there are more than 400 cities around the world that contain more than a million residents, about three-quarter of which are in low and middle income countries.

This trend is not without its attendant challenges for urban centres of which environmental-related problems and Climate change are inclusive. Olagunju (2015) classified different types of environmental problems in this regard as ecological, poaching and habitat loss, increasing desertification and soil erosion. These, according to Olagunju, were subdivided into pollution (water, land, visual and noise), deforestation, global warming and slum development. Apart from these, Aliyu and Amadu (2017) reported that there are urban health crises among city dwellers notably the urban poor in Nigeria as a result of increasing urban growth caused by a multitude of push and pull factors. They further discovered that the pace of urbanization is unprecedented with cities such as Lagos having annual urban growth rate of 5.8%. This urban growth was observed to be mainly demographically driven without commensurate socio-economic dividends and benefits to the urban environment. Thus, it was recommended that improved health outcomes will need a concerted effort to create and maintain the so called urban advantage through reshaping of city environment (see also Berrang et al. 1985).

Oyeleye (2013) lamented on the various health challenges posed by increasing environmental degradation characterized or found in urban centres. In furtherance, it was also noted that improper waste management has made the societal fabric of many cities in Nigeria to be unsightly. Thus, the concluded that environmental problems in urban centres outweigh the experiences in the countryside as the environmental problems are seen as the results of human activities which are higher in urban centres.

Apart from this, Odjugo (2011) stated that Nigeria is experiencing global warming at the rate higher than the global mean temperatures. It was revealed that the mean increase in temperature from 1971 and 2008 is 1.78°C compared to the global mean increase in the temperature of 0.74°C since instrumental global temperature measurement started in

1860. The increased temperature in Nigeria during that period could be attributed to the effects of Climate change and its associated global warming earlier reported (Mabo 2006; Odjugo 2011).

The implied Climate change due to urban expansion results in the incessant flood occurrence and harsh temperature which are mostly characteristic feature of urban centres in Nigeria today. It was on the premise of these observations that Amao (2012), Lanrewaju (2012) and Oyeleye (2013) suggested, among others, planting of trees (evergreen trees and not deciduous ones that shed leaves during a part of the year) to ensure environmental comfort and sustainable living in cities.

Consequences of urban growth on the natural environment

The unabated expansion of urban centres in developing nations will invariably have consequential implications on the natural environment. For instance, quite an expanse of land will have to be removed in order to erect buildings, parks, institutions, industries, business outlets, religious centres and markets to mention but a few. The removal of the natural forest without proper planning will lead to the destruction of watersheds, loss of habitats, development of erosion channels, loss of rich top soils, loss of biodiversity and so on (Kumar and Hundal 2016). Apart from these, a lot of environmental challenges will arise amongst which are air and water pollution, problem of waste disposal, urban heat and increase in temperature, and so on. Kumar and Hundal (2016) revealed that urban lands have become severely degraded due to anthropogenic activities and are also heavily contaminated with priority pollutants, especially heavy metals and polycyclic aromatic hydrocarbons. Thus, the author discovered that it is desirable that urban soils need to be worked upon through practices such as the use of composts and biosolids to grow plants and also to reclaim degraded fields, manage storm water and improving the overall ecosystem functioning.

Urban reforestation: a step towards climate change/environmental degradation mitigation

In order to ensure a sustainable reforestation task of urban centers, adequate provision must be made for appropriate tree species to be planted. Gilman and Sadowski (2007) noted that the selection of the right tree for a particular place can avoid costly disappointment later. Trees adapted to the planting site are likely to remain resistant to strong winds. Thus, thorough site evaluation can ensure that the chosen tree will survive conditions inherent to the location. Gilman and Sadowski cited an example of oak trees which could be chosen for successful canopied streets because they have the ability to provide shade, and also wind-resistant structure. However, oak trees can only strive where there is adequate open soil space and distance from above ground structures such as street lights and wires. They further suggested that a simple way to carry out a site evaluation is to tour round the town to assess which tree species will grow well in landscapes with similar site attributes. It should be noted that no two sites are exactly alike, as various conditions both above and below the ground influence the success of a particular tree species. It is equally crucial that environmentalist and urban reforest specialists are acquainted with different tree specie that are available in local gardens and nurseries.

In order to ensure a successful urban reforestation, Ferrini and Fini (2011) highlighted various steps that should be followed to ensure a sustainable reforestation namely site design to ensure that the site condition is appropriate for the plant, contract to be in line with plant requirements, site preparation, supply of trees of the highest quality possible and of the right fitness, planting with the assurance that all necessary intervention are provided before, during and after planting, establishment to anticipate the typical problems of the urban environment like water scarcity, weed competition and man damages, maintenance and monitoring trees for an early detection of stress and diseases.

Tree selection

Selection of tree species for urban reforestation must be carefully done though all living trees help to decarbonize

the environment, the type of tree planted must be with consideration of other environmental facilities (which will not endanger their purpose, e.g. signposts, road signs, wires, street lights, fences etc.). If adequate attention is paid to these, the overall benefits of reforestation will be realized. Chacalo et al. (1994); Sæbø (2005) and Sanders et al. (2013) had remarked that tree inventory is necessary to best manage public trees, an inventory typical of total number of trees, species composition, tree location and tree condition to provide a better context for informed management decisions. They, however, reiterated that the process of tree selection to match urban tree species avoids and often makes difficult, urban planting sizes is a fundamental aspect of urban environmental design and management. Climate change scenario has been found to be attributed to uncontrolled deforestation which at times is as a result of urban expansion, construction, industrialization among others. This can be mitigated with planting of trees that are carefully and appropriately selected. It is noteworthy that most African cities are conurbation of many villages or towns and most lack modern planning to meet up with the aforementioned criteria for urban reforestation. All attributes of these traditional cities should be studied and appropriate steps should be followed so that species of trees are obtained.

Most buildings run into road sides to the extent that space may not be available for any tree growth and sustainability. In this situation, small plants can be adopted at such road edges. Greening urban environment is the bottom line to ensure an oxygenated environment. According to Gilman and Sadowski (2007), more work and creativity may be required to find a variety of trees that can withdraw urban various conditions, but it is well worth the efforts, especially in the light of change in climate and its manifestations. It was further stated that species diversity in cities allow a landscape to withstand devastation by insect or disease outbreaks, and if implemented appropriately can provide a more aesthetic appeal. Appropriate and timely maintenance is also required to ensure that the Urban tree serve their purposes for the survival of man.

Appropriate and relevant laws must be put in place and if possible an agent held responsible for urban reforestation at local state and federal levels. The cutting and replanting of ageing trees must be guided by relevant laws. Cleanliness of streets and every public place dominated with urban tree, trimming of trees to ensure their trees does not affect other public utilities and private ones must be carried out according to their laid down rules.

In addition, the harvest and sales of fruits that could be generated from urban tree must be kept in the hands of an investor to ensure accountability and appropriate use of public assets for its sustenance. It is always advisable that a private investor is charged with the responsibility of planting, maintenance, replacement, sales of fruits for proper accountability. Private sector have been found relevant successful in maintaining public utilities than the public agents.

Nilcon (2005) stated that urban trees are an increasingly important quanlity of life issue in tropical cities as economic growth swells increasingly affluent urban population. Tzouks et al. (2007) in corroborating this fact stated that urban free standing trees growing along streets, in street medial, or on private property are a critical foundation for both a healthy human population and healthy economy. The UN- World Health Organization recommends at least 9 m^2 of urban green space per capita to mitigate several undesirable environmental effects and provide aesthetic benefits (Deloya 1993). Kjelgren et al. (2010), also in supporting this fact, revealed that urban forests are particularly critical to healthy cities in developing countries with some of the world's largest metropolitan trees. Furthermore, green space and Urban tree become increasingly important where the rate of urbanization is the greatest in developing countries, mostly smaller cities of about 500,000 in Asia and Africa (United Nations Department of Economics and Social Affair 2003).

According to Jim and Liu (2001), tropical cities in developing countries have a large diverse pool of adapted species available from tropical forests. Thus, selection of tree species best suited for tropical urban conditions depends on marching above- and below-ground space (Jim 2001) and urban climate to species from an appropriate tropical forest type. A case was made for selection of Urban tree from an appropriate tropical forest type depending on where a tropical city falls along the seasonality gradient of rainfall distribution between all-time wet (no dry periods) and a monsoonal climate (alternating dry and wet seasons of varying lengths). According to Tee and Wee (2001), cities in wet equatorial climates can possibly use drought-adapted trees

from monsoonal climate while those cities in equatorial wet climates use trees from equatorial wet evergreen aseasonal forests. Santiago et al. (2004) also added in their investigation when they stated that tropical dry forest species either avoid drought with deciduous leaf habit or tolerate drought with evergreen foliage.

However, Brodribb and Holbrook (2005) submitted that when grown in a wet evergreen environment, drought deciduous species often retain their leaves most of the year, sometimes shedding foliage briefly during short dry periods. Kjelgren et al. (2010) also corroborated that understanding the differences in ecological physiology between dry and wet tropical forest species can possibly help explain the relative distribution and abundance of deciduous and evergreen species in tropical cities. They further added that tropical cities can potentially select appropriate deciduous and evergreen tropical species better adapted to future hotter and drier urban conditions beyond model projecting. Genge et al. (2007) further observed that urban microclimate can be viewed as a proxy for projected increases in CO_2 and temperature. In view of this, Kjelgren et al. (2010) reiterated that understanding which and how tropical tree species succeed in urban conditions with potential insights that can be gleaned through the informal selection process of tropical Urban tree for tolerance to urban stresses, in particular urban heat, islands and planting into confined, drought-prone urban soils.

Mitigating climate change in cities

Belčáková et al. (2019) and Sturiale and Scuderi (2019) revealed that the actions against Climate change and its effects on society and the environment are oriented in two directions: mitigation, to progressively reduce the emissions of climate-changing gases responsible for global warming, and adaptation, to reduce the vulnerability of environmental, social and economic systems and to increase the capacity for climate resilience. In their submission, Genge et al. (2007) also remarked that cities are a reasonable proxy for Climate change. They revealed that anthropogenic CO_2 emission creates a dome of elevated urban concentrations. Although, vegetation can mitigate heat island impact as noted by Roth (2007) and Demuzere et al. (2014), urban vegetation in tropical cities will be the first to be affected by elevated temperatures through increased heat loading from asphalt (Kjelgren and Montague 1998) and other non-transpirating surfaces (Montague and Kjelgren 2004). Freestanding, isolated street tree crowns in particular will be subject to high heat loading according to Kjelgren and Clark (1993) analogous to higher temperatures associated with Climate change. However, Jones and Somper (2014), Oldfield et al. (2014) and Idiata (2016) in agreement with Roth (2007) enumerated various benefits of GI in London to include decrease in risk of flooding, temperature regulation, maintenance of freshwater quality and supply, enhancement of species resilience through provision of varied habitats and green corridors among others.

Challenges of urban reforestation exercise

Urban reforestation in developing nations could be bedeviled with a series of challenges both anthropogenic and or natural induced. Sanders et al. (2013) had opined that urban areas are quite heterogeneous and environmental stresses may vary considerably, even among adjacent planting sites. Thus, any impending reforestation effort should ensure that adequate preparations are made to cater for the challenges which are itemized here. The challenges which are not limited to these include:

Community attitude to urban tree

Zhang et al. (2007) revealed that public attitudes have a significant influence on many aspects of life including the public budgetary process and subsequent fund allocation, public involvement and participation, the integration of tree programs into social infrastructure, and community identity. Thus, it was asserted that consulting the public for better understanding of their attitudes in developing a diverse and adaptable strategy is salient to its success. Although, many studies on urban forestry have analyzed public attitudes about the benefits of Urban tree (e.g., Dwyer and Miller 1999; McPherson et al. 1999; Thompson et al. 1999; Tyrvainen 2001; Gorman 2004), a more critical issue is developing a sustainable and adequate community forestry support program (e.g., Lorenzo et al. 2000). The purpose of this article is to examine public attitudes from the per-

spective of funding urban forestry programs. Following a brief literature review, we present the methodology used and describe the sources of data, followed by results and conclusions.

Apart from this, the attitudes of local communities need to be understood especially as it relates to developing nations. While people may welcome the project of urban reforestation, some may act contrarily. In Nigeria, for instance, people from some community may not allow urban reforestation for fear of that such forested portion could be converted to hideouts for criminal activities, especially in view of poor maintenance culture, which may endanger their comfort in the town.

Also, in connection with the above observation is the belief of people about certain trees. The belief that some trees harbor evil spirits may hinder the success of urban reforestation. Extensive searches must be carried out to ascertain which of the tree species will be acceptable to the public where such belief is noted to ensure that the objectives of urban reforestation project, as a way of mitigating climate mitigation, is realized. Such belief needs to be incorporated into urban tree selection to see that appropriate trees that will be allowed to thrive by the hosts will be made.

The challenge of space for urban tree in ancient settlements

Also, most urban centres in developing countries such as Nigeria have poor urban planning. The situation is even more terrible in the core traditional urban centres where many buildings are almost on the road. This may pose inadequate space for tree planting. Therefore, a thorough investigation by physical visitation and survey must be carried out to identify such locations in order to determine appropriate action and step to be taken in that wise. The proposed plan of households in the project area should be sought. Such plans could have made room for the intention to expand their buildings or any other proposed use for the available space required for a successful urban reforestation. Some buildings could still be under construction while some could still be expanded in future, Thus, it is important that information is obtained from the space owner before embarking on urban reforestation.

The sustainability of Urban tree to enhance the delivery of benefits over the long term, given the impermanence of past urban tree cover has been questioned. This is in view of several reports of variability of annual tree mortality (Roman 2011), decline in urban tree cover with losses ranging from 32% to >50% for newly plants of street trees, depending on local land-uses and social influences (Nowak et al. 2004; Lu et al. 2010). According to Escobedo (2011), a diverse range of factors influence urban tree survival, ranging from vandalism or removal of the tree itself, to restricted access to key resources such as soil moisture. Also, Tubby (2012) observed that the threat on urban tree sustainability also emerges from globalization, urbanization and population growth. Also, observed by Young (2011) and (Tubby 2012) are the issues of long term funding, political support, future risks from factors such as pests, diseases and Climate change, which could threaten urban reforestation.

The complexity of cities and their metastability, with highly coupled flows of mass, energy, people and capital (Conway and Urbani 2007; Petts et al. 2008; Boyko et al. 2015). Thus, analyses of the risks to the ecosystem services supplied by Urban tree must therefore recognize that trees are embedded within this broader 'system of systems' and may benefit from identifying key systems components, dependencies, processes and outputs. For any given benefit to be sustained, a set of system conditions needs to persist which extend beyond the simple presence of an urban tree (Escobedo et al. 2011; Rogers et al. 2012; Lawrence et al. 2013; Pincetl et al. 2013).

A culture of planting the right tree in the right place recognizes the importance of context and is clearly embedded in the psyche of many arboriculturists and foresters (Akbani et al. 2001; Lombardi et al. 2012). Hale et al. (2015) resolved that the potential benefits of urban street trees planting are often dependent on the presence of system conditions related to the level of tree maintenance, public values, local government policies and the density and configuration of the surrounding built form.

Operating laws guiding urban forest

Relevant laws must be promulgated to safeguard the sustainability of Urban tree. Such laws must however be sup-

ported by the government agencies or departments for timely and optimal implementation. Most forest reserves have been reportedly become devastated, not that laws were not made to safeguard them, but due to lack of political willingness to implement such laws. Falade (1989) reported that despite the fact that planning legislation in Nigeria provides for amenity and open spaces in rural and urban areas, landscape studies of most cities show a great deficiency of both- the situation that was partly attributed to poor implementation and relevant policies to guide land use. Coupled with this fact is the prevailing poverty and corruption in most of developing nations which crippled the sustenance of forests. Proper execution of appropriate legal instruments should be put in place to protect such urban tree. It is suggested here that a special unit/agency should be saddled with the responsibility of managing, protecting, maintaining and replanting of urban tree for a good success.

Current and future urban planning activities

Urban planning at the periphery of towns and cities should be given proper planning to give room for Urban tree growth and management. Reforesting degraded urban landscapes are important due to the many benefits urban forests provide (Pregitzer et al. 2016). Parks and other relevant spaces should be adequately provided with appropriate trees and greening. Borelli et al. (2015) and Belčáková et al. (2019) had observed that there is paradigm shift in dealing with urban landscapes, which presents a mosaic of opportunities but also a stratification of interests, blockages and conflicts. Urban greening has been observed to be one of the approaches to address complex and widespread environmental, social and political challenges that transcend traditional management boundaries. Demuzere et al. (2014) and Borelli et al. (2015) emphasized that in existing and future cities, open green spaces must be planned and designed to fulfill different interests and needs, provide ecosystem services required by an increasingly urban society, and enhance the rural-urban continuum. Ensuring sustainable future for cities requires urban forestry, urban agriculture, horticulture, gardens and parks, bioengineering, biofilters, phytoremediation and other disciplines to be strategically integrated. They offered that GI is capable of providing a unifying framework for integrating urban forestry and urban agriculture as well as other green components of a city.

Urban soil status

Urban soils are usually characterized with hard landscape as a result of exposure to the surface wash, direct sunlight or deliberate paving the surface with concrete. Pregitzer et al. (2016) corroborated this observation in stating that urban soils are highly variable, yet little is known about how this variability in urban soils influences tree seedling performance and survival. Apart from this, Oldfield et al. (2014) revealed that healthy soils are critical for vigorous tree growth. In order to ensure good growth of urban tree, investigations must be carried out on the soil nutrient needs of plants to ensure their good growth. Thus, in realizing this fact, Oldfield et al. (2014) emphasized on the importance of soil restoration as part of large scale urban afforestation project. Sanders et al. (2013) revealed that the issue confronting the application of forest management principles to urban tree management decisions is the lack of data correlating site, tree size and tree age. Li et al. (2013) further stated that chemical analysis of urban soil is of high pH and low organic matter. In addition, it was also revealed that soils along roadsides and in residential areas have greater concentration of calcium (Ca), sulfur (S), copper (Cu), manganese (Mn) and Zinc (Zn) which city planners and policy makers need to take into cognizance for livable cities. In the same vein, USEPA (2011) corroborated this observation when it was stated that reconditioning of urban soils is desirable in order to adjust drainage characteristics, improve soil structure, add organic matter and mitigate compaction. All these, according to USEPA, activities involved in reconditioning include raking out construction debris and using a subsoiler to break up compacted soils; adding compost and tilling; altering the soil chemistry to achieve desired parameters like pH and manipulating organism populations to achieve a desired change in soil characteristics. Such needs include water requirements, enhancing soil nutrients through chemical fertilizers and/or organic manure. In the humid regions where there are marked seasons of dry and wet, arrangements should be

made for artificial supply of water when rain seizes or during the dry spells.

Tree mortality rates/ageing trees

The population dynamics and growing conditions of planted trees in landscape and heavily built-up urban areas are quite dissimilar from trees in natural forest (Urban 2008, Roman et al. 2016). According to Hilbert et al. (2019) research have indicated that as trees mortality from natural forests suggests that trees often die as a result of many different additive and interacting factors. Maintenance of Urban tree should include the management of trees that have become aged and matured for harvest. So also, maintenance should include replacing those trees that could not survive strong winds and possible drought that may arise. Trimming and regular monitoring of the status of Urban tree are required for a successful project. Also, litters of trees such as leaf falls and fallen branches need to be adequately taken care of so that urban centres do not become filthy as a result of such litters. The understanding of what contribute to the sustainability of Urban tree such as tree age, the impact of chronic and acute stressors accumulated, which ultimately leads to tree death is required in urban reforestation exercise. Franklin et al. (1989) in remarked that urban tree mortality are often categorized by life stages with emphasis on the first few years after tree planting (Shernon et al. 2016). Levinnom et al. (2017), Harris and Day (2017) and Leers et al. (2018), in their observations, showed that the first few years after tree planting is generally viewed as the stage with the highest mortality for Urban tree and has Thus, been the focus of many mortality studies (e.g. Kaeser et al. 2014; Roman et al. 2014; Roman et al. 2015; Widney et al. 2016).

Tree mortality, according to Hilbert et al. (2016), is a fundamental component of managing urban forest population cycles: planting, growth, pruning, removal and replacement. Thus, in heavily managed portions of the urban forest, such as streetscape, yards and landscaped parks, human intervention influence tree population cycles (Roman et al. 2016, 2018). In view of this, Hilbert et al. (2019) suggested that stakeholders in urban tree management practices should enhance projection models. Amongst other findings, Hilbert et al. found that characterizing the factors that influence mortality into categories according to biophysical versus human influence, and predisposing, inciting and contributing factors are helpful to maintaining the urban tree disease-decline spiral.

Conclusion

A review into urban reforestation exercise as a way of mitigating climate change effects was carried out. Prerequisites to the effectiveness of the project include urban soil nutrients investigation, appropriate tree type study, public perception about the tree types, relevant legal instrument to achieve successful reforestation exercise in cities among other factors were examined. In view of the implications of climate change/global warming, appropriate steps should be taken to inculcate the habit of tree planting in urban centres as this will go a long way to checkmate the consequences of climate change among other benefits. However, cognizance should be taken of the characteristics of settlements in the developing countries as most of the buildings are ancient with little or no modern planning of buildings running into one another. Thus, creating space for urban tree will require efforts from both urban planners and the local people in terms of education and enlightening programmes on the relevance of urban forests to human sustainability. Also, appropriate study should be carried out on befitting tree kinds for any given area or settlement and their perception on the tree kind so that it can be sustained through timely maintenance by the hosts. Relevant legal instruments are also required to be put in place to prevent undue destruction of the tree in view of the enormous costs which the planting and maintenance must have been incurred. Relevant ministry/agency could be put in charge for the maintaining, cutting and replanting of urban tree and all that are involved in urban tree sustainability. Urban reforestation has enormous potentials to subdue Climate change consequences, including urban renewal if adequate provision is made for its sustainability, especially in developing countries.

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