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Analysis of Green Spaces in Gombe Metropolis, Gombe State, Nigeria

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Abstract

The benefits provided by urban green spaces are quite difficult to measure and quantify, but yet indispensable. This study aimed at analyzing the distribution of green spaces and its integration into urban ecosystem services in the town. Data for this research were drawn from fieldwork, image interpretation and oral interviews. Ground truth was conducted to measure tree heights and diameter at breast height (dbh). To determine the trees height, density and DBH a 30 m tape, ranging poles and abney level were used. For fauna distribution such as birds, butterfly and lizard field observation were carried out during morning, afternoon and evening periods. Results of the study revealed high density residential areas has sparse trees and flowers due to nature of the plots allocated (15 by 15 m or less) and are mostly unplanned, hence no space for planting trees and ornament. In term of species composition, GRA, educational and health institutions, fauna such as birds, lizards, grasshoppers and other migratory birds dominate ministries and hotels among others. The most dominant local trees in the study area includes *Adansonia digitata* (Baobab) *Khaya senegalensis* (Mahogany) *Phoenix dactylifera* (Date palm), *Tamarindus indica* (Tamarind) *Parkia biglobosa* (Locust bean) *Ficus thonningii* (Common wild fig), *Zuzuphus spina christii* *Vitex doniana* *Vitellaria paradoxum* and *Ficus Platphylla*. While exotic plant species include *Azadirachta indica* (Neem) *Citrus sinensis* (Orange) *Psidium guajava* (Guava) *Delonix regia* (Flamboyant) *Terminalia catappa* (umbrella tree) *Polyalthia longifolia* (masquerade) *Thuja plicata* (coco tree) *Thaetia peruianum* and *Sanna siamea* (cassia). Absence of standard master plan has attributed inadequate provision of green space in Gombe town.

Keywords: Green, space, Gombe, species, fauna, flora

Introduction

According to SIDA (2016), more than half of the world's population lives in towns and cities and by 2050 the figure will rise to two-thirds. This is likely to result in significant biodiversity loss when natural habitats are replaced through construction of infrastructure and city extensions. Cities cover about 3% of the earth's land surface with green spaces as a major environmental resource of urban landscape (Aderounmu A.F and Oladele, A.T 2019). Yuan *et al.* (2005, Agnes, *et al.*, 2015) noted particularly that the expansion of residential and commercial landuses towards the periphery of urban areas has been recognized as the main factor in influencing the urban ecosystems. The negative environmental impact of urban growth especially in developing countries has led to reduction of green spaces and ecosystem deterioration. FAO (2010) asserted that the challenges of the fast growing cities will be to steer urbanization from its current, unsustainable path, towards sustainable, greener cities that offer their inhabitants choice, opportunity and hope. Urban green spaces are viewed as public and private spaces in urban areas covered by green vegetation that is either natural or artificial, which are directly or indirectly available to the residents of the city (Baycan-Levent *et al.* 2009). Ajayi and Omole, (2019), see a green area as an area in city plans with green surface, trees and other elements of vegetation. This study therefore sees urban green spaces as everything in cities that has vegetation. These includes green space covers parks, private and public gardens, public squares, roundabouts, trees planted along the streets, sports and

recreation fields, Petrol stations, grave yards, urban forests, and vacant land.

The benefits provided by urban green spaces are quite difficult to measure and quantify, but yet indispensable. According to Milton, (2002) and Mensah, Andres,(2016) some of the many benefits of urban green spaces are; air and water purification, mitigation of the impact of environmental pollution, carbon sequestration, regulation of microclimate, habitat for urban wildlife, recreational, spiritual and therapeutic value as well as social integration. Hence, green space improves the environmental quality of life, urban tourism, active and passive recreations and many other urban ecological functions. California Department of Forestry and Fire protection (1994) also calculated that a single tree lives for 50 years will contribute service worth nearly USD 200 000 to the community during its lifetime. This include providing oxygen(31,250); recycling water and regulating humidity(32,000); controlling air pollution (62,500); producing protein (2,500); providing shelter for wildlife (31,250) and controlling land erosion and fertilizing the soil (31,250). Therefore urban greening in form of trees and flowers and the establishment of public parks and gardens contribute to the beautification of a city.

In Nigeria, urban planning integrates green areas for recreation purposes only on paper; however, there is extremely poor execution of such plans in most cases Aderounmu, A.F and Oladele, A.T 2019; Oladele AT and Udo NE (2017)). Scanty occurrence of urban green spaces for recreation in developing West Africa countries may be linked to poor execution of urban plans.

Gombe town with total land area of about 56 square kilometers and absence of or the very low standards of a Master Plan over 40 years

ago has no provision of green space. In addition, there has been no provisions made for green space in the past 30 years in land use proposals; the Master Plan does not outline any policy and strategy for the development and management of green spaces. The situation is further compounded by the fact that most of the land is owned by private individuals under customary titles. The Nigerian Land Use Act of 1978 stated that all land belongs to the government to be held in trust by the state governors on behalf of the people. The same act also recognizes "Customary Title" to land and government is required to acquire land from such customary title holders by paying compensation before it can plan and service the land for the purpose of urban development (Yakubu, 2012). Consequently, the town has no formal green space despite the importance of urban green spaces. The physical expansion of Gombe town is having negative impact on the ecosystem and therefore the need to analyze the distribution of green spaces and its integration into urban ecosystem services in the town.

Methodology

The Study Area

Gombe town is located between latitudes 10° N to $10^{\circ} 20' \text{N}$ and longitudes $11^{\circ} 01' \text{E}$ and $11^{\circ} 19' \text{E}$ (Figure 1). It shares common boundary with Akko LGA in the South and West; Yamaltu-Deba to the East and Kwami to the North. It is the capital of Gombe State and occupied an area of about 45km^2 (Ministry of Land and Survey, Gombe, 1008). Gombe town is well linked by road to other regional centres like Biu / Maiduguri, Potiskum / Damaturu, Bauchi / Jos and Yola / Jalingo. A single gauge railway line on the

Bauchi – Maiduguri route also links the town, in addition to an international airport.

The relief of Gombe developed on complex geologic crystalline bedrock. Although, the ancient crystalline basement complex underlies much of the area, sedimentary formation during the late cretaceous period has influenced the topography. Subsequent dissection and stream incision in the area have carved a landscape consisting of flat topped to conical hills, a granitic residuals and pediment landscape. The study area has prominent landforms consisting of Lijji, and the Gombe hills, which falls within a stretch of the Benue Trough known as Zambuk ridge. The stratigraphy consists of the alluvium, the Kerri Kerri Formation, Gombe Formation, Pindiga Formation, Yolde Formation, Bima Formation and the basement rocks as the oldest. Alluvium includes most soils and comprises those deposits formed in situ by the chemical and physical decomposition of the bedrocks. Alluvium is generally poorly developed over erinaceous member of the Cretaceous Formation in the study area, the extent of alluvium cover increases westward but it can be estimated that 10% of the Gombe Formation is covered by alluvium (Obaje, 1999). The spatial and temporal analysis of Gombe's urban layout disclosed centrifugal growth, building densification and urban layout modification (Balzerek et al., 2003). This development resulted in the unification of the traditional settlement and the peri-urban areas in the 1990s to formed a single urban body, which reached the size of 30km^2 in 2000 (Balzerek et al., 2003). This expansion has led to an urban intrusion into the periurban environs far beyond the original town borders and is followed by significant change in land use which has

increased the sealed surface thereby reducing the infiltration rate of the rain water (Balzerek et al., 2003).

The main tree species commonly found include: *Acacia nilotica*, *Ficus sycomorus*, *Albizia chevalieri*, *Commiphora kerstingii*, *Parkia biglobosa*, *Acacia albida*, *Anogeissus leiocarpus*, *Diospyros mespiliformis*, *Ziziphus spina-christi*, *Butyrospermum paradoxum*, *Vitex doniana*, *Ficus spp.*, *Tamarindus indica*, *Balanites aegyptiaca*, *Guiera senegalensis*, *Terminalia macroptera*, *Bomax costatum*, *Lannea acida*, *Ziziphus mauritiana*, *Combretum micranthum*, *Piliostigma thonning*.

The pattern of population growth of Gombe town was slow from 1900 to 1952 (300 to 18,500 people) while; from 1964 to 1991 the population growth has increased tremendously from 47,000 to 138,000. However, from the year 1996, when Gombe became the State capital, there was a noticeable sharp increase in population from 169,894 (1996) to 219,946 in 2000 (Tiffen, 2006) and 312,467 in the census 2006 and is projected to reach about 400,000 in 2010 (NPC, 2007). This population explosion resulted in high demographic pressure on land and consequent developmental processes such as building of houses.

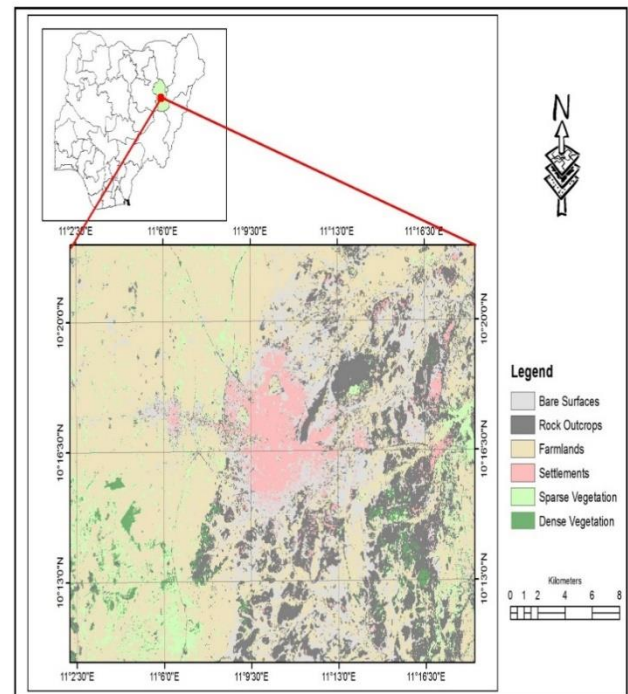


Fig.1: Landuse of Gombe Town the study area
Source: Ministry of Environment and Water Resource, Gombe, 2003

Methods and materials

Data for this research were drawn from fieldwork, image interpretation and oral interviews. Ground truth was conducted to measure tree heights and diameter at breast height (dbh) and to confirm the distribution of vegetation types as shown on the 2009 Google Earth image. The fieldwork was carried out in August 2016 as vegetation cover was at its peak of growth. The field measurements were aimed at determining nature of green space, trees morphological features and fauna species in the study area.

Analyses of tree diversity were carried out in all landuse categories that have green infrastructures landcover. Both native and exotic tree species were sampled randomly and their morphological features were

determined. To determine the trees height, density and DBH a 30 m tape, ranging poles and abney level were used. For fauna distribution such as birds, butterfly and lizard field observation were carried out during morning, afternoon and evening periods. For the analysis of trees diversity the Shannon-Weiner Index was adopted (Beer1997).

3.0 Results and Discussion

3.1 Forms of Open Spaces

Gombe metropolis with total area of about 56sq km consists of varied form of green spaces ranging from residential, educational, federal and state government offices, parks/gardens, hills and hospitals among others (Table I). Based on field observation and measurements residential areas has few trees and flowers except GRA compared with institutions such as university, collages, secondary schools, hospitals and ministries.

Table 1: Form of Green Space in Gombe Metropolis

S/NO	Green area landuse	Examples	Status of plants
1	Residential	Low density Area (GRA) Medium density Area High density area	Dense trees and flowers Few trees and more flowers Sparse trees and flowers
2	Public and private institution	University Colleges Secondary schools Primary schools Hospitals / teaching hospitals	Dense /Variety of trees and flowers Sparse trees and flowers Few trees Dense flowers and few trees
3	Road side / streets trees	GRA and others	Dense trees and flowers
4	Federal and State Government offices	Government House Ministries Agencies Secretariats Electrical distribution station NNPC depot Barracks	Dense flowers and sparse trees Sparse trees and flowers sparse trees and flowers sparse trees and flowers Sparse trees and flowers

5	Park/ Garden/ lawns	Motor park, Botanical garden Recreational areas	Sparse trees Nursery and fowers sparse trees and flowers Flowers
6	Fuel stations	NNPC mega station and others	Spares flowers
7	Sport infrastructure	Pantami and Oji Stadiums	Grasses and flowers
8	Hospitality/ Tourism	International hotel Medugu hotel Emerald Custodian hotel and others	Flowers and few trees
9	Cementary	Old grave yard	Sparse trees
10	Hill	Gombe hill Lijji hill	Sparse trees Sparse trees
11	Public and private tree plantations on vacant land	Iddi ground, Gully corridors peri-urban farming	Dense trees Dense vetiver and few trees Scattered trees and shrubs

Source: Fieldwork 2017

High residential areas has sparse trees and flowers due to nature of the plots allocated (15 by 15 m or less) and are mostly unplanned, hence no space for planting trees and ornament. During the peak of hot months (April – May) residents has to trek up to 200 – 300 metres looking for trees to rest. While on the other low density areas are bigger in size (30 by 15 metres or more) and are well planned with provision of trees and flowers.

3.2 Flora and Fauna Compositions

In term of species composition, the study area consists of dense to sparse trees and flowers. These green landuses have attracted many fauna such as birds, lizards, grasshoppers and other migratory birds.. The most dominant

local trees in the study area includes *Adansonia digitata* (Baobab) *Khaya senegalensis* (Mahogany) *Phoenix dactylifera* (Date palm) *Borassus aethiopum* (Deleb palm) *Acacia nilotica* (Egyptian mimosa) *Tamarindus indica* (Tamarind) *Parkia biglobosa* (Locust bean) *Ficus thonningii* (Common wild fig) *Balanites aegyptiaca* (Desert date) *Zuzuphus spina christii* *Vitex doniana* *Vitellaria paradoxum* and *Ficus Platphylla*. While exotic plant species include *Azadirachta indica* (Neem) *Citrus sinensis* (Orange) *Psidium guajava* (Guava) *Delonix regia* (Flamboyant) *Terminalia catappa*(umbrella tree) *Polyalthia longifolia* (masquerade) *Thuja plicata*(cocnut tree) *Thaetia peruianum* and *Sanna siamea* (cassia)(Table 2). Field observations revealed exotic species in form of flowers are mostly found in private and public buildings such as schools, ministries, hospitals and hotels, while local tree species are dominated in the outskirts of the town and Gombe state university.

Table 2: Flora and Fauna Composition in Gombe Town

Local Tree Species	Exotic plant Species	Birds and other animals	
<i>Adansonia digitata</i> (Baobab)	<i>Azadirachta indica</i> (Neem)	Herons	
<i>Khaya senegalensis</i> (Mahogany)	<i>Citrus sinensis</i> (Orange)	Falcons	
<i>Phoenix dactylifera</i> (Date palm)	<i>Psidium guajava</i> (Guava)	Lapwings	
<i>Borassus aethiopum</i> (Deleb palm)	<i>Delonix regia</i> (Flamboyant)	Doves and	
<i>Acacia nilotica</i> (Egyptian mimosa)	<i>Terminalia catappa</i> (umbrella tree)	Pigeons	
	<i>Polyalthia longifolia</i> (masquerade)	Goshawks	
	<i>Thuja plicata</i> (cocnut tree)	Owls	
		Bulbuls	
		Barbets	
		Rollers	
		Larks	
		Kingfishers	
		Hornbills	
		Turcos	
		plantain eaters	
		Yellowbills	
		Swifts	

<i>Tamarindus indica</i> (Tamarind)	<i>Thaetia peruianum</i>	Estrildid finches	
<i>Parkia biglobosa</i> (Locust bean)	<i>Sanna siamea</i> (cassia)	Starlings	
<i>Ficus thonningii</i> (Common wild fig)	Flowers	Sunbirds	
<i>Balanites aegyptiaca</i> (Desert date)	<i>Rosa indica</i>	Sparrow and weavers	
<i>Zuzuphus spina christii</i>	<i>Sansaieria trifasciata</i>	Larks	
<i>Vitex doniana</i>	<i>C asuarinas aqiseliflora</i>	Bulbuls	
<i>Vitellaria paradoxum</i>	<i>Inculia grandiflora</i>	Storks	
<i>Ficus Platphylla</i>	<i>Codiaeum variegatum pictum</i>	Cattle Egret	
	<i>Bougainuilla glabra</i>	Bats	
	<i>Ficus microcarpa</i>	Lizards	
	<i>Ficus benjamina</i>	Butterflies	
	<i>Jacubinia coccinea</i>	Grasshoppers	
	<i>Narium indica</i>		
	<i>Duranta rupens</i>		
	<i>Ixora coccinea</i>		
	<i>Phylanthus nlivosus</i>		
	<i>Bignonia venusta</i>		

Source: Field work 2017 and Nsor,C. A and Adang, K. L 2012



Plate I: Cattle Egret (*Bubulcus ibis*) attracted by Green space in Gombe state university



Gombe hill



Increasing green space in Gombe metropolis especially Gombe state University has witnessed increased in population of migratory birds over the years. Nsor, C. A and Adang, K. L (2012) stated that since the establishment of the university several migratory birds population has been attracted as a result of increased in landscaping / green

spaces. These migratory birds includes Black headed (*Ardea melnocephala*), Abdim's Stork (*Ciconia abdimii*), Roller (*Corcias abyssinicus*), African grey Hornbill (*Tackus nasutus*), Tinkerbird (*Pogoniulus chrysocous*), Crested Lark (*Galerida cristata*), Wagtail (*Motacilla flava*), Melodious Warbler (*Hippolais polyglotta*), Pygmy Sunbird (*Hedydipna platura*), Scarlet chested Sun bird, Piapiac, Pied Crow, Village Weaver, Red-cheeked Cordon-bleu, African Silverbill among others.

3.3 Common Tree Parameters in the Study Area

Fig.2 - 4 shows the main tree species' parameters analyzed (Tree height, tree density and average girth at breast height). Analysis revealed that the girth at breast height (dbh) of major tree species such as *Adansonia digitata* was 356 cm followed by *Ficus Platphylla* (257cm); *Phoenix dactylifera* (147cm); *Parkia biglobosa* (123cm); *Khaya senegalensis* (95cm) among others. Tree height also varied among species types from 8.7 m to 32 m for *vitex doniana* and *Phoenix dactylifera* respective. Tree density among residential areas were very low except GRA and some institutions such Gombe state university, FCE (T) and Teaching hospital Gombe. The species density ranges from 0.1 to 4.3 m per 100 square metres for *Adansonia digitata* (Baobab) *Khaya senegalensis* (Mahogany) *Phoenix dactylifera* (Date palm) *Borassus aethiopum* (Deleb palm) *Acacia nilotica* (Egyptian mimosa) *Tamarindus indica* (Tamarind) *Parkia biglobosa* (Locust bean) *Ficus thonningii* (Common wild fig) *Balanites aegyptiaca* (Desert date) *Zuzuphus spina christii* *Vitex doniana* *Vitellaria paradoxum* and *Ficus Platphylla*.

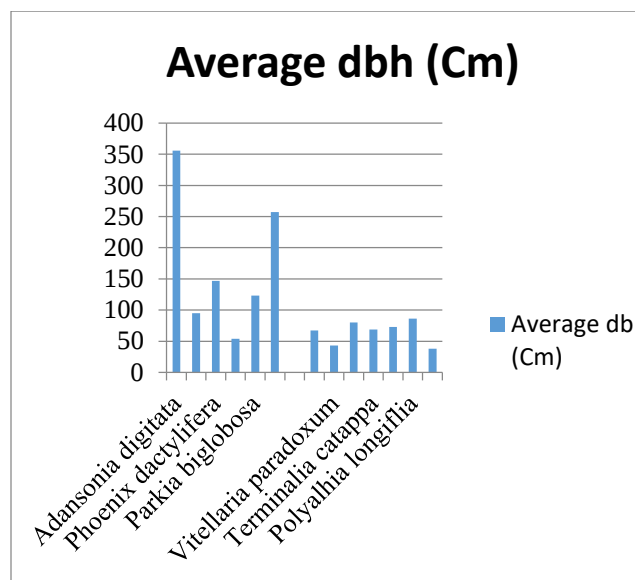


Fig. 2: The average dbh of the 13 most common tree species

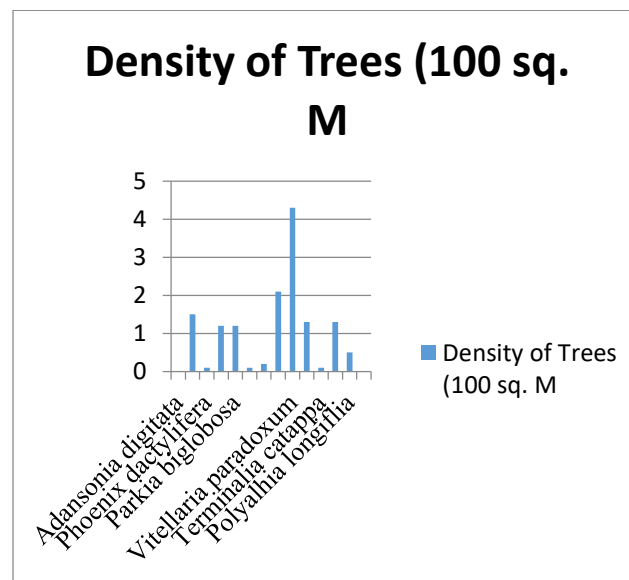


Fig. 4 The average density of Trees (100 sq. M)

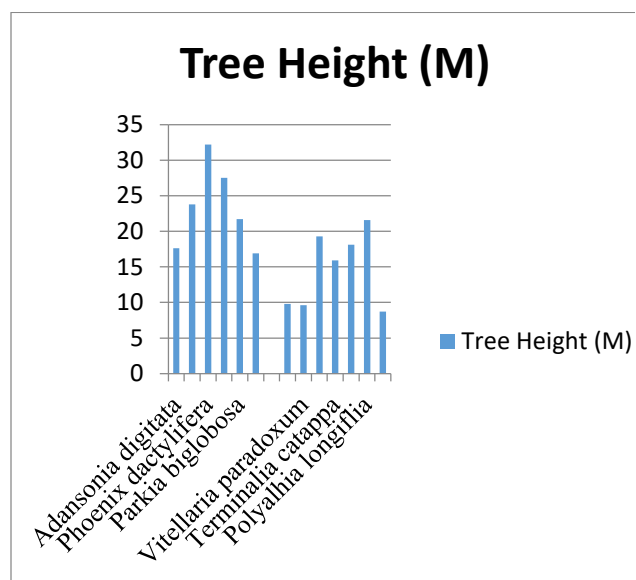


Fig.3 The average height of most common Trees

Problems of Managing Open Spaces in the Study Area

1 Conversion and misuse of open spaces:

There is an increased demand of land from the public for the various human activities. This has led to conversion of open spaces legally or illegally for other uses like refuse dumps, shops, residential buildings, and other uses other than that which it was initially developed for (Alabi, 2009; Ayatamuno, 2010).

2) **Lack of coordination:** The poor coordination of physical planning activities within cities has resulted in encroachment of open spaces by some individuals. There is lack of harmony in carrying out their corporate task in planning, development and protection. For instance, Gombe state urban development board, Ministry of land and

survey and local government works department.

3) Illegal development: Gombe state since its creation has no master plan and most of the private developers are involved in illegal development of their buildings. This is because of conflicting interest in allocating land for various development purposes (customary and statutory). They build without relevant approval from authority and hardly provide open spaces in case of customary. This has defeated the management plan, design and landscaping (Arigbola 2008, Aluko, 2011, Collins, 2017). At present Gombe town has no formal green space system except what can be termed incidental open spaces utilized as play fields and vacant parcels of land that are being used for agriculture until the time that they will serve another purpose.

4) Poor Organization: Most plots developed for residential areas in Gombe town were of 15 by 15 metres and are poorly organized in terms of physical planning and, hence, characterized by none or inadequate open spaces. Since developers wanted to maximize space for house no provision of space to plant trees and ornamental flowers. Other challenges include lack of priority to green spaces in development agenda, high urban poverty, uncooperative attitudes of local people, and poor enforcement of development control by institutions responsible, high rate of urban sprawl and informal settlements destroying green vegetation and insufficient operation of urban planning regulations.

Conclusions

Green spaces is an essential part of any urban development and serves several functions to urban dwellers. However, the continuous

growth of urban areas without effective management and monitoring of their use has resulted in the poor quality and further decay of the built environment.

It is therefore suggested that natural base solutions such as smart green infrastructure

- i. (planting of trees and restoring green public spaces helps lowering temperature and pollution level, improving health and increase tourism revenue and recreational opportunities),
- ii. supporting urban farming in parks, communal and private gardens can provide food security and contribute to extra income especially among women;
- iii. green roof and walls can reduce building energy consumption, heat waves, noise and absorb and re use rain water;
- iv. restoration of flood plain, creating permeable surfaces and storm water tree pits can protect cities from flood damage, improving living conditions of wild species, reduce nutrient loads and improve landscape.
- v. Others include prioritizing green spaces plan/strategy; stable financial support for green space, budgetary allocations and income generating activities;
- vi. enforcement of development controls through upgrade old development plans and prevent encroachments of green spaces ;
- vii. strong Institutional support Human resource, logistics and funds and collaborative governance through engaging the services of different Stakeholders (Gov't agencies, civil

society, private sector, NGOs, donor agencies etc.) should be adopted.

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