ABSTRACT
This paper examined the relevance of trees for the promotion of Port Harcourt ecosystem. The paper argued that Port Harcourt as a major urban centre in Nigeria is growing in size and complexity. As a major industrial and commercial city, it is presently experiencing an increase in air and noise pollution. This pollution is a function of two primary factors: increase in the use of fossil fuel by the rapid growth in automobiles and industrial domestic power plants (generators) and growing affluence in the life style of city residents. Thus, there is correspondent increase in traffic, noise and emission of CO₂ (carbon dioxide) and CO (carbon monoxide). As a result of this, air pollution over Port Harcourt had reached a critical stage and efforts must be made to combat this environmental challenge. The cheapest and clearest way of addressing this problem is by massive planting of trees across the length and breadth of the city. Trees help to remove pollutants especially O₃NO₂ and VOCs from the air which makes the atmosphere cleaner. The removal of pollutants by trees is a local effects whereas the formation of pollutants from compound emitted by trees occur downward of trees themselves. Thus, the cumulative and interactive effect of trees on pollution removal is an essential part of greener, cleaner and pollution free environment.

Keywords: Port Harcourt, Air Pollution, Air Quality, Trees, Urban forestry

INTRODUCTION
Urban centres are centres of high residential, commercial and industrial activities. One of the environmental problems associated with urban centres is air pollution which
results to poor air quality. Air pollution occurs when harmful substances including particulates and biological molecules are introduced into Earth’s atmosphere. It may cause disease, allergies or death of humans. It may also cause harm to other living organisms such as animals and food crops and may damage the natural or built environment. Human activity and natural processes can both generate air pollution.

Mayhew (2009) defined air pollution as the presence of substances in the air in quantities which can affect animal or plant life, human health and welfare, or can unreasonably interfere with life or property; and that common pollutants include carbon dioxide (CO₂), carbon monoxide (CO), lead (Pb), nitrogen oxide (NO₂), ozone (O₃), smoke, and sulphur dioxide (SO₂). Air pollution may cause disease, allergies or death of humans; it may also cause harm to other living organisms such as animals and food crops, and may damage the natural or built environment. Human activity and natural processes can both generate air pollution. According to World Pollution Organization (2010) indoor air pollution and poor urban air quality are listed as two of the World’s worst toxic pollution problems in the 2008 Blacksmith Institute World’s Worst Polluted places report. According to the 2014 World Health Organization report, air pollution in 2012 caused deaths around 7 million people worldwide an estimate roughly echoed by one from the International Energy Agency (WHO, 2014 and IEA, 2016).

Air pollutions all over the world are measured by a method known as Air pollution index (API). Air quality index is a number used by government agencies (International Air quality 2015) to communicate to the public how polluted the air currently is or how polluted it is forecast to become (National Weather Service, 2015). According to Wikipedia, the free encyclopedia, as the air quality increases, an increasingly large percentage of the population is likely to experience increasingly severe adverse health effects (Wikipedia, n.d.). Thus different countries have their own air quality indices, corresponding to different national air quality standards. Some of these are Air quality Health index (Canada) the Air pollution index (Malaysia) and the pollutants standards index (Singapore). Air quality index measurement is between 0–300+ and it is categorized into six sections. The air in a city is rated as follows: 0 to 50 (safe), 51 to 100 (moderate), 101 to 150 (unhealthy for sensitive groups), 151 to 200 (unhealthy), 201 to 300 (very unhealthy) and 301 to 500 (hazardous).

A tree is a noble organism, unique in its beauty and home and refuge for birds, insects and small animals. Trees are more than just heavens for animals, birds, insects and humans; they are also the wings of the earth. Just as we do breathe oxygen into our lungs and exhale carbon dioxide, so trees breathe carbon dioxide into their leaves and exhale oxygen. Trees are really upside-down lungs: their trunks are equivalent to the trachea, their branches to the rights and left main bronchi and all their branching twigs and leaves to small bronchi and alveoli, air sacs, where the exchange of oxygen and carbon dioxide takes place. Tree trunks and branches may appear solid, but they are really rigid channels that transmit water and nutrient to the leaves the way the trachea and air passages transmit air to the alveoli. Trees play a significant role in moderating the earth’s climate. They remove carbon dioxide from the atmosphere and store large quantities of carbon in their tissue.

Nigeria, like other developing countries in the world is witnessing a significant growth in population size and rate of urbanization especially in the last two decades. According to the Federal Ministry of Environment (2015a) despite this increase, there appears to be imbalance between urban growth and availability of such infrastructure to reduce the impact of urbanization on the environment. The ministry further observed that
one of the consequences of this imbalance is the emergency of accelerated urban air pollution which is most dominant in emerging potential mega cities in the country.

In Nigeria the Federal Ministry of Environment (2015b) opines that Nigeria is among the most intensive atmospheric aerosols in the world and that the two main pollutants and sources in the country are particles from desertic zones of Sahara and biomass burning that constitute huge amount of black and organic carbon; and these account for over 70% of air pollution in the country. The ministry further noted that the sources of this air pollution are associated with combustion from vehicles, domestic power generations and industrial plants.

The problem of air pollution in Nigeria has been receiving much attention locally and globally. Not long ago, the World Health Organization (WHO, 2016) listed four Nigerian cities (Onitsha, Kaduna, Aba and Umuahia) among the world’s most polluted cities. According to the report, Onitsha was rated as the world’s most polluted city for air quality when measuring small particulate matter concentration (PM$_{10}$). Kaduna came fifth in the world and it is a major transport hub in the North; and Aba and Umuahia came sixth and sixteenth respectively. (Uwaegbulam, 2006), both cities are major trade centres in Southern Nigeria. The report explained that “reliance on using solid fuels for cooking, burning waste, and traffic pollution from very old tyres” were contributory factors to the pollution in these cities. To arrive at the ranking, WHO compared a total of 795 cities in 67 countries for levels of small and fine particulate matter concentration (PM$_{10}$ and PM$_{2.5}$) during the five year period, which started from 2008 to 2013. This PM$_{10}$ and PM$_{2.5}$ include such pollutants as sulphate nitrates and black carbon, which penetrate deep into the lungs and into the cardiovascular system posing the greatest risk to human health (Uwaegbulam, 2006). Data were then analyzed to develop regional trends. PM 2.5 are atmospheric particulate matter (PM) that have a diameter of less than 2.5 micrometers, which is about 3% the diameter of a human air. Particles of this category are so small that they can only be detected with an electron microscope. They are even smaller than their counterpart PM$_{10}$, which are particles that are 10 micrometers or less, and are also called fine particles.

Although Port Harcourt was not mentioned by World Health Organization as one of the cities in Nigeria suffering from air pollution, studies by Sun newspapers (2017), Popoola (n.d), Tamuno (2016), Allen (2017), and Igbenedion (2018), have shown that the city of Port Harcourt is heavily polluted by air pollution and black sooth. According to Igbenedion (2018), the pollution of the air in Port Harcourt has been detected as “unsafe” by a global app used to detect how safe the air is at any location in the world. The app also indicated that the air in the city contains a dangerous substance known as PM 2.5 which can cause cancer and lead to premature death, respiratory illness etc. The app record showed that Port Harcourt city has an air quality index of 190, which is unhealthy.

According to the sun newspaper, residents of Port Harcourt and its environs have been battling soot in their homes, offices, and business premises, churches, on vehicles, clothes and food items. The paper further reported that to contain the situation, the state governor, Chief Nyesom Wike set up a task force headed by the Commissioner for Environment, Prof Rosliyn Konya, to investigate and resolve the environmental challenge. The task for has since shutdown three companies whose activities were said to be responsible for the pollution while the soot was found to be a result of incomplete combustion of petroleum products. The paper cited that operations of illegal refineries and petro-chemical companies as well as burning of old tyres to access the copper embedded in
them are said to be other sources of the pollution. The Rivers State government has enjoined residents of the areas affected by the soot to cover all foods and avoid drinking rain water and other exposed water. They should also avoid all exposed foods such as roasted plantain and suya and keep their doors and windows closed.

The aim of this paper is therefore to examine one of the easiest and cheapest means of tackling the problem of air pollution over the city of Port Harcourt using trees.

**Study Area**

Port Harcourt was founded in 1912 by the British. It is named in honour of Lewis Vernon Harcourt, the then Secretary of Colonies. It is located between latitudes 4° 42 ' and 4° 55' N and between Longitudes 6° 53' and 7° 08'E (Weli and Adekunle (2014) and is situated 40 kilometers up the North of the Bonny River. Port Harcourt, which lies in the heart of the Niger delta region. It is bounded in the north by Etche and Ikwerre Local Government Areas, East by Eleme Local Government Area, West by Emohua Local Government Area and South by the Atlantic Ocean. Its metropolis stretches from the international airport at Omagwa and also from the Refinery at Eleme to Choba community at the New Calabar River and its entire metropolis area is between 1,300 and 1,800 square kilometers (Akinfolarin, Boisa and Obunwo, 2017).

Port Harcourt features a tropical wet climate with lengthy and heavy rainy seasons and very short dry seasons. Only the months of December and January truly qualify as dry season months in the city. The harmattan, which climatically influences many cities in West Africa is less pronounced in Port Harcourt. Port Harcourt’s heaviest precipitation occurs during September with an average of 367 mm of rain. December on average is the driest month of the year, with an average rainfall of 20mm. Temperatures throughout the year in the city are relatively constant, showing little variation throughout the course of the year. Average temperatures are typically between 25°C-28°C in the city.

Port Harcourt, which is the current capital of Rivers State, is highly congested as it is the only major city of the state. It is now the centre of Nigeria’s oil and gas industry. In 2009, a law was passed by the Rivers State House of Assembly under Governor Amaechi’s Administration to spread development to the surrounding communities as part of the effort to decongest the Port Harcourt metropolis. The Greater Port Harcourt region, spans eight local government areas that include Port Harcourt, Okrika, Obio/Akpor, Ikwerre, Oyigbo, Ogu/Bolo, Etche and Eleme. Its total population was estimated at 2, 000, 000 as of 2009, making it one of the largest metropolitan areas in Nigeria and one of the fastest growing metropolitan cities in Africa (RVSG Diary, 2014).

Port Harcourt, is known all over the world as the Garden city, because of its beautiful layout and decent environment. It is Nigeria’s second largest commercial and industrial centre and has the second busiest seaport in Nigeria. This cosmopolitan city has a busy international airport with regular local and international flights to all parts of the country and major cities of the world. It marks the eastern terminal of Nigeria’s railway system.

**LITERATURE REVIEW**

Augustine (2012) investigated the impact of air pollution on the environment of Port Harcourt. The study involved measurement of six air pollutants (Sulphur dioxide, Nitric oxide, Nitrogen dioxide, Ozone, Hydrogen sulphide and carbon monoxide) and one climatic element-temperature over six locations (Isaac Boro Park, Harbour Road, Diobu, Link Road, Forces Avenue (Old GRA) and Mile One Market) over the city of Port Harcourt. The air pollutants were measured with the use of Wolfsense Multiple Analyzer.
The results of the study revealed that the observed levels of the carbon monoxide (CO), a critical pollutant, exceeded the set of limits of 10 and 11.4 ng/m³ by the Department of Petroleum Resources (DPR) and the Federal Ministry of Environment (FME) respectively, while sulphur dioxide (SO₂) exceeded the set of limits of 01ug/m³ by DPR. The highest levels of CO and SO₂ emissions were observed at Mile 1 market road. The study concluded by recommending that construction and repair works on road, and streets should be monitored so that the rate of emission and deposition of particulates could be minimized and Port Harcourt city would be protected from the potential health hazard.

Nwokocha, Edebeatu and Okujagu (2015) assessed air quality of Port Harcourt. The study involved 13 locations around port Harcourt metropolis and involved measurement of Sulphur dioxide (SO₂), Nitrogen dioxide (NO₂), Hydrogen sulphide (H₂S) Particulate matter (PM 10), Ammonia (NH₃), Methane (CH₄) and Carbon monoxide (CO). The measurement was made in an effort to characterize air pollution in the urban environment of Port Harcourt. The results revealed that there were significantly strong positive correlations between SO₂ concentration and all other parameters and there were significantly negative correlations between NO₂ concentration and all other parameters. The authors argued these gases have contributed greatly to the environmental problems in the Niger Delta.

Akinfolarin Boisa and Obunwo (2017) undertook an assessment of the status of particulate matter at three emerging industrial sites in Port Harcourt. The result of the study showed that the three industrial sites had higher concentrations compared to the control for both P.M 2.5 and P.M 10. Seasonal variations P.M 2.5 and P.M 10 were observed with the dry season indicating concentrations higher than the local acceptable limits of 150ug/m³ and 230ug/m³. The air quality index of the three emerging industrial sites indicated a category for ‘good to moderate’ for wet season while for dry season, they varied from ‘very unhealthy’ to ‘hazardous’ in all the sampling sites. The study concluded that this poses a great threat to health and environment of the inhabitants.

Abali, Etebu and Leton (2018) investigated seasonal particulate pollution in Port Harcourt. According to the authors, air quality in Port Harcourt had reached such an alarming level that particulate matter that has been observed to be literally falling out of the atmosphere. The particulate matters studied were PM 2.5 and P.M 10 and the climate elements studied were relative humidity, temperature and wind speed. The study lasted for a period of nine months from January to September 2017, covering both wet and dry seasons. The results revealed that particulate matter especially P.M 2.5 and P.M 10 exceeded the exposure limits set by both the Federal Ministry of Environment and World Health Organization (WHO) by up to 90 percent.

Based on this brief review of literatures, it can be seen that air quality of Port Harcourt is bad and efforts are needed to mitigate this problem.

The Biology of Trees
A tree is a noble organism, unique in its beauty and home and refuge for birds, insects and small animals. Trees are more than just heavens for animals, birds, insects and humans. They are also the lungs of the Earth just as we breathe oxygen into our lungs and exhale carbon dioxide, so trees breathe carbon dioxide into their leaves and exhale oxygen. Trees are really upside down lungs, their trunks are equivalent to the trachea, their branches to the right and left main bronchi and at their branching twigs and leaves to small bronchi and alveoli or any air sacs, where the exchange of oxygen and carbon dioxide takes place.
place. Tree trunks and branches may appear solid but they are really rigid channels that transmit water and nutrients to the leaves the way the trachea and air passages transmit air to the alveoli.

Trees are woody plants but not all woody plants are trees. Ekeke (2014) opines that a tree usually grows upright to at least 15 metres at maturity and has a unique stem called bole or trunk. The stem supports limbs and leaves forming the crown or top. Trees generally develop typical shapes when they are grown in an open area. Ekeke (2014) further stated that trees that grow in crowded forests usually grow singly in open spaces. These open space trees tend to have larger crown and shorter boles.

A tree means different thing to different people. For instance, to our ancestors, a tree is a source of fuel and shelter and occasionally, an object of worship to their gods. To an average man in the street, a tree may be a source of pleasant shade in a sunny day. On the other hand, it becomes a nuisance when it shades it leaves on the lawn. To an arborist, it is an ornamental object in the landscape. To a botanist, a tree is a perennial plant with an elongated stem or trunk, supporting branches and leaves in most species. To a forester, a tree is the product of timber and pulpwood. To a plant physiologist, a tree is complex biochemical factory which starts from a seed and literally builds itself up. To a climatologist, a tree is an object which purifies the air and moderates the earth’s climate; and finally to a hydrologist, it is a material for checking flood and erosion in an area.

Trees may be divided into two main groups called angiosperms and gymnosperms (Ekeke, 2014). The angiosperms (flowering plants) are mainly hardwoods and the gymnosperms (non-flowering plants) are mainly softwoods. The angiosperms have broad leaves and the gymnosperms have needle like or scale leaves. The angiosperms are generally deciduous (shedding leaves) and the gymnosperms bear hard seeds from flowers and inside fruits but the gymnosperms bear seeds on cones (naked fruits) or cone like structures.

For centuries, trees have been attracting the attention of all categories of people including the growers (silviculturists), scientists and environmentalists. Trees are multi-purpose in their utility to all living matter including flora and fauna. Their benefits are endless and they are always in the service of mankind. Thus trees being perennial plants, are the main source of providing green cover to the soil; they bind the soil and provide more biomass to the soil than other sources (Sharma, 1998). The green parts of the trees, particularly, the foliage converts the solar energy into real energy carbohydrates, sugar, fats, proteins, vitamins, hormones, wood, charcoal, petrol, jems, diamonds, etc.

According to Caldicott (1992), trees are an energetic necessity to the biological health of the planet. Thus as human beings fill the air with carbon dioxide and destroy the ozone layer with man-made chemicals (Chlorofluorocarbons), trees offer an excellent means of buffering these effects. It has been calculated that if an area the size of Australia or the Continental United States were planted with trees, the air could be cleared of carbon dioxide related from fossil fuels (Corson, 1990).

The importance of trees in the urban environment cannot be over-emphasized. Thus trees can improve the urban environment in the following ways: increasing biodiversity, benefiting human health, increasing a sense of community, affecting air quality, providing shade and humidity, increasing property prices and, having aesthetic qualities. Besides these benefits, it should also be noted that trees can also damage property and require maintenance. Furthermore we should also be aware that people plant trees for so many reasons that it is not possible to produce a scoring system that considers all the factors.
The biology of tree cannot be fully understood without making reference to the tree prayer. The tree prayer according to Ekeke (2014) is more like a poem in which the tree is calling all and sundry to its importance in the society by recognizing its multiple uses.

The Tree’s Prayer (ANON-PORTUGUESE)

Ye who would pass by and raise your hand against me;  
Harken ere you harm me.  
I am the heat of your heart in the cold winter nights  
The friendly shade screening you from the summer sun  
And my fruits are refreshing droughts,  
Quenching your thirst as you Journey on  
I am the beam that holds your house,  
The board of your dining table  
The bed on which you lie and the timber that builds your boat  
I am the handle of your hoe and the door of your homestead,  
The wood of your cradle and the shell of your coffin  
I am the gift of God and the friend of man.  
Ye pass by listen to my prayer. Harm me not

Urban Forestry and Urban Air quality

Urban forestry is a branch of forestry that relates to trees and woodland in towns and cities: garden and farm trees, street and park trees, remaining woodlands and emerging woodland on vacant and derelict land (Larinde, 2010). According to Konijnendijk, Ricard, Kenney and Landrup (2006), the term ‘Urban Forestry’ was first used by a municipal park official in the late 1800s in the United States while referring to the care of individual trees in urban space. An early common definition of urban forestry was that of the American Association of Foresters (1958), which defined urban forestry as the “treatment of street, shade and park trees to preserve and protect their aesthetic value” (Owen, 2000).

The scope of the definition was later expanded by foresters to embrace the social and economic dimensions, and thus includes both planted trees and natural landscapes within the urban units. However, Konijnendijk et al (2006) stated that urban forestry is “the art, science and technology of managing trees and forest resources in and around urban community ecosystems for the psychological, sociological and economic and aesthetic benefits that trees provide in the society. This definition has also been endorsed by Larinde (2010).

In urban forestry, foresters, government agencies and even non-governmental organizations (NGOs) are involved in planting trees. The governments in Nigeria, at the local, state and the national levels have achieved this through the National Tree Planting Campaign (NTPC) which is done every year by the three tiers of government, as it fulfills one of the policy objectives of the campaign which is “to conserve and protect the environment”. In this respect therefore, the urban environment is inclusive. Furthermore, one of the strategies of the campaign is “to enforce that each urban house hold plant a minimum of two trees in addition to planting ornamentals”. The NTPC was first introduced in 1981 to mark the World Environment Day which is observed on June 5th every year. The ceremony involved the planting of commemorative at the launching site by the highest of the land (Mr. President). The NTPC is a strategy devised by the government to sensitize the people and create public awareness on the need for forest conservation and to impart tree
planting culture in the citizenry in recognition of the roles forest and trees play in our environment and in the general wellbeing of our people.

In planting trees in urban centres, certain things are taken into considerations such as the need to select tree species and the need to consider many different factors including size, shape growth rate, water needs, root structure, life span, leaf/seed drop and more. Tree planting in urban areas has both positive and negative effects. Basically, the negative effect is that trees can emit gases known as volatile organic compounds (VOCs). These compounds are what you can smell in the forests. VOCs in combination with man-made oxides of Nitrogen (NOx) can contribute to the production of other pollutants, especially ozone (O3) and particles which damage human health when in the lower atmosphere.

Tree planting has many positive impacts upon air quality, but it is important to select tree species that have the most air quality beneficial characteristics. Trees can remove pollutants, especially ozone (O3), nitrogen dioxide (N2O) and particles from the air which makes the atmosphere cleaner (Beckett, Freer-Smith, and Taylor, 2000). Furthermore, trees also remove carbon dioxide, a major greenhouse gas which is having effects on the earth’s climate (global warming). It should be noted that the removal of pollutants from compounds emitted by trees happens downwards of trees themselves (Hewith, n.d.)

Roles of Trees on Urban Air Quality

Urban centres have vegetation both natural man-made. This vegetation can either directly or indirectly affect local and regional air quality by altering the urban atmospheric environment.

According to Bruch (n.d.) the following are some positive effects of trees on air quality in urban centres:

- All trees enhance deposition of particulate matter and gaseous air pollutants like ozone and nitric oxide
- Trees also absorb carbon dioxide which is a significant greenhouse gas.
- Trees provide shade and cooling through evapo-transpiration. This local cooling from trees reduces the need of air conditioning which helps reduce nitrogen oxide (NO2) from power plants. Urban scale cooling also helps to reduce evaporative emissions from cars, trees and other sources.
- In a similar vein, Nowak (2002) observed that urban forest management strategies to help improve air quality include:
  - Increase the number of healthy trees (Increases pollution removal).
  - Sustain existing tree cover (Maintains pollution removal).
  - Maximize low VOC emitting trees (reduces ozone layers and carbon monoxide formation)
  - Sustain large healthy trees (reduces long term pollutants emissions from maintenance activities).
  - Use long lived trees (reduces long term pollutants emissions from planting and removal)
  - Use low maintenance trees (reduces pollutants emissions from maintenance activities).
  - Reduce fossil fuel use in maintaining vegetation (reduces pollutant emissions).
  - Plant trees in energy observing locations/reduces pollutant emissions from power plants
  - Plants trees to shade parked cars (reduces vehicular VOC emissions)
- Supply ample water to vegetation (enhances pollution removal and temperature reduction)
- Plant trees in polluted areas or heavily populated areas (maximizes tree quality benefits)
- Utilize evergreen trees for particulate matter reduction (Year-round removal of particles)
- Avoid pollutant sensitive species (increases tree, health).

Nowak (2002) concluded that as urbanization continues to increase on a global scale, proper urban forest design and management will become increasingly important to enhance human health and global environment quality.

According to Nowak (2002) and the United Kingdom’s Department of Environment, Food and Rural Affairs (2010), the following are the ways in which trees affect air quality in an urban centre:

- Temperature Reduction and other Microclimate Effects
- Removal of Air Pollutants
- Emission of Volatile Organic Compounds
- Tree Maintenance Emission
- Energy Effects on Buildings

1. Temperature Reduction and Microclimatic Effect:

   Tree transpiration and tree canopies can affect air temperature, radiation absorption and heat storage, wind speed, relative humidity, turbulence, surface albedo, surface roughness and consequently the evolution of the mixing-layer height. Such changes in local meteorology and microclimatology can have an effect on local pollutant concentrations in urban areas. Urban trees are generally associated with contributing to cooler summer air temperature; however in some instances they may have the opposite effect causing an increase in air temperature. Where tree stands consists of scattered tree canopies, radiation can reach and heat ground surfaces; at the same time, the canopy may reduce atmospheric mixing preventing cooler air from reaching the area. In such cases, trees shade and transpiration may not compensate for the increased air temperatures due to a reduction in overall mixing. However reduced air temperature as a result of tree planting is believed to improve air quality because emissions of many pollutants and/or bone-forming chemicals are temperature dependent. Decreased air temperature can also reduce ozone formation.

2. Removal of Air Pollutants

   Trees can remove gaseous air pollution either through uptake via leaf stomata or the plant surface. Once inside the leaf, gases diffuse into intercellular spaces and may be absorbed by water films to form acids or react with inner leaf surface. Recent research suggests that the planting of trees along sides of roads could reduce nitrous oxide (NO\textsubscript{2}) concentrations in addition to providing amenity value (Xu, 2018). Trees can also remove pollution by intercepting airborne particles. Some particles can be absorbed into the tree, though most that are intercepted are retained on the plant surface. The intercepted particle is often re-suspended to the atmosphere, washed off by rain, or dispersed through leaf full. Consequently, vegetation is thought to be only a temporary retention site for many atmospheric particles.
3. Emission of Volatile Organic Compounds (VOCs):

Trees can also have an adverse effect on air quality through the emission of volatile organic compounds (VOCs). VOCs in combination with oxides of nitrogen (NOx) can contribute to the production of other pollutants, especially ozone and particles. However under low nitrogen oxide concentrations (e.g. some rural environments) VOCs may actually remove ozone because VOC emissions are temperatures dependent and trees generally lower air temperatures, increased tree cover can often lower overall VOC emissions and, consequently, ozone levels in urban areas. VOC emissions rates however also vary by species e.g. Sycamore (*Plantanus, spp*.), popular (populous spp.) and Oak (*Quercus spp*.) have some of the highest standardized isoprene emission rate and therefore the greatest relative effect among genera on increasing ozone. However due to the high degree of uncertainty in atmospheric modeling, results are currently inconclusive as to whether these genera will contribute to an overall net formation of ozone in cities (i.e. Ozone formation from VOCs, emissions are greater than ozone removal).

4. Tree Maintenance Emissions:

Because urban trees often receive relatively large inputs of energy, primarily from fossil fuels to maintain vegetation structure, the emissions from these maintenance activities need to be considered in determining the ultimate net effect of urban forests on air quality e.g. equipment used, vehicles, shredders, clippers and leaf blowers may all contribute to concentrations of CO2, VOCs carbon monoxide, nitrogen, sulphur oxides and particulate matter.

5. Energy Effects on Buildings

Additional effects of urban trees can be through energy conservation from buildings. Trees reduce building energy use by covering temperatures and shading buildings in winter, and may increase or decrease energy use by blocking summer breezes. Thus proper tree replacement near buildings is critical to achieve maximum building energy conversation benefits. When building energy use is lowered, pollutants emissions from power plants are also lowered. Pollutants emissions generally improve air quality, lower nitrogen oxide emissions, particularly ground level emissions may lead to a local increase in ozone concentrations under certain conditions due to nitrogen oxide scavenging of ozone.

Conclusion and Recommendations

Environmental issues are of critical concern in all countries of the world and one of such is air pollution. Trees could be used in addressing this problem. The beneficial effects that trees have on air quality cannot be over emphasized. Thus, sustainable urban tree development could be a vital tool for providing a healthy and sustainable living environment in the urban centres. Tress along with other plants can make living in our cities more enjoyable and comfortable. Trees help in absorbing noise, reduce air pollution and help to reduce human stress. Urban trees also help in conserving household energy, aid in wind control, land reclamation, wastewater, and affect carbon storage and sequestration.

Port Harcourt as a major industrial city is experiencing rise in air and noise pollution as a result of the expansion of automobile ownership and vehicular traffic, domestic and industrial power plants (generating set) and the increasing affluence of the residents. Given the accelerated rate of economic growth and development of Port Harcourt, the management of environmental issues and concerns will no doubt require sincere commitment, coordination and cooperation by all concerned. Therefore the state government should come up with sound environmental policies, strategies and programmes
that will help to improve air quality in Port Harcourt. The Ministry of Environment and the Department of Forestry in the Ministry of Agriculture should come up with such urban forestry design that will lead to sustainable urban air quality in Port Harcourt, by providing the right urban forest trees and seedlings and as well mapping out the appropriate areas these trees will be planted.

Furthermore, these urban tree seedlings should be made available free of charge to resident of Port Harcourt so that they can key in into the project. Again, respective government’s establishments should launch extensive enlightenment campaign and using in the radio, television, newspaper and social media to encourage inhabitants of Port Harcourt to embrace the culture of tree planting in their neighborhood. In addition to that, the National Tree Planting Campaign that is carried out yearly should be sustained in the state whereby other establishments of government should be encouraged to participate in it. Finally, environmental education should be included in the school curriculum at primary and secondary levels.

References


Hewitt, N. (n.d.) *Trees & sustainable urban air quality*. Lancaster University, Lancaster, UK. Department of Environmental Science

Igbenedion, J. (2018). *App detects Port Harcourt air is contaminated with PM 2.5 from soot, could lead to premature death*. Retrieved from https://wired.ng/health/port-harcourt-air-contaminated-PM-2.5-lead-premature-death


Worst pollution Organization (2010) Reports. Worst polluted organization. Archived from the original from 11 August, 2010