Inventory of Street Tree Population and Diversity in the Kumasi Metropolis, Ghana

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Abstract
Urban greenery is an important component of urban environment and is fast gaining prominence especially in the developing countries. The destruction of urban trees has resulted to the degradation of the environment, thus the introduction of green Kumasi project by Kumasi Metropolitan Assembly, Ashanti Region of Ghana. The composition and diversity of urban trees gives rise to adequate management and monitoring, thus an inventory of urban trees of the Metropolis was conducted to document complete information on its density, diversity, composition and distribution. A total tree population of 1,101 was enumerated in the principal roads of the Metropolis. The ten most encountered tree species accounted for 61.04% of all the individual tree populations with Mangifera indica being dominant. The dominant families: Fabaceae, Moraceae and Arecaceae constitute 38.57% of the tree population. Diversity of the tree species was very high. The minimum diversity criteria were met on analysis of the diversity of this population. The proportion of exotic species was high with 65.71% of the trees belonging to the introduced species. It is recommended that greater emphasis should be placed on the planting of indigenous trees in future tree planting exercise.

Key Words: species diversity, composition, urban tree populations, phenology

Introduction
Urbanization has been portrayed as the development from a common to an urban culture, and incorporates an augmentation in the amount of people in urban extents in the midst of a particular year. Urbanization and industrialization has offered live up to individuals’ high desires of environmental defilement, in this way an invalidation of the evident ideal circumstances of industrialization. Kuchelmeister (2000) defined urban forest as trees, and forests located in cities, including ornamental and grown trees, street and parkland trees, protected forests and green areas. Several studies on urban trees have been carried out in the developed world (Kuchelmeister 2000). Regrettably, urban forestry studies in African countries are still at its infancy. Raoufuo et al. (2011), study on urban trees in...
Lome Togo produced a checklist of species that contribute to the beautification of the streets, production of shade and protection of the environment. Kayode (2010) enumerated and produced a checklist of 62 tree species belonging to 27 families that are found in and around the urban centres of Ekiti State, Nigeria. Borokini 2012 assessment of diversity and distribution of trees in Ibadan, Nigeria, identified 62 species and concluded that Ibadan, Nigeria is a green city.

Roadside trees are an imperative part of the urban woodland as they give basic biological community administrations which add to human wellbeing and environmental quality. The need to embrace urban nature by urban environments cannot be over emphasized. Green cities declaration during World Environmental day in 2005 states categorically in action 11, the inventorization of existing canopy coverage in the City and goal establishment based on ecological and Community considerations to plant and maintain canopy coverage in not less than Fifty percent of all sidewalk planting site.

Kumasi, Ashanti Regional Capital and Second biggest City in Ghana was established in the tropical rainforest (Tipple 1987) and thus had one of the focal points offered by regular scene, particularly urban trees, to end up a superb illustration of environmental city in Africa. Kumasi really earned the honour the “Greenery enclosure city of West Africa” after the 1945 City arrangement was affected (Korboe 2001) because of flower beautification of the City (Oppong and Dunster 2008). Unfortunately, urban trees had been depleted due to urbanization, resulting in warmer temperatures, vehicular air pollution, emissions of hydrocarbons forming ground level ozone layer and excessive heat radiation (Amos-Abanyie 2011). In spite of all the recorded advantages of trees in urban zones, trees have been less esteemed in urban regions of most developing nations of which Ghana is no special case, what is clear is that the current ones are not appropriately secured. Road trees in developed nations are desirously ensured, the couple of urban trees in Ghanaian urban communities are left to their destiny with all the weight that people and creatures put on them. Nails are regularly crashed into trees in order to hold different blurbs of promotion. These nails are a wellspring of harm to trees and contrarily influence the capacity of trees to give every one of the advantages named previously. Both people and creatures don’t just rest under trees additionally urinate there. What is most likely obscure is that urine is acidic in nature and henceforth influences tree roots. Additionally, individuals park vehicles under shade of trees and this causes compaction of the dirt just around the tree trunk. Such compaction implies that less air and dilute can enter to tree roots and this has a tendency to abbreviate lifespan of trees (Guuroh 2016).

To forestall these problems, Kumasi Metropolitan Agency has launched a programme tagged “Kumasi Urban Forestry project: me and my tree”. It is aimed at planting over a million trees along drive ways and open spaces and school compounds across the Metropolis. This will restore Kumasi metropolis to its former status as the Garden city of West Africa, an accolade given to the Metropolis by Queen Elizabeth of England several years ago.

The knowledge of urban trees composition and diversity is an important aspect of urban forestry because it aids and enhances adequate monitoring and management (Eludoyin et al. 2014). Socio-economic factors, acceptance of the species, function or purpose are some of the factors that influence urban forest composition and diversity (Grey and Deneke 1978). The determination of stability and tolerance of road side tree population is premised on the level of biological and genetic diversity (Sun 1992). This study assessed the composition and diversity of urban trees in the principal roads of Kumasi metropolis. The assessment of current diversity level of tree populations will give rise to the development of strategic planning programme that will aid in the realization of urban greenery project as well as forestall homogenization of the urban trees in the Metropolis.

Materials and Methods

Study area

Kumasi is the second largest city in Ghana. It is located in the transitional forest zone and it is about 270 km North of the National capital, Accra, 397 km South of Tamale (Northern Regional capital and 120 km South-east of Sunyani (Brong Ahafo Regional capital). Kumasi is located between latitude 6.35°-6.40° and longitude 1.30°-1.35° and has a total land area of 254 km² (Fig. 1). It is situated in the wet subequatorial region. The average minimum temperature is about 21.5°C with maximum average temperature of 30.7°C. The city almost features two different rainy sea-
sons, a longer rainy season from March through July and a shorter rainy season from September to November. Lasting from December to February, the harmattan is the primary source of the city’s dry season. The Metropolis enjoys a double maxima rainfall regime (214.3 mm in June and 165.2 mm in September).

**Field data collection**

A complete inventory of the tree species on the seven principal roads of Kumasi Metropolis was conducted between May and October, 2015. These roads were selected because of its position as the major arterials of the Metropolis. The standard line transect sampling method was used. The transect line was made using a nylon rope marked and numbered at 1m intervals, all the way along its length. The trees located on either side of the roads were identified to species level using the taxonomic keys of keys of Lebrum and Stork (2008) and Grisvard et al. (1990). Trees with 5 m height and diameter breast height $\geq$ 10 cm within 20 m from the road were enumerated. The number of individuals of each tree species per road was obtained from the total number of individuals of the species recorded in the transect line numbered at 1m intervals. The Diversity of the street trees in this study was determined using inverse
Urban Trees in Ashanti Region of Ghana

of Simpson’s index as derived by Sun (1992):

\[ D = \frac{\sum N_j (\sum N_j - 1)}{\sum N_j (N_j - 1)} \]

where \( N_j \) = number of individuals in the \( j \)th (\( j = 1, 2, 3... n \) group (species or genus), and \( n \) = the total number of groups in a particular population.

The Inverse of Simpson’s Index (SDI) can be translated as the probable number of samples with two randomly selected trees, of which one sample may have two trees belonging to a similar species. The larger the SDI, the higher the diversity level. This SDI is thought to be the adjusted number of species in a street population based on species composition. This is because SDI equals the number of species if all the species are evenly represented in a population. Any street population with a \( SDI + X \) is diverse as much as an evenly-distributed population with \( X \) species. The SDI permits linear comparisons of species diversity levels between any street tree populations (Sun 1992).

Results and Discussion

Tree species composition of Kumasi Metropolis

A total of 1101 trees represented by 70 species from the study sites were identified. The highest number of trees encountered was 283 individuals in Accra road, while Lake road had the least number of individual trees (Fig. 2). However, the most diverse tree species composition was in Accra road, while Lake and Mampong roads had the least species composition (Fig. 3). The Species composition was high when compared to Mensa (2011) report of 23 species and 206 individuals in the Danyame-Kumasi Exotic-Indigenous tree count. The Correlation coefficient (\( r \)) between road length (\( x \)) and tree species (\( Y \)) was 0.789, \( r^2 \) was 0.623,
and thus the coefficient of determination was 62.3%. This implies that the variance of the road length determines 62.3% of the tree species. Regression analysis between tree species and tree density (Number of individuals) are shown in Fig. 4. The regression analysis indicates that there was a close relationship between tree species and tree density with $R^2 = 0.916$. This means that 91.6% of the variance of tree species can be explained by the variance of the tree density of the study area.

The survey demonstrated that 64.29% of the tree species were exotics and 35.71% were indigenous (Fig. 5). This is not unusual in a developing country like Ghana because of introduction of exotic species between countries by colonial masters (Nagendra and Gopal 2010). In Eastern Cape of South Africa, 60% of most frequently occurred tree species were alien. In Bangalore, India, 67% of the street trees were alien to India (Nagendra and Gopal 2010). In Ghana, exotic tree species constitute a greater proportion of amenity trees in cultivated urban landscapes (Abbiw 1995). It has been reported that by McIntyre and Hobbs (1999) and Hunter (2007) that mix of introduced and indigenous species may actually be beneficial for some aspects of biodiversity, Mackinney (2006) stated that the presence of high number of introduced species alters the ecosystem structure and function in a fundamental manner. Utilization of indigenous trees advances biodiversity and creation of wildlife corridors while fortifying a feeling of spot for connection to nature. According to Kuhns (2009) indigenous plants by and large, are most appropriate for local environments, when contrasted with the exotics, in light of the fact that they have the upside of being climatically suited and live in some level of harmony with nuisance creatures such as insects and fungi.

The Ten most common species: Mangifera indica, Terminalia cathapa, Tectonia grandis, Cassia seamea, Blighia sapida, Polyalthia longifolia, Gmelina aborea, Terminalia mantally, Elais guinensis and Ficus ptyrophylla jointly make up 61.04% of the total population (Table 1). This result corroborates with Jim 1985; Gilbertson and Bradshaw 1987; Kainick 1987 and Sreetheran et al. (2011) studies that few tree species dominate in urban areas. Thaiutsa et al. (2008) opined that there may be large species composition of street and heritage trees in a specific city dominated by few species. Also five most abundant species contributing 75% of the trees at Port Alfred and Somerset East, and 55% in Grahamstown, South Africa was reported by Kuruneri-Chitepo and Shackleton (2011). Mangifera indica was utilized as a part of all streets as road trees in relatively more prominent numbers, trailed by, Terminalia cathapa and Tectona grandis in Kumasi Metropolis. The similarly state of utilization could be ascribed to their structure and above all fast rate of development, as ornamentals fruit value, shade and wood value.

Family wise distribution of tree species revealed that Fabaceae (21.43%), Moraceae (10%), Arecaceae (7.14%), Anacardiaceae (5.71%), Annonaceae (5.71%) and Meliaceae (5.71%) were the most distinct as it relates to species richness (Table 2). In this study, highest percentage of trees species composition was found in Fabaceae. It has been pos-ited Fabaceae family are highly adapted to severe roadside environmental conditions and as well has the ability to fix atmospheric nitrogen (Sreetheran et al. 2011). The study phenologically indicates that deciduous, semi-deciduous and evergreen trees constitute 45.71%, 11.43% and Evergreen (42.86%) of the trees species re-spectively (Fig. 6). The increased number of deciduous trees could be due to favourable environmental factor. In a survey of data carried out by Way and Oren, 2010 in 63 different investigations, they concluded that growth including stem height, stem diameter and biomass was promoted more by increased temperature in deciduous species than evergreen tree species. Increase in temperature has resulted to change in weather pattern with increased frequency and intensity of extreme weather conditions in most African countries, including Ghana and that matter Kumasi. There has been a mean temperature increase of about 0.4°C over a decade (Ghana Metrological Agency 2011).

**Species diversity**

An evaluation of Species diversity index in Kumasi Metropolis showed that the Species diversity index (SDI) was 20.16 (Table 1). This value has revealed high SDI in comparison to other Cities of the world. Sreetheran et al. 2011 reported SDI of 5.0 for Kuala Lumpur. Sun (1992) reported that in 11 tree populations of USA cities and towns had an average of 11.5, while seven cities in United Kingdom had an average of 6.19. Bassuk (1988) recommended that a 5% benchmark for urban street planting
Table 1. Inventory of Tree Species in the Principal roads of the Kumasi Metropolis

| S/no | Species                          | Family           | Origin       | Phenology | Freq. | %  | (Nj) | Nj-1 | Nj (Nj-1) |
|------|----------------------------------|------------------|--------------|-----------|-------|----|------|------|-----------|
| 1    | Albizia adianthifolia (Schumach.) | Fabaceae         | Indigenous   | Deciduous  | 1     | 0.09 | 1    | 0    | 0         |
| 2    | Albizia petersiana (Bolle)       | Fabaceae         | Exotic       | Evergreen  | 1     | 0.09 | 1    | 0    | 0         |
| 3    | Amphimas pterocarpoides (Harms)  | Fabaceae         | Indigenous   | Deciduous  | 1     | 0.09 | 1    | 0    | 0         |
| 4    | Annona senegalesis Pers          | Annonaceae       | Indigenous   | Evergreen  | 1     | 0.09 | 1    | 0    | 0         |
| 5    | Bambusa vulgaris Schrad         | Poaceae          | Exotic       | Deciduous  | 1     | 0.09 | 1    | 0    | 0         |
| 6    | Canarium schweinfurthii Engl     | Burseraceae      | Indigenous   | Deciduous  | 1     | 0.09 | 1    | 0    | 0         |
| 7    | Cussonia sp Thunb.ex Thunb       | Araliaceae       | Exotic       | Evergreen  | 1     | 0.09 | 1    | 0    | 0         |
| 8    | Erythrina spp L                  | Fabaceae         | Exotic       | Deciduous  | 1     | 0.09 | 1    | 0    | 0         |
| 9    | Ficus capensis Forss             | Moraceae         | Indigenous   | Evergreen  | 1     | 0.09 | 1    | 0    | 0         |
| 10   | Ficus exasperata P. Beau         | Moraceae         | Exotic       | Deciduous  | 1     | 0.09 | 1    | 0    | 0         |
| 11   | Khaya grandiflora C. DC          | Meliaceae        | Indigenous   | Evergreen  | 1     | 0.09 | 1    | 0    | 0         |
| 12   | Khaya senegalensis (Desr.) A. Juss | Meliaceae   | Indigenous   | Evergreen  | 1     | 0.09 | 1    | 0    | 0         |
| 13   | Lagerstroemia sp L               | Lythraceae       | Exotic       | Deciduous  | 1     | 0.09 | 1    | 0    | 0         |
| 14   | Milicia excelsa (Welw.) C. Berg  | Moraceae         | Indigenous   | Deciduous  | 1     | 0.09 | 1    | 0    | 0         |
| 15   | Piliostigma thonningii Fabaceae  | Exotic           | Deciduous    | 1         | 0.09  | 1    | 0    | 0    | 0         |
| 16   | Pinus spp L                      | Pinaceae         | Exotic       | Evergreen  | 1     | 0.09 | 1    | 0    | 0         |
| 17   | Polyalthia sp Annonaceae         | Exotic           | Evergreen    | 1         | 0.09  | 1    | 0    | 0    | 0         |
| 18   | Pseudospondias microcarpa Rich   | Anacardiaceae    | Indigenous   | Deciduous  | 1     | 0.09 | 1    | 0    | 0         |
| 19   | Psidium guajava L Myrtaceae      | Exotic           | Semi deciduous | 1       | 0.09  | 1    | 0    | 0    | 0         |
| 20   | Raphia africana Otedoh Arecaceae | Exotic           | Evergreen    | 1         | 0.09  | 1    | 0    | 0    | 0         |
| 21   | Raphia hookeri G.Mann & Wendl   | Arecaceae        | Indigenous   | Evergreen  | 1     | 0.09 | 1    | 0    | 0         |
| 22   | Sterculia tragacantha Lindl      | Sterculiaceae    | Exotic       | Deciduous  | 1     | 0.09 | 1    | 0    | 0         |
| 23   | Terminalia ivorensis A. Chev    | Combretaceae     | Indigenous   | Deciduous  | 1     | 0.09 | 1    | 0    | 0         |
| 24   | Adansonia digitata L Malvaceae   | Indigenous       | Semi deciduous | 2       | 0.18  | 2    | 1    | 2         |
| 25   | Albizia saman F. Muell Fabaceae  | Indigenous       | Semi deciduous | 2       | 0.18  | 2    | 1    | 2         |
| 26   | Anacardium occidentale L Anacardiaceae | Exotic | Semi deciduous | 2       | 0.18  | 2    | 1    | 2         |
| 27   | Cola gigantea A. Chev Sterculiaceae | Indigenous | Evergreen    | 2         | 0.18  | 2    | 1    | 2         |
| 28   | Funtumia africana Benth Apocynaceae | Indigenous | Deciduous    | 2         | 0.18  | 2    | 1    | 2         |
| 29   | Millettia pinnata Harms Mimosaceae | Exotic           | Evergreen    | 2         | 0.18  | 2    | 1    | 2         |
| 30   | Cananga odorata (Lam.) Hook f Annonaceae | Exotic | Semi deciduous | 4       | 0.36  | 4    | 3    | 12        |
| S/no | Species                          | Family      | Origin     | Phenology  | Freq. | %   | (Nj) | Nj-1 | Nj (Nj-1) |
|------|----------------------------------|-------------|------------|------------|-------|-----|------|------|------------|
| 37   | Cedrela odorata L                | Meliaceae   | Exotic     | Evergreen  | 4     | 0.36| 4    | 3    | 12         |
| 38   | Cordia anthope L                 | Boraginaceae| Exotic     | Deciduous  | 4     | 0.36| 4    | 3    | 12         |
| 39   | Margaritaria diversa (Baill.) G  | Phyllanthaceae| Exotic     | Deciduous  | 4     | 0.36| 4    | 3    | 12         |
| 40   | Ficus benjamina L                | Moraceae    | Exotic     | Deciduous  | 6     | 0.54| 6    | 5    | 30         |
| 41   | Coccos nucifera L                | Moraceae    | Exotic     | Evergreen  | 8     | 0.73| 8    | 7    | 56         |
| 42   | Ficus sp L                       | Moraceae    | Exotic     | Evergreen  | 8     | 0.73| 8    | 7    | 56         |
| 43   | Raysonoa regia (Kunth) Cook      | Moraceae    | Exotic     | Deciduous  | 8     | 0.73| 8    | 7    | 56         |
| 44   | Acacia senegalensis L            | Fabaceae    | Exotic     | Deciduous  | 9     | 0.82| 9    | 8    | 72         |
| 45   | Cérus sp L                       | Rutaceae    | Exotic     | Evergreen  | 9     | 0.82| 9    | 8    | 72         |
| 46   | Luscaua lucifera L, aluca        | Arecaceae   | Exotic     | Evergreen  | 11    | 1   | 11   | 10   | 110        |
| 47   | Ceiba pentandra (L) Gaertn       | Malvaceae   | Indigenous | Deciduous  | 11    | 1   | 11   | 10   | 110        |
| 48   | Terminalis superba Engl. & Dick  | Combretaceae| Indigenous | Deciduous  | 11    | 1   | 11   | 10   | 110        |
| 49   | Tetradenia laurina P. Beauv      | Bignoniaceae| Indigenous | Evergreen  | 12    | 1.09| 12   | 11   | 132        |
| 50   | Azadiracu indica A. Juss         | Meliaceae   | Exotic     | Evergreen  | 13    | 1.18| 13   | 12   | 156        |
| 51   | Albizia zygia (DC.) J. F. Macbr  | Mimosaceae  | Indigenous | Deciduous  | 14    | 1.27| 14   | 13   | 182        |
| 52   | Albizia lebeck (L.) Benth       | Fabaceae    | Exotic     | Evergreen  | 15    | 1.36| 15   | 14   | 210        |
| 53   | Marula laevia Benth             | Rubiaceae   | Exotic     | Semi deciduous | 15   | 1.36| 15   | 14   | 210        |
| 54   | Pittosporum dalix (Roxb.) B      | Fabaceae    | Exotic     | Deciduous  | 19    | 1.73| 19   | 18   | 342        |
| 55   | Alstonia bousoni De Wild        | Apocynaceae | Indigenous | Deciduous  | 26    | 2.36| 26   | 25   | 650        |
| 56   | Senna geechell Irwin & Barneby   | Fabaceae    | Exotic     | Deciduous  | 28    | 2.54| 28   | 27   | 756        |
| 57   | Delonix regia (Boj. ex Hook.) Raf| Fabaceae    | Exotic     | Deciduous  | 30    | 2.72| 30   | 29   | 870        |
| 58   | Persa americana Mill            | Lauraceae   | Exotic     | Evergreen  | 36    | 3.27| 36   | 35   | 1,260      |
| 59   | Acacia mangium Wild             | Fabaceae    | Exotic     | Evergreen  | 38    | 3.45| 38   | 37   | 1,406      |
| 60   | Millettia huningi (Schumach.)    | Fabaceae    | Indigenous | Deciduous  | 38    | 3.45| 38   | 37   | 1,406      |
| 61   | Ficus platiphylla Del           | Moraceae    | Exotic     | Deciduous  | 45    | 4.09| 45   | 44   | 1,980      |
| 62   | Elaeis guineensis Jacq          | Arecaceae   | Indigenous | Evergreen  | 48    | 4.36| 48   | 47   | 2,256      |
| 63   | Terminalis mantally A. Chev     | Combretaceae| Exotic     | Deciduous  | 50    | 4.54| 50   | 49   | 2,450      |
| 64   | Gmelina aborea Roxb              | Labiatae    | Exotic     | Deciduous  | 52    | 4.72| 52   | 51   | 2,652      |
| 65   | Polyalthia longifolia Sonn      | Annonaceae  | Exotic     | Evergreen  | 55    | 5   | 55   | 54   | 2,970      |
| 66   | Blighia sapida K.D. Koeng        | Sapindaceae | Exotic     | Semi deciduous | 70   | 6.36| 70   | 69   | 4,830      |
| 67   | Cassia siamea Lam               | Fabaceae    | Exotic     | Evergreen  | 82    | 7.45| 82   | 81   | 6,642      |
| 68   | Tetonia grandis L, f            | Labiatae    | Exotic     | Deciduous  | 83    | 7.54| 83   | 82   | 6,806      |
| 69   | Terminalis catappa L            | Combretaceae| Exotic     | Deciduous  | 86    | 7.81| 86   | 85   | 7,310      |
| 70   | Mangifera indica L              | Anacardiaceae| Exotic     | Evergreen  | 101   | 9.17| 101  | 100  | 10,100      |
| Total|                                |             |            |            | 56,294 |     |      |      |            |

Simpson's Reciprocal Index of Diversity (SDI) = 20.16.
Table 2. Tree species distribution in Kumasi Metropolis according to family

| Family         | No. of species | %   | No. of trees | %   |
|----------------|----------------|-----|--------------|-----|
| Fabaceae       | 15             | 21.43 | 268          | 24.34 |
| Moraceae       | 7              | 10.00 | 65           | 5.90  |
| Arecaceae      | 5              | 7.14  | 66           | 5.99  |
| Anacardiaceae  | 4              | 5.71  | 107          | 9.72  |
| Annonaceae     | 4              | 5.71  | 61           | 5.54  |
| Combretaceae   | 4              | 5.71  | 148          | 13.44 |
| Meliaceae      | 4              | 5.71  | 19           | 1.73  |
| Apocynaceae    | 2              | 2.86  | 28           | 2.54  |
| Bignoniaceae   | 2              | 2.86  | 14           | 1.27  |
| Labiatae       | 2              | 2.86  | 135          | 12.26 |
| Malvaceae      | 2              | 2.86  | 13           | 1.18  |
| Mimosaceae     | 2              | 2.86  | 16           | 1.45  |
| Myrtaceae      | 2              | 2.86  | 4            | 0.36  |
| Sterculiaceae  | 2              | 2.86  | 3            | 0.27  |
| Araliaceae     | 1              | 1.43  | 1            | 0.09  |
| Asteraeae      | 1              | 1.43  | 9            | 0.82  |
| Boraginaceae   | 1              | 1.43  | 4            | 0.36  |
| Burseraceae    | 1              | 1.43  | 1            | 0.09  |
| Canabaceae     | 1              | 1.43  | 2            | 0.18  |
| Lauraceae      | 1              | 1.43  | 36           | 3.27  |
| Lythraceae     | 1              | 1.43  | 1            | 0.09  |
| Poaceae        | 1              | 1.43  | 1            | 0.09  |
| Phyllanthaceae | 1              | 1.43  | 4            | 0.36  |
| Pinaceae       | 1              | 1.43  | 1            | 0.09  |
| Rutaceae       | 1              | 1.43  | 9            | 0.82  |
| Rubiaceae      | 1              | 1.43  | 15           | 1.36  |
| Sapindaceae    | 1              | 1.43  | 70           | 6.36  |

which is equivalent to SDI of 20 (Sun 1992). Therefore the diversity of tree populations in the Metropolis is very high as compared to other cities of the world reported by Sun (1992). Biodiversity assessment in existing tree populations sets target levels for taxon diversity within a street population using guidelines posited Santomour (1990) that not more than 30% of any one family, 20% of anyone genus or 10% of species should be found in an urban tree populations (Galvin 1999). Results of this study revealed that the dominant families: Fabaceae (21.43%), Moraceae (10%), Arecaceae (7.14%) and Anacardiaceae (5.71%) respectively, constitute the total tree species (Table 2), while Mangifera indica had the highest percentage of tree population of 9.17% and Amphimas pterocarpoides having the least percentage of 0.09% (Table 1), thus the families and as well as the tree species populations falls within this 30:20:10 rule. The correlation coefficient (r) existing between road length and species diversity was 0.374, $r^2$ was 0.140 and coefficient of determination was 14%. This result also showed that road length was a determinant factor in 14% of the species diversity in the Metropolis. Regression analysis between tree species and tree species diversity is shown in Fig. 7. The regression analysis result between tree species and species diversity $R^2$ was 0.065. This suggests that 6.5% of the species diversity can be explained by tree species in the study area.

The stabilization and tolerance of street tree populations is anchored on biological diversity (Sun 1992). Species diversity index permits measurable appraisal of species diversity among tree populations. It has been reported that low species diversity leaves the tree population more susceptible to environmental stress. It is likewise of key significance for protection of normal groups which are progressively debilitated by mechanical and urban development's and forest clearing (Naveh and Whittaker 1980). Richards (1993) and Graves (1998) asserted that biological diversity within populations is important in order to minimize plant maintenance needs and disease tolerance of urban tree populations. Low species diversity makes urban trees vulnerable to stressed environments (Graves 1998). The diversity of tree populations at the level of the genus, species or genotype is important when considering the ability of the urban forest to withstand stress (Wen 1992). Diversity indices provide more information that the number of species present. It ac-
counts for some species being rare and others being common (Roth et al. 1994).

Conclusion

In Kumasi Metropolis emphasis should be on indigenous vegetation in a urban setting for a more sustainable urban greenery, thus indigenous tree species should be considered in future Kumasi Urban Forestry project street planting in order to increase diversity. It is suggested that studies on the Air pollution tolerance of these trees should carried in order to identify those that are best suited for urban plantation. The city unfortunately lacks a tree policy that specifies which species to plant, and towards what purposes. Authorities in Kumasi Metropolitan Agency should in their urban greenery programme should plant large trees for better sequestering of greater amount of carbon and provide more effective removal of air particulate pollutants, greater shade and more effective cooling (Mepherson and Rowntree 1989; Pauleit 2003) and as well select suitable blend of trees that supports ecological and biological community administration.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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