Centre for Research and Development (CERAD) **JoST 2018**
The Federal University of Technology, Akure, Nigeria (www.journal.futa.edu.ng)

Carbon Sequestration of Urban Trees along Selected Roads in Abeokuta, Ogun State, Nigeria

BADA, B.S.[1*]; OYEGBAMI, I.E.[1]; ADEOFUN, C.O.[1]; SOAGA, J.A.[2]; ADEDEJI, O.H.[1] and TOWOLAWI, A.T.[1]
[1]Department of Environmental Management and Toxicology, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria
[2]Department of Forestry and Wildlife Management, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria

ABSTRACT: Carbon dioxide (CO_2) is the major greenhouse gas and global warming propellant which is released from human activities especially vehicular emission. The study examined carbon sequestration potential of roadsides trees in Abeokuta, Ogun State. The major roads selected were Asero-Obantoko (AO), Brewery-Itaoshin (BI), Iyana Mortuary-Idiaba (IMI), Presidential Boulevard Kuto (PBK) and Pansheke-Ojere (PO). After tree identification, concentrations of CO_2, CO, NOx, SO_2 and H_2S along the roadsides were determined using Land-Duo gas analyser. Haga Altimeter, Girth Tape and Range Finder were used to determine diameter at breast height and height of the trees for the estimation of Above-Ground Biomass (AGB). Regression model was used to estimate carbon sequestered by the urban trees. Data obtained were subjected to descriptive and inferential statistics. Mango (*Mangifera indica*), Gmelina (*Gmelina arboreal*) and Neem (*Azadirachta indica*) were identified in all the roads while Cassia (*Cassia seamea*) were found along BI road, Step tree (*Terminalia mentalis*) along PBK road, and Masquerade (*Polyalthia longifolia*) along AO, IMI and PO roads. The non-green spaces zones had ($p < 0.05$) higher CO_2 and other gases compared to the green spaces zones. The non-green spaces zones had ($p < 0.05$) higher CO_2 and other gases compared to the green spaces zones. Highest AGB 66.82×10^6 kg m^{-2} was estimated in Neem (*Azadirachta indica*) along BI roads while highest carbon sequestration of 14273.00 kg m^{-2} was calculated for Gmelina (*Gmelina arboreal*) along PO road. Carbon dioxide concentration due to vehicular emission reduced with roadsides trees.

Keywords: Vehicular emission; Greenhouse gases; Carbon stock; Urban trees

JoST. 2018. 9(2): 67-77.
Accepted for Publication, September 17, 2018

INTRODUCTION

Immigration has been identified as a major factor responsible for increase in population of some countries. Rise in population with consequent increasing vehicular traffic has tendencies to result in high levels of carbon dioxide in the environment. The severe increase in temperature from 1971 to 2005 in Nigeria could be attributed to the impact of climate change and its accompanying global warming previously reported (Mabo, 2006; Odjudo, 2011). A greenbelt/ space/ pocket is the plantation of pollutant tolerant trees (evergreen and deciduous) that could filter, intercept and absorb pollutants thereby helping to mitigate air pollution in an effective manner (Sharma and Roy, 1997). Fruits and forest trees help mitigate climate change by absorbing CO_2 and sequestering atmospheric carbon (Abdollahi *et al.,* 2000).

*Correspondence to: Bada, B.S.; badabs@funaab.edu.ng

Green space mitigates air pollution and such roles in urban ecosystem need to be taken cognizant of as the greenbelt acts as hotspots in urban biodiversity (Kulkarni *et al*., 2001). Metropolitan green roofs (Kuronuma and Watanabe, 2017) are thought of as an effective means to mitigate metropolitan millennium environmental problems with the realized benefits that include urban heat island effect mitigation (Susca *et al.,* 2011), cooling and insulation of edifices (Wong *et al.,* 2003; Sailor, 2008), storm water management (Villarreal and Bengstsson, 2005; Getter *et al.,* 2007), air pollution abatement (Yan *et al.,* 2008), habouring of other organisms (Kadas, 2006), and carbon sequestration (Getter *et al.,* 2009; Ondono *et al.,* 2016). The green pockets do not only have impact on local and regional air quality by shifting the atmospheric environment, lowering temperature and other microclimatic effects, abating and maintaining air pollutants, and providing cooling effects but also aid to resolve, absorb and adsorb particle pollutants that could damage human inhalation tracks; sequester CO_2 and other obnoxious gasses and replace the atmosphere with enough oxygen.

Ogun State Government is envisioned to make Ogun an Industrial State and also there is notable increase in the population of Abeokuta, the State Capital which might be due to the influx of people from Lagos State. The increasing population, industries and vehicular traffic have a tendency to increase the concentration of greenhouse gases in the environment. Therefore, there is need to investigate the potential roadside vegetation to sequester carbon in the atmosphere.

MATERIALS AND METHODS

Study Area

This study was carried out in Abeokuta metropolis, Ogun State Capital. The area is located in the sub-humid tropical region of South-west, Nigeria (Latitudes 70º 5′ N to 70º 20′ N and Longitude 3° l7′ E to 30º 27′ E) and has a geographical area of 1, 256 km. Abeokuta shares a common boundary with Lagos and Oyo States. The area has a mean annual rainfall of 1090.5 mm and massive rugged geological formations (Akanni, 1992). Different forest tree species can be found within the city dispersedly and around the neighbourhoods. The selected roads were Asero-Obantoko (AO), Brewery-Itaoshin (BI), Iyana Mortuary-Idiaba (IMI), Presidential Boulevard-Kuto (PBK) and Pansheke-Ojere (PO).

Traffic Densities and Plant Identification on the Selected Roads

Traffic count data for the selected roads were obtained from Bureau of Transportation, Ogun State. The data were further analysed and the percentage of traffic count for each study road in relation to the other roads were computed. A study was carried out to identify the plant species within the selected green space.

Air Quality Assessment

Air quality assessment was carried out at tree and tree-free (control) zones for parameters such as Carbon dioxide, Carbon monoxide, Hydrogen sulphide, Sulphur dioxide and Nitrogen oxides using handheld multi-gas (Land-Duo 2000, Flue Gas) analyzer.

Estimation of the Sequestered Carbon

The amount of carbon sequestered in the trees were estimated by determining (1) total (green) volume/ weight of the tree, (2) dry weight of the tree, and (3) weight of carbon in the tree.

Total (green) weight of the tree

An algorithm was adopted to calculate the above ground biomass of a tree. For trees with diameter less than 11 inches or 27.94 cm, W = 0.25D2H while W = 0.15D2H with diameter greater than or equal to 11 inches or 27.94 cm. These two equations were the “average” of all the species (Clark *et al.,* 1986). Where W is the Above

Ground Biomass (AGB) of the tree in kilogram, D is the Diameter at Breast Height (DBH) of the trunk in metres, and H is the Height of the tree in metres. The root system weighs about 20 % as much as the above-ground biomass of the tree. Therefore, to determine the total green weight of the tree, the above ground biomass of the tree was multiplied by 120 %.

Dry weight of the tree

This was calculated using the method of Aboal *et al.* (2005) and Dewald *et al*. (2005). According to Dewald *et al*. (2005), an average tree is 72.5 % dry matter and 27.5 % moisture taking all species into account. Therefore, to determine the dry weight of the tree, the total green weight of the tree was multiplied by 72.5 %.

Measurement of girth and tree height

The girth of individual tree species was obtained using girthing tape at 1.3 m from the tree base and the Diameter at Breast Height (DBH) was computed. The unit of measurement was centimeter and was converted to meter by multiplying the value by a correction factor of 0.3 (Hamilton, 1975). Height of tree species was measured using the Haga Altimeter. This was calibrated before being used based on the height of the trees i.e. about 9 m for very tall trees while shorter trees were measured at about 3 m away from the tree (Hamilton, 1975).

Weight of carbon in the tree

The average carbon content is generally 50 % of the trees total volume (Birdsey, 1992; Aboal *et al*., 2005). Therefore, to determine the weight of carbon in the tree, the dry weight of the tree was multiplied by 50 %.

Statistical Analysis

The obtained data were subject to descriptive and inferential statistics. Duncan's Multiple Range Test was used for means separation, at $p< 0.05$.

RESULTS

Traffic Densities of the Roads and Plant Identification

Percentage number of passing vehicles in the study areas per hour is as shown in Table 1. The order both in the morning and evening was observed to be Presidential Boulevard-Kuto (PBK) > Brewery-Itaoshin (BI) > Asero – Obantoko (AO) > Iyana Mortuary-Idiaba (IMI) > Panseke-Ojere (PO). The variation of traffic counts observed showed that PBK had the highest percentage vehicle counts per hour with a range of 21.03 to 37.20 % in the morning periods and a range of 25.89 to 39.53 % in the afternoon periods. The least traffic count (%) was detected to be along PO roads per hour with a range of 10.86 to 15.94 % in the morning periods and a range of 5.51 to 11.02 % in the afternoon periods. However, the road survey showed that the study roads were in all busy (Table 1). The PBK had more greenbelt than any other while IMI had the highest number of diversified tree species. This would enhance reduction of prevailing exhaust fumes (emitted pollutants) from the high percent vehicle counts. Tree species found along the major and study roadsides in the metropolis (Ogun State capital, Abeokuta) were a mix of native tree species that existed prior to the development of the city and exotic species that were introduced by past governments and residents in the area. Gmelina (*Gmelina arboreal*)*,* Mango (*Magnifera indica*) and Neem (*Azadirachta indica*) were present along the five roads while Cassia (*Cassia seamea*) were identified in BI, Step tree (*Terminalia mentalis*) in PBK, Masqurade tree (*Polyantha longivolia*) in PO, IMI and AO.

Air quality assessment in the vicinity of the urban forest

The results of air quality parameters along tree zone and tree-free zone (control) of the roads were shown in Tables 2 – 6. Significantly ($p<0.05$) higher concentration of air pollutants were

Table 1: Traffic Count (%) of the Study (greenspaces) Areas

Time	BI	PBK	PO	IMI	AO
7-8 AM	18.62	28.08	15.94	19.30	18.07
8-9 AM	17.78	30.40	12.11	18.23	21.47
9-10 AM	19.43	37.20	10.86	14.81	17.69
10-11 AM	21.07	31.62	12.81	17.09	17.41
11AM-12 PM	22.35	21.03	13.75	18.44	24.43
12-1 PM	23.61	34.16	11.02	14.93	16.29
1-2 PM	24.74	25.89	5.70	14.86	28.80
2-3 PM	33.08	33.11	6.61	10.44	16.75
3-4 PM	29.57	39.53	6.04	9.54	15.31
4-5 PM	30.09	35.51	6.86	12.62	14.92
5-6 PM	27.23	31.36	6.85	13.60	20.95
6-7 PM	25.86	29.64	5.51	14.93	24.05

BI = Brewery-Itaoshin, PBK = Presidential Boulevard-Kuto, PO = Panseke-Ojere, IMI = Iyana Mortuary-Idiaba, AO = Asero-Obantoko
Source: Ogun State Bureau of Transportation

Table 2: Levels of CO_2 at the Greenspaces

Tree	BI	PBK	PO	IMI	AO
Gmelina	1.50^{b}	1.70^{b}	1.50^{b}	1.90^{ab}	1.87^{a}
Mango	2.43^{a}	1.27^{b}	1.40^{b}	1.99^{ab}	1.72^{a}
Neem	1.43^{b}	2.63^{a}	1.43^{b}	1.51^{b}	1.84^{a}
Cassia	1.24^{b}	-	-	-	-
Step tree	-	1.70^{b}	-	-	-
Masquerade	-	-	1.22^{b}	1.80^{ab}	1.87^{a}
Control	2.58^{a}	2.83^{a}	2.58^{a}	2.20^{a}	2.18^{a}

BI = Brewery-Itaoshin, PBK = Presidential Boulevard-Kuto, PO = Panseke-Ojere, IMI = Iyana Mortuary-Idiaba, AO = Asero-Obantoko
Means with different superscripts in the same column indicate significant difference at $p<0.05$ (DMRT)

Table 3: Levels of NO_X (ppm) at the Greenspaces

Tree Species	BI	PBK	PO	IMI	AO
Gmelina	0.67^{b}	0.63^{b}	0.67^{b}	0.53^{a}	0.06^{b}
Mango	BDL	0.67^{b}	BDL	0.53^{a}	0.04^{b}
Neem	0.50^{b}	0.33^{b}	0.50^{b}	0.01^{b}	0.04^{b}
Cassia	0.33^{b}	-	-	-	-
Step tree	-	0.50^{b}	-	-	-
Masquerade	-	-	0.33^{b}	0.07^{b}	0.06^{b}
Control	2.55^{a}	2.55^{a}	2.56^{a}	0.52^{a}	0.35^{a}

BI = Brewery-Itaoshin, PBK = Presidential Boulevard-Kuto, PO = Panseke-Ojere, IMI = Iyana Mortuary-Idiaba, AO = Asero-Obantoko, BDL = Below Detection Limit
Means with different superscripts in the same column indicate significant difference at $p<0.05$ (DMRT)

Table 4: Levels of CO (ppm) at the Greenspaces

Tree Species	BI	PBK	PO	IMI	AO
Gmelina	0.63^b	1.83^b	0.63^b	2.10^b	0.27^a
Mango	0.50^b	1.67^b	0.50^b	2.00^b	BDL
Neem	0.67^b	0.83^b	0.67^b	BDL	0.50^b
Cassia	0.30^b	-	-	-	-
Step tree	-	1.00^b	-	-	-
Masquerade	-	-	0.33^b	1.00^b	0.27^b
Control	5.62^a	5.75^a	5.62^a	4.67^a	3.00^a

BI = Brewery-Itaoshin, PBK = Presidential Boulevard-Kuto, PO = Panseke-Ojere, IMI = Iyana Mortuary-Idiaba, AO = Asero-Obantoko, BDL = Below Detection Limit
Means with different superscripts in the same column indicate significant difference at $p<0.05$ (DMRT)

Table 5: Levels of SO_2 (ppm) at the Greenspaces

Tree Species	BI	PBK	PO	IMI	AO
Gmelina	0.11^b	0.12^b	0.11^b	BDL	0.02^{ab}
Mango	0.01^b	0.23^b	0.01^b	BDL	0.03^a
Neem	0.03^b	0.10^b	0.03^b	BDL	BDL
Cassia	0.08^b	-	-	-	-
Step tree	-	0.20^b	-	-	-
Masquerade	-	-	0.03^b	BDL	0.02^{ab}
Control	0.33^a	0.40^a	0.33^a	0.33^a	0.04^a

BI = Brewery-Itaoshin, PBK = Presidential Boulevard-Kuto, PO = Panseke-Ojere, IMI = Iyana Mortuary-Idiaba, AO = Asero-Obantoko, BDL = Below Detection Limit
Means with different superscripts in the same column indicate significant difference at $p < 0.05$ (DMRT)

Table 6: Levels of H_2S (ppm) at the Greenspaces

Tree Species	BI	PBK	PO	IMI	AO
Gmelina	0.06^b	0.60^b	0.06^b	BDL	0.03^a
Mango	BDL	0.01^b	BDL	BDL	0.02^a
Neem	0.01^b	0.06^b	0.01^b	BDL	BDL
Cassia	0.03^b	-	-	-	-
Step tree	-	0.01^b	-	-	-
Masquerade	-	-	0.03^b	BDL	0.01^a
Control	0.28^a	0.27^a	0.28^a	0.20	0.02^a

BI = Brewery-Itaoshin, PBK = Presidential Boulevard-Kuto, PO = Panseke-Ojere, IMI = Iyana Mortuary-Idiaba, AO = Asero-Obantoko, BDL = Below Detection Limit
Means with different superscripts in the same column indicate significant difference at $p<0.05$ (DMRT)

observed in tree-free zones compared to tree zones.

Levels of CO_2 along the Roads

Levels of carbon dioxide (CO_2) in % were observed to be highest (7.30) along Presdiential Boulevard-Kuto (PBK) road and from 1.27 around Mango (*Magnifera indica*) to 2.63 around Neem (*Azadirachta indica*). Along Asero-Obantoko (AO), it ranged from 1.72 around Mango (*Magnifera indica*) to 1.87 around both Gmelina (*Gmelina arboreal*) and Masquerade tree (*Polyalthia longifolia*). The least (5.55) level of CO_2 was detected along Pansheke-Ojere (PO) road between 1.22 around Masquerade tree (*Polyalthia longifolia*) and 1.50 around Gmelina (*Gmelina arboreal*) (Table 2).

Levels of NO_X along the Roads

The nitrogen oxide, NO_X (ppm) concentrations were detected to be highest (1.79) along PBK road and ranged from 0.33 around both Mango (*Magnifera indica*) and Neem (*Azadirachta indica*) to 0.63 Gmelina (*Gmelina arboreal*). The least (0.20) concentrations were observed along AO road and ranged from 0.04 around both Mango (*Magnifera indica*) and Neem (*Azadirachta indica*) to 0.06 around both Gmelina (*Gmelina arboreal*) and Masquerade tree (*Polyalthia longifolia*) (Table 3).

Levels of CO along the Roads

Level of carbon monoxide, CO (ppm) was observed to be highest (5.10) along IMI road, where it spanned between Below Detection Limit (BDL) around Neem (*Azadirachta indica*) and 2.10 around Gmelina (*Gmelina arboreal*). The least (2.04) level was detected along AO road to span between BDL around Mango (*Magnifera indica*) and 1.27 around Masquerade tree (*Polyalthia longifolia*) (Table 4).

Levels of SO_2 along the Roads

Concentrations of Sulphur dioxide, SO_2 (ppm) were detected to be highest (0.52) along PBK road where it ranged from 0.10 around both Mango (*Magnifera indica*) and Neem (*Azadirachta indica*) to 0.20 around Step tree (*Terminalia mentalis*). The least (BDL) concentrations were observed alond IMI road (Table 5).

Levels of H_2S along the Roads

Levels of Hydrogen sulphide, H_2S (ppm) were observed to be highest (0.73) along PBK road and ranged between 0.01 around Step tree (*Terminalia mentalis*) and 0.60 around Gmelina (*Gmelina arboreal*). The least (BDL) concentrations were observed along IMI road (Table 6).

Heights of Identified Trees

The shortest: 967 cm tree species was observed to be Mango (*Magnifera indica*) along PBK road while the highest (2300 cm) tree species was Masquerade tree (*Polyalthia longifolia*) along PO. However, the tree species' height was significantly ($p < 0.05$) different along all the roadsides (Table 7).

Diameter at Breast Height of the Tree Species

The diameter at breast height (cm) of the tree species was observed to be broadest at PBK and it ranged from 23.70 in Masquerade tree (*Polyalthia longifolia*) to 61.50 in Gmelina (*Gmelina arboreal*). Thinnest tree was observed at BI where it spanned between 20.00 in Gmelina (*Gmelina arboreal*) and 33.57 in Mango (*Magnifera indica*) (Table 8).

Table 7: Greenspace Tree Species' Height (cm)

Tree Species	BI	PBK	PO	IMI	AO
Gmelina	15.60^{a}	22.47^{a}	21.00^{a}	21.83^{a}	15.60^{a}
Mango	11.33^{a}	9.67^{b}	14.77^{a}	14.67^{ab}	11.33^{a}
Neem	15.63^{a}	13.53^{ab}	15.67^{a}	14.83^{ab}	15.63^{a}
Cassia	17.20^{a}	-	-	-	-
Step tree	-	17.00^{ab}	-	-	-
Masquerade	-	-	23.00^{a}	22.83^{a}	17.20^{a}

BI = Brewery-Itaoshin, PBK = Presidential Boulevard-Kuto, PO = Panseke-Ojere, IMI = Iyana Mortuary-Idiaba, AO = Asero-Obantoko

Means with different superscripts in the same column indicate significant difference at $p<0.05$ (DMRT)

Above Ground Biomass of the Identified Tree

Above Ground Biomass (AGB) in kg m^{-2} of tree species alon PO road ranged from 8.70 × 10^6 in Neem (*Azadirachta indica*) to 12.30 × 10^6 in Masquerade tree (*Polyalthia longifolia*). Along IMI road, it ranged from 4.83 × 10^6 in Masquerade tree (*Polyalthia longifolia*) to 15.40 × 10^6 in Neem (*Azadirachta indica*). However, it was observed that Neem (*Azadirachta indica*) had the highest AGB among the tree species identified along the roadsides and ranged from 8.70 × 10^6 along PO road to 66.82 × 10^6 along BI roads (Table 9).

Weight of Carbon in Identified Trees

Values of the estimated carbon sequestered in various were shown in Table 10. There was variation in amount of carbon sequestered in the tree species along the roadsides. It was observed that carbon (kg m^{-2}) sequestered in Cassia (*Cassia seamea*) was 2031.10 along BI road, Gmelina (*Gmelina arboreal*): 14273.00 along PBK, Mango (*Magnifera indica*): 6652.00 along PO road, Neem (*Azadirachta indica*): 6366.00 along IMI, and Masquerade tree (*Polyalthia longifolia*): 2103.10 along AO road.

Table 8: Greenspace Tree Species' Diameter at Breast Height(cm)

Tree Species	BI	PBK	PO	IMI	AO
Gmelina	20.00^{bc}	61.50^{a}	35.90^{a}	42.10^{ab}	22.00^{bc}
Mango	33.57^{a}	44.70^{b}	53.00^{b}	34.80^{ab}	33.57^{a}
Neem	16.33^{c}	38.50^{bc}	36.95^{a}	54.60^{a}	16.33^{c}
Cassia	27.87^{ab}	-	-	-	-
Step tree	-	23.70^{c}	-	-	-
Masquerade	-	-	33.50^{a}	19.30^{b}	27.87^{ab}

BI = Brewery-Itaoshin, PBK = Presidential Boulevard-Kuto, PO = Panseke-Ojere, IMI = Iyana Mortuary-Idiaba, AO = Asero-Obantoko
Means with different superscripts in the same column indicate significant difference at $p<0.05$ (DMRT)

Table 9: Greenspace Tree Species' above Ground Biomass (kg m^{-2})

Tree Species	BI	PBK	PO	IMI	AO
Gmelina	3115.00^{a}	34664.58^{a}	12.07E6^{a}	14.26E6^{a}	3115.00^{a}
Mango	4384.00^{a}	7099.47^{a}	16.15E6^{a}	8.06E6^{a}	4384.00^{a}
Neem	66.80E6^{a}	28.26E6^{a}	8.70E6^{a}	15.40E6^{a}	66.82E6^{a}
Cassia	4310.00^{a}	-	-	-	-
Step tree	-	3510.49^{a}	-	-	-
Masquerade	-	-	12.30E6^{a}	4830843^{a}	4310.00^{a}

Table 10: Greenspace Tree Species' Weight of Carbon

Species	Weight of carbon in tree (kg m^{-2})				
	BI	PBK	PO	IMI	AO
Gmelina	937.70^{ab}	14273.00^{a}	4974.00^{a}	5872.00^{a}	937.70^{ab}
Mango	1905.20^{a}	2923.00^{b}	6652.00^{a}	3322.00^{a}	1905.20^{a}
Neem	638.00^{b}	2925.00^{b}	3597.00^{a}	6366.00^{a}	638.00^{b}
Cassia	2031.10^{a}	NA	NA	NA	NA
Step tree	NA	1551.00^{b}	NA	NA	NA
Masquerade	NA	NA	5068.00^{a}	1989.00^{a}	2031.10^{a}

BI = Brewery-Itaoshin, PBK = Presidential Boulevard-Kuto, PO = Panseke-Ojere, IMI = Iyana Mortuary-Idiaba, AO = Asero-Obantoko
Means with different superscripts in the same column indicate significant difference at $p<0.05$ (DMRT)

DISCUSSION

The traffic counts along the roads indicated possible high levels of obnoxious pollutants. This corroborated to the reiteration that vehicular emissions could be responsible for global air pollution more than any other human activity and possibly dispersing virtually all of the gaseous and metal dusts in urban air as well as major portions of related organic compounds, fine particles and toxic chemicals (Durrani *et al.*, 2004; Chauhan, 2010; Narwaria and Kush, 2012). Presidential Boulevard road with the highest traffic density had higher concentration of greenhouse gases. This is in agreement Bada and Akande (2010) where high concentrations of greenhouse gases along roadsides in Abeokuta were reported.

The tree species height recorded in this study was higher than Bhatt *et al.* (2010) highest value. The highest AGB (kg m^{-2}) observed in Neem (*Azadirachta indica*) suggested that it is a fast growing species which respond better to high levels of CO_2 than slow growing hardwoods do (Tangley, 2001). The high values of height and DBH indicated that the available tree species along the roadsides had adapted to the existing gaseous emission conditions. Highest AGB was estimated in Neem (*Azadirachta indica*) along BI roads whereas highest carbon sequestration was observd in Gmelina (*Gmelina arboreal*) along PO road. This corroborated Khan and Miria (2013) findings that the total biomass was maximum in *Syzygium cumini* while maximum carbon sequestration was in *Millingtonia hortensis*. The reason being that the whole carbon sequestered would not participate in growth production and many CO_2 elevated level researches reiterated that higher rates of photosynthesis would not result in a corresponding increase in biomass and yield of tree species (Sulpice *et al.,* 2009). Significant ($p<0.05$) variation in the greenspace tree species biomass (AGB) corroborated to previous observation and documentation that tree species responded to a reduction in edaphic (belowground) resources (such as water and nutrients) with an upturn in the biomass allocation to the roots (Poorter and Nagel, 2000). Khan and Miria (2013) affirmed that it is necessary to think through maintenance practices such as fertilizer application to enhance effectiveness of the green spaces tree species. Greenpocket and earths constitute the main terrestrial carbon pool with potential of absorbing and storing carbon dioxide (CO_2) from the atmosphere (Kaul *et al.,* 2010). Carbon stocking and other nutrient assimilation and storage vary with different plant species and parts. Non-uniformity in green spaces tree species features (height, diameter and biomass) might be as a result of relevance of physiological and morphological traits which regulate the sequestration of carbon in their various body parts (Khan and Miria, 2013). Various tree species respond differently to carbon utilization (Negi *et al.,* 2003). Long term exposure of tree species to increased CO_2 resulted in significant growth and biomass production. This high development could be from the production of supplementary photosynthetic enzymes and their subdivision into various plant portions to eventually increase the total biomass production. Upturn in biomass production might be due to enriched photosynthesis rate and fixation of carbon and its allocation to the tree species components. High levels of CO_2 stirred total dry biomass accumulation which is a prominent biological response to elevated CO_2 (Righetti *et al.,* 1996; Atkinson *et al.,* 1997). Baker and Allen (2005) also reported similar observation that CO_2 augmentation significantly influenced tree species covering photosynthetic rate. Increase in tree species photosynthesis rate had also been observed under high levels CO_2 (Bhatt, *et al.,* 2010). Variations among tree species in growth features might explain reasons the estimations of carbon storage can differ among tree species even of the same diameter (Johnson and Gerhold, 2001; Freilicher, 2012). This might be that nutrient assimilation and storage in various tree species components differs according to its utilization to normalize various physiological processes (Voronin *et al.,* 2005).

CONCLUSION

Cities are a major source of vehicular emissions due to their heavy traffic density and vehicular emissions contribute to greenhouse gases in the atmosphere. Among the tree species identified along roadsides; Gmelina, Neem, Mango, and Masquerade trees were common. These tree species along roadsides have great carbon sequestration potential with the Gmelina tree (*Gmelina arboreal*) having the highest.

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