Green Spaces Planning in Lafia Town, Nasarawa State, Nigeria: Challenges and Way Forward

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Abstract

Green space constitutes one of the major components of green infrastructure in city planning. The case of depletion of natural vegetation due to challenges posed by urbanization in Lafia town is alarming. Land allocation priorities to green spaces are completely neglected. This paper sought to give a wider discussion on the challenges of green spaces planning in Lafia town and way forward. Among the challenges uncovered are rapid expansion/urbanization, inadequate operational planning regulations guideline, lack of documented urban master plan, lack of political will on the side of those in authority, socio-economic status of the citizens resulting in the destruction of natural vegetation to source for alternative energy and lack of awareness and priority to green space planning. The paper adopted a systematic review method. OLI data obtained were used to calculate Normalized Difference Vegetation Index (NDVI). Three Landsat images were all acquired including remote sensing datasets of the year 2002, 2012 and 2022. They were interpreted and quantified based on high resolution Google Earth images based on the map of present land use. The study further proposed a strategic base map and way forward on green spaces planning in Lafia town. Also, the paper has given useful recommendations on land management and plant cover, town planning and green open spaces planning to address the challenges. Conclusively, policy makers, urban planners, local authority and local community should treat green spaces planning with utmost priority to preserve the natural vegetation that will enhance better health and create beautiful environment in Lafia town.

Key words: Green spaces, Urbanization, Planning, Land use, Community engagement

1.0 Background of the study

Urbanization globally has been on the increase with more than 50 percent of the world population presently living in urban areas (Debnath et al., 2014). Less than 5 percent of the earth has been taken by cities with quite a number of world resources found in them (Zitkovic, 2008). The proportion of world's population living in these towns and cities has increased tremendously from about one third in the 1950s to more than half in 2008 (Grimm et al, 2008). It is further projected to increase to two-third by 2050 (UN-habitat, 2005, United Nation, 2019). Expansion of towns and

cities entails infrastructural development and other human activities which have profound impact on the natural vegetations and landscape. The natural environment of town planning does not only cover the built environment such as housing and transportation road networks. Urban living limits access to nature can increase exposure to certain environmental hazards. Many urban areas face increasing pressure from population expansion and limited resources with consequential impact of climate change. (WHO Regional Office for Europe, 2017).

One of the problems of cities planning in developing countries for instance, is haphazard development. Growth and expansion of these towns and cities gives rise to paved areas surface and structures substituting the natural environment. Gloomy surface like parking lots, roofs and roads are exposed to meteorological impact (Ebuga et al., 2023). According to (Bigili, 2009) green spaces are ecological based requirement which is a necessary element of ecological, aesthetic and recreational value within an urban setting. Green spaces in town and cities for the purpose of this study include parks, woodlots scenic and lots more. The importance of green spaces in planning can be summarize as follows; A park like area consisting of grass and sparse stands of vegetation appears to be the best means of avoiding temperature and moisture extremes and maintaining a certain amount of ventilation. Studies have shown that green environment provide a wide range of benefits. Socially, they have been found to create land uses that provide a means for recreation, support the development of children and also promote social togetherness (Jim and Chen, 2006). From environmental view, it has been observed that they help in reducing local climate, improve urban air quality, conserve biodiversity and bring out architectural beauty of towns and cities (Fam et al., 2008). And from economic perspective, they offer benefits in value increase in landed properties especially houses situated close to green spaces, creation of employment opportunity to individual to work in various parks and gardens and other related businesses and also revenue generation to the government. (Aldous, 2005, Baycan, Levent and Nijkamp, 2009).

Meanwhile, to meet social and psychological desires of the populace satisfactorily, green spaces in town and cities should be easily accessible and adequately optimal in quality and quantity. There should be uniformity in the distribution, and the total area occupied by green spaces in the city should be large enough to cater for the population need (Haq, 2011). Green spaces are not only essential component in housing areas but also in business, leisure, retail and other commercial developments (Baycan-Levent, 2002). Global statistics have shown a faster depletion of green areas in urban areas. For instance, a study conducted in 25 cities in Europe on land use changes shows that 7.3 and 41 percent of lands reserve for green spaces have been lost to different land development. Also in the USA, a research on land use changes in 274 metropolitan areas show a loss of about 1.4million hectares of green areas to different developments (MacDonald et al., 2010). More so, the case of this depletion in African countries is worse. (Cilliers et al., 2012) in his studies revealed that there is intense pressure on green areas as a result of human activities resulting in the continued deterioration of these spaces in urban areas. Rapid depletion of green areas in Africa has resulted in it occupying small percentage in many urban settings. For instance, it has been discovered the situation in Lagos city, Nigeria is alarming. Green spaces presently cover only less than 3 percent of the entire city landmass (Oduwaye, 2013). Furthermore, Lafia town as the administrative headquarter in Nasarawa State has attracted population increase and urban growth since in 2000s. It has also been observed that migration of people has been the primary contributing factor for unplanned urban growth with consequential depletion of the natural

vegetation. This is as result of increase in infrastructural development and physical expansion in Lafia town over the years with no recourse to green spaces planning. Infrastructure and other development have resulted in the removal of natural vegetation. The trend of urbanization is increasing heat intensity and contributing greatly as one of the likely reasons for urban heat wave in Lafia town. (Ebuga et al., 2021).

Notwithstanding the destruction and poor management of the natural environment in many regions of the world and particularly in Africa with Nigeria as a study case, research on green spaces with emphasis on unraveling the challenges against the factors militating against green areas planning in Africa are less focused. A study conducted by (Mensah, 2014) on green spaces in Africa; nature and challenges asserts that most of these studies are focused on European cities and not broad based in Africa. It remains uncertain whether inconsistencies are due to the environmental conditions. It is against this background that the paper seeks to identify challenges confronting green spaces planning in Lafia town and proffer useful suggestions on the way forward.

2.0 Conceptual Framework

Different scholars have defined the concepts of green spaces which support their inclusion in the planning of town and cities to enhance better living conditions. Meanwhile, MacHarg, 1971 as cited in Mensah, 2014 sees the idea of including some elements of nature into town or city plan as an important feature in the history of urban planning. This paper, however will consider few of those definitions of the concept.

Manlum, 2003) opined that green spaces refer to those land uses and land cover that are covered with natural or man-made vegetation in the city and planning areas. He further state that different disciplines have used various definitions from their own professional point of view, such as Horticultural Greenland system, urban Greenland system, ecological Greenland system, urban green spaces and green open spaces. Also, Fratini and Marone, 2011, used the term green spaces to describe it as areas that are covered by natural or artificial vegetation.

Fam et al, 2008 cited in Mensah, 2014 defined green spaces as all vegetation covered areas including trees, shrubs and grasses. In the views of (Kit Cambell Associates, 2001) green spaces consist of vegetation land or structure, water or geological features found in a geographical area. Green spaces has also been defined by (Sandstrom,2002) to cover all green infrastructure as network of natural, semi-natural and ecological system within a defined area. Despite minor differences emanating from various definitions of the concept, it can be concluded that green spaces in town and cities covers all areas that to some extent have some forms of either both natural and artificial vegetations. According to Swanick et al, 2003 as sited in Mensah, 2014 gave more understanding of the description of green spaces and further evolve the following clarifications. Their studies see urban areas to be made up of built and the external environment between buildings. External environment is divided into two main entities namely green space and grey space. Green spaces may either take linear form occurring along transport routes such as roads and railways, semi natural occurring in wetlands or woodlands, functional occurring in allotments, churchyards, mosque yards, schools grounds and amenities that is around parks and gardens. (Dunnet et al., 2002).

3.0 Materials and Methods

3.1 The Study Area

The focused of the present study is Lafia urban area the capital of Nasarawa State and the administrative headquarters of Lafia Local Government Area is located at the south – west part of the state on latitude 8° 30" N and longitude 8° 31"E..Lafia urban area covers a total land area of 82.90 km^2. The population of Lafia urban area by 1991 census was 87,352 inhabitants and for the purpose of this study the population is projected to 269,958 to 2022 using a growth rate of 3.5% per annum.

Source: Greater Lafia master plan, 1998

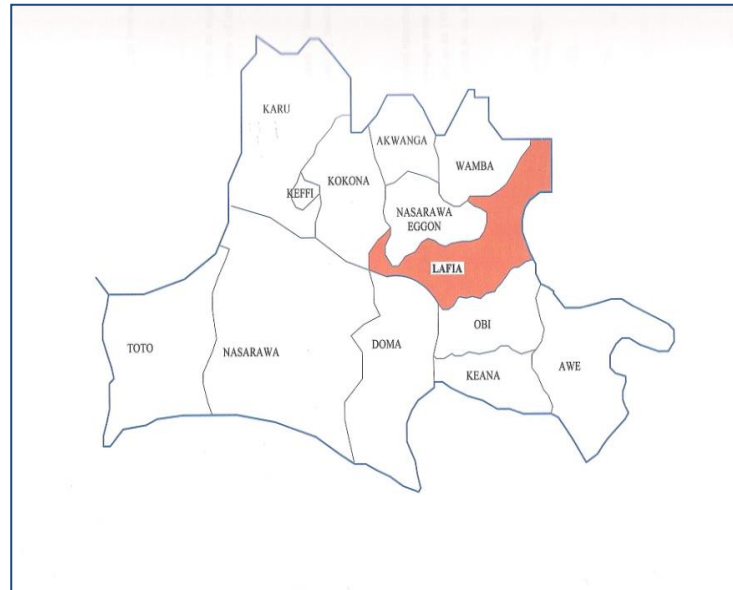**Figure 1**: **Map of Nigeria showing Nasarawa State**

Figure 2: Map of Nasarawa State Showing Lafia

3.2 Materials, satellite images data description and processing

The research is qualitative in nature and adopts systematic review of relevant and available literature to satisfy the aim of the study. The paper dwelled much on secondary materials such as journal, conference papers and reports that are related to the study. Also four cloud-free Landsat 8 OLI/TIRS images (Fig. 1 -9) and high-resolution Google Earth images. The Landsat 8 OLI/TIRS which forms part of the data required for the study were acquired from the United States Geological Survey (https://glovis.usgs.gov/) and detailed information were shown in Table 1.0. Three Landsat images were all acquired including remote sensing datasets of the year 2002, 2012 and 2022 from National Centre for Remote Sensing (NCRS) in Jos, Plateau State were used for this study. The OLI data were used to compute Normalized Difference Vegetation Index (NDVI); and the TIRS data were used to derive LST. The boundaries of Lafia town and the landscape indicators were interpreted and quantified based on high-resolution Google Earth images through manual interpretation based on the map of present land use. The LST maps were derived using radiative transfer equation (RTE) method and results were shown in Figure 3-5

3.3 Result
Table 1.0 Characteristics of data used

Data	Source	Resolution	Format	Date of Acquisition
Landsat ETM+(2002)	www.earthexporer.usgs.gov	30m	GeoTIFF	6th February, 2002.
Landsat ETM+(2012)	www.earthexporer.usgs.gov	30m	GeoTIFF	2nd February, 2012.

Landsat OLI (2022)	www.earthexporer.usgs.gov	30m	GeoTIFF	21st February, 2022.

ETM+: Enhanced Thematic Mapper Plus
OLI: Operational Land Imager
Meter: m

3.4 Analysis of Urban Growth of Lafia Town
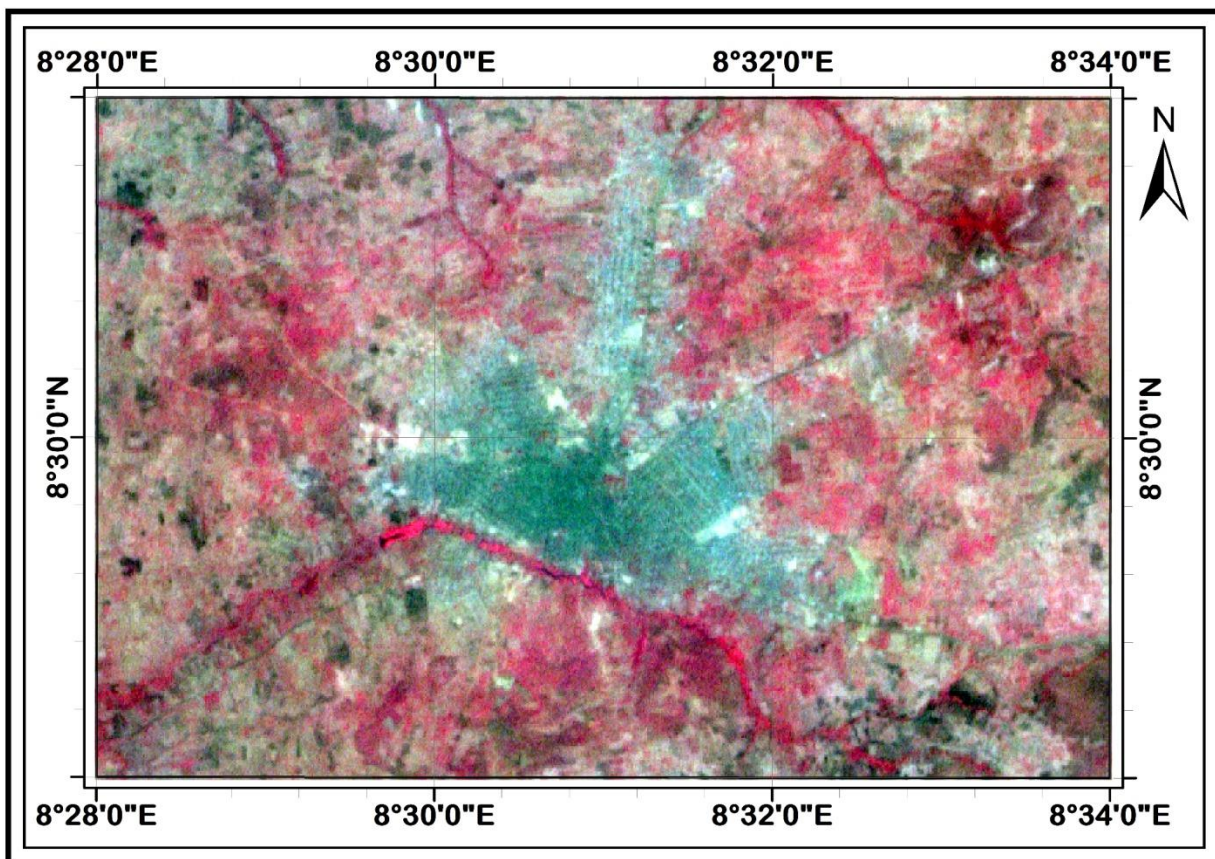### Satellite Images showing Urbanization Trend

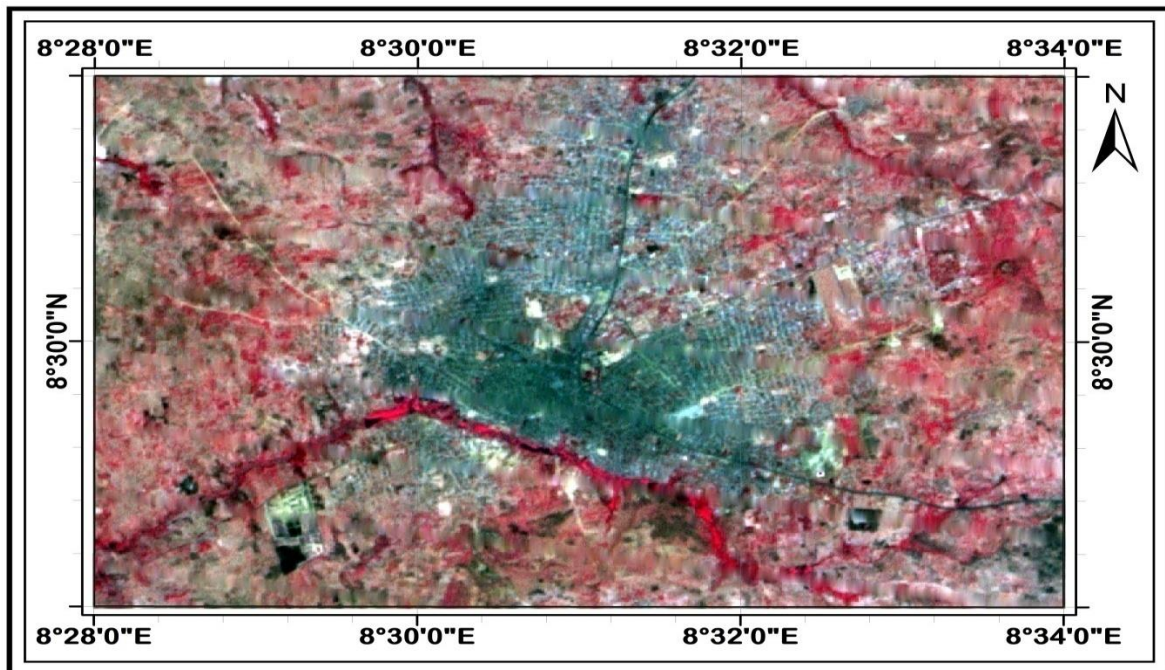Fig 3: Landsat image of Lafia Town in 2002 (False Color Composite: Bands 4, 3 and 2).

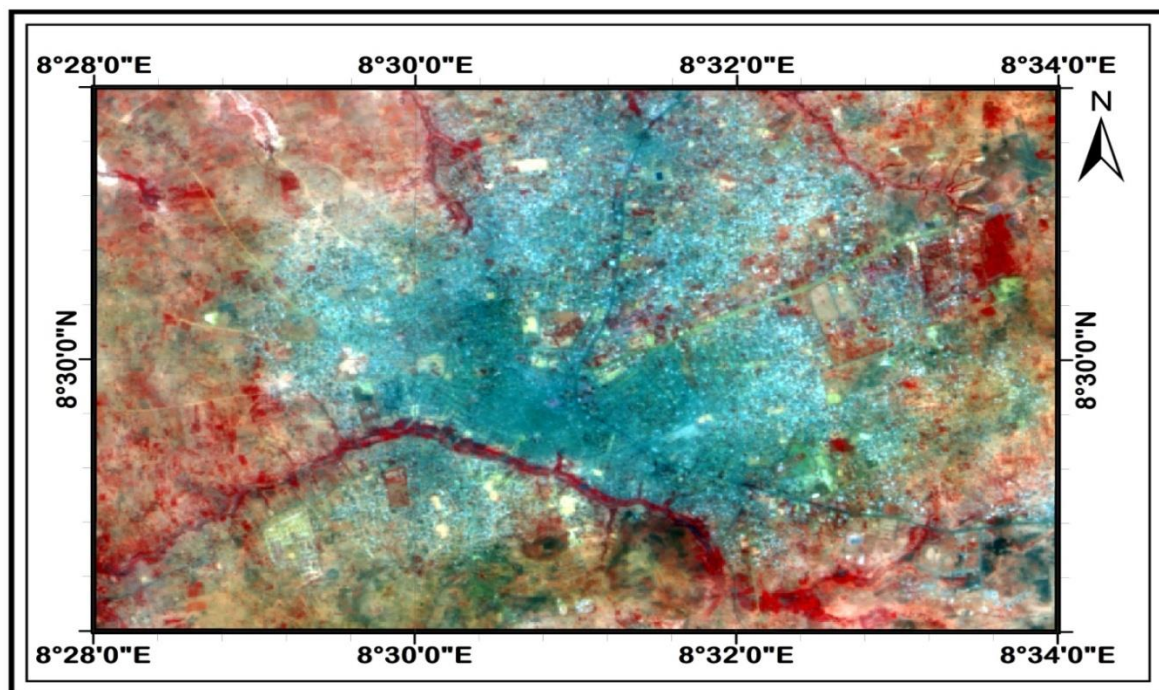Fig 4: Landsat image of Lafia Town in 2012 (False Color Composite: Bands 4, 3 and 2).

Fig 5: Landsat image of Lafia Urban Area in 2022 (False Color Composite: Bands 5, 4 and 3).
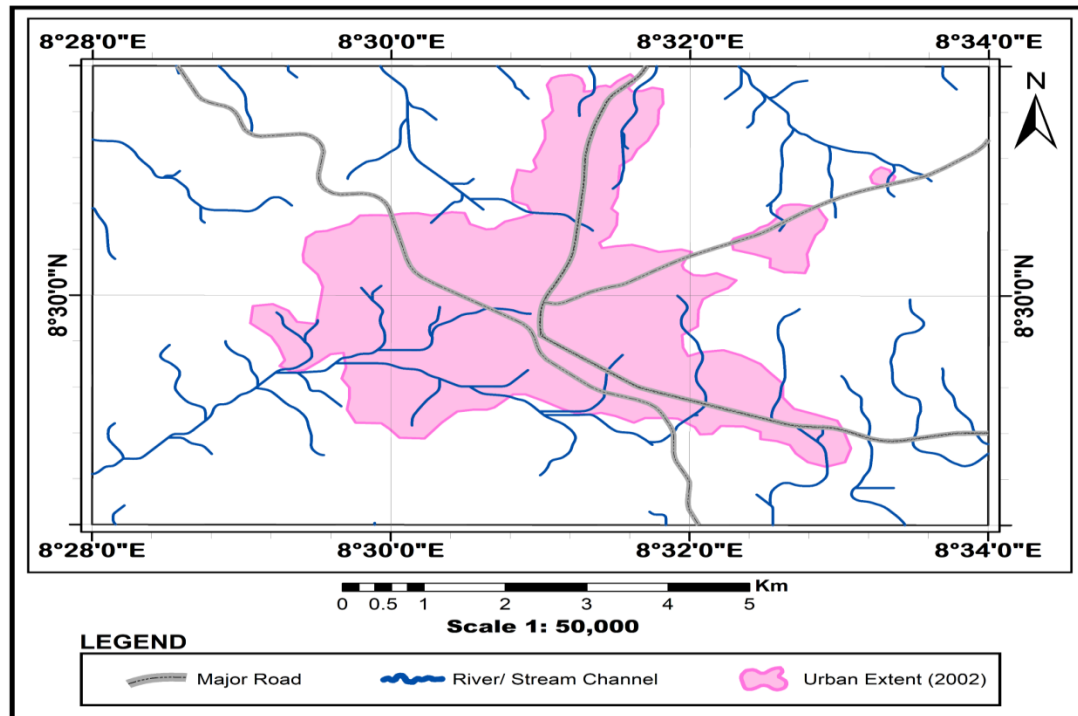
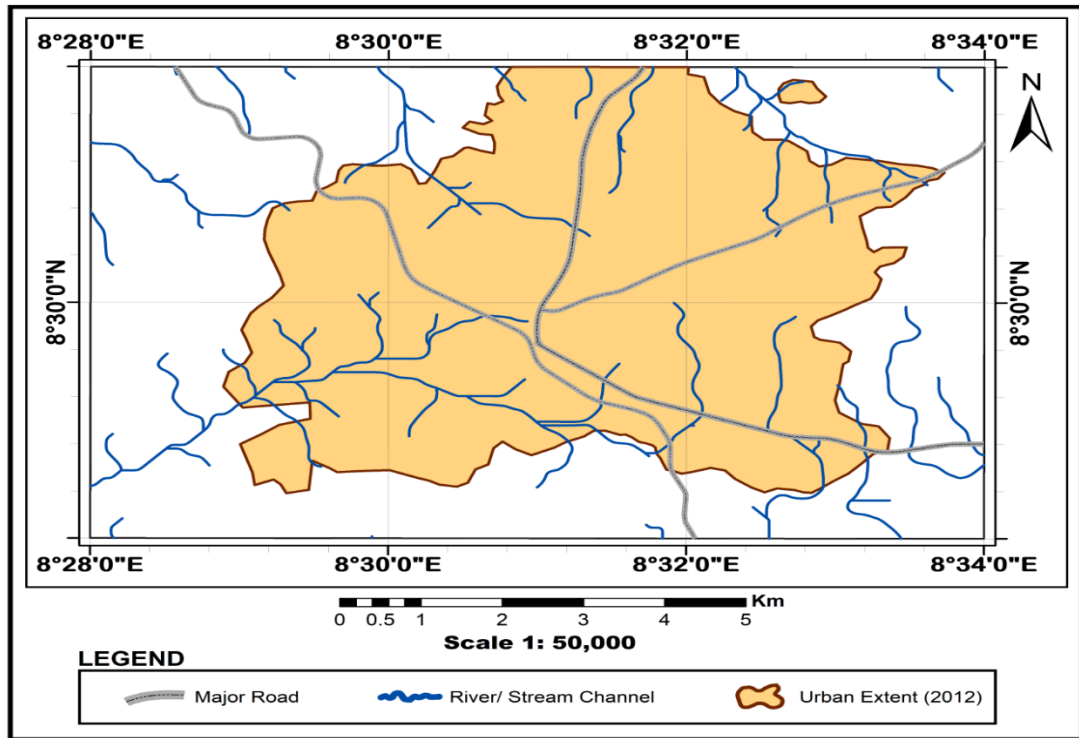Fig 6: Map of Lafia town in 2002.
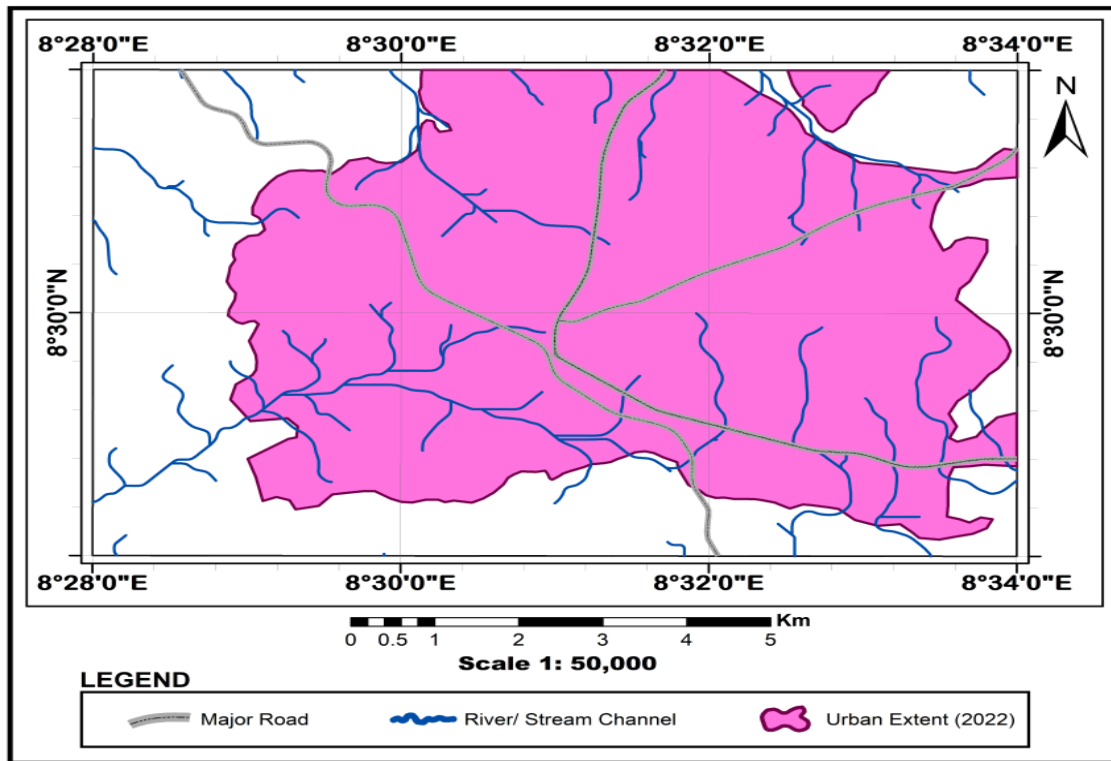
Fig 7: Map of Lafia Town in 2012
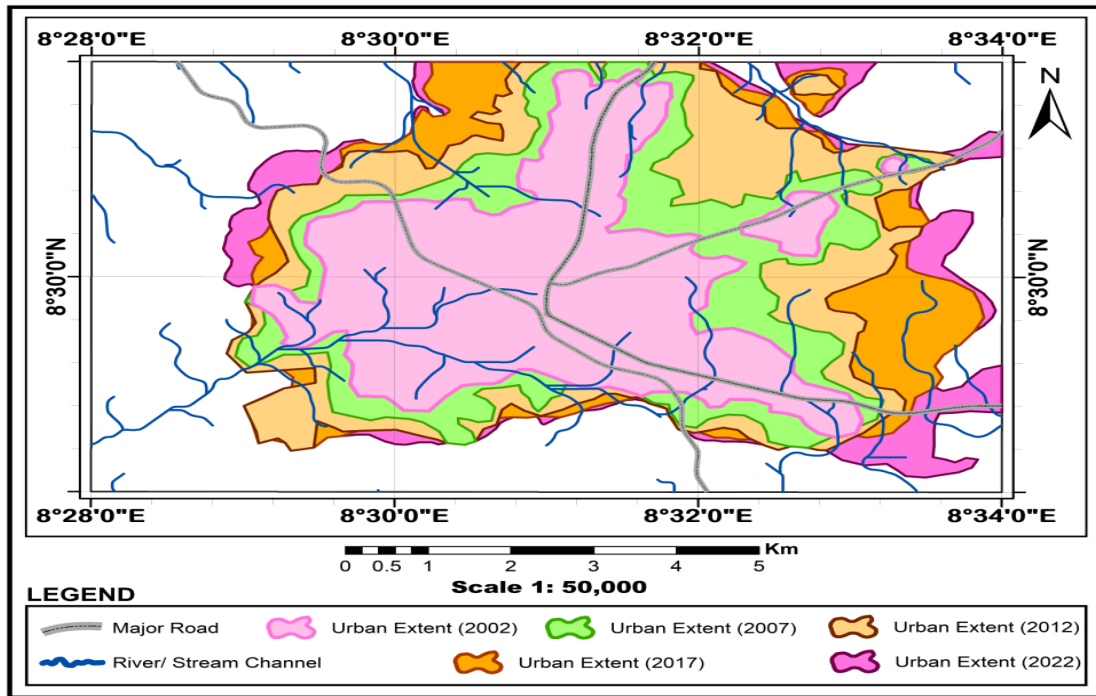
Fig 8: Map of Lafia Town in 2022.

Fig 9: Map of Lafia Town in 2002 - 2022.

Table 2.0 Rate of Growth of Lafia Metropolis in 2002, 2012 and 2022.

S/No	Year	Total Land Area (Km²)	Built – Up Area (Km²)	% Built – Up Area	Absolute Growth (Km²)
1	2002	82.90	32.20	38.84	-
3	2012	82.90	45.20	54.52	13.0
5	2022	82.90	60.15	72.56	14.95

*Note

% Built – Up Area (2002) = $\dfrac{32.20}{82.90}$ x 100% = 38.84%

% Built – Up Area (2012) = $\dfrac{45.20}{82.90}$ x 100% = 54.52%

% Built – Up Area (2022) = $\dfrac{60.15}{82.90}$ x 100% = 70.15%

Absolute Growth (Km²) = Change in Built – Up Area (Km²) over a period of time

Table 3.0 Land use changes in the Lafia town between 2002, 2012 and 2022

S/N	Land use/cover	2002		2012		2022	
		Area (km²)	%	Area (km²)	%	Area (Km²)	%
1	Built-up	32.20	38.84	45.20	54.52	60.15	72.53
2	Vegetation/Nature	17.07	20.59	13.10	15.80	8.15	9.83
3	Agriculture	25.03	30.19	19.06	22.99	11.50	13.87
4	Open spaces	8.60	10.37	5.54	6.68	3.10	3.74
	Total	82.90	100	82.90	100	82.90	100

Table 4.0 Summary of table 3.0

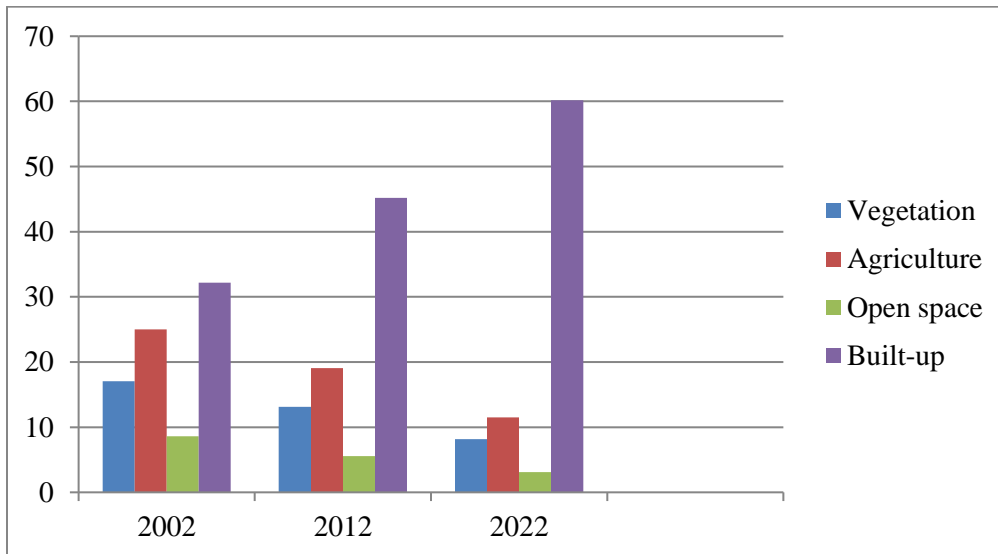| Period	Vegetation/Nature	Agriculture	Open spaces/Vacant land	Built- up
2002	17.07	25.03	8.60	32.20
2012	13.10	19.06	5.54	45.20
2022	8.15	11.50	3.10	60.15

Fig. 10: Land use changes in Lafia Metropolis in 2002, 2012 and 2022

4.0 Discussion
The classified LandSat ETM imagery as shown in Table 1.0 shows that Lafia town covers a total area of 82.9 km² and also indicates the land use/cover changes of the period 2002, 2012 and 2022.

From the result obtained, changes have occurred over these years taken away agricultural land/vegetation covers and replacing it with improvements as a result of pressure of urbanization. The results clearly shows that the built-up area in 2002 shows an increase of 38.84% while in 2012 indicates an increase of 54.52% and 2022 shows a remarkable increase of 72.53% which is more than half of the land space for urban area of Lafia town. This trend has affected the geographical morphology of the urban system in Lafia town resulting in the depletion of the natural vegetation and an increased in the air temperature. The increase is as result of human activities through constructions coupled with the nature of the soil which trapped heat from the sun leading to urban heat wave.

This research was able to ascertain that urban green space can produce cooling effects which will significantly contribute to wellbeing of the people as confirmed by many studies (Yu, Gao, Wang, Vejre, 2019). However, it is worth noting that the cooling effect of green space is related to the distance from the green space boundary. That is, with the increase of the distance, the change of the effect becomes lower and lower.

5.0 Challenges of Green Spaces Planning in Lafia Town

This study discovers some factors militating against the planning and development of green spaces in Lafia town. Among which are; rapid expansion/urbanization, inadequate operational planning regulations guideline, lack of documented urban master plan, lack of political will on the side of those in authority, socio-economic status of the citizen resulting in the destruction of natural vegetation to source for alternative energy and lack of awareness and priority on green space planning.

6.0 Developing Green Spaces Planning in Lafia town

This research has developed a proposed green space planning strategies in Lafia town in consideration of the some of the unraveled challenges. The green spaces planning design is done for landscaping of Lafia Metropolis to ensure the plants absorb the heat that may warm houses at night. Most of the roads were proposed with trees along roads to reduce surface heat and to give a cooling effect.. According to the study, the examined distant effect of such cool surfaces is not significant, thus it is practical to rather design green surfaces covered by water surfaces and closed tree stands with a high rate of closed crown canopy layers and consisting of eurytopic tree species capable of high transpiration. It is also very important to create and develop urban green networks instead of closed and an isolated blocks of urban green space, it means that the planting and sustaining of linear urban green elements (allées, street tree rows) must be given utmost priority.
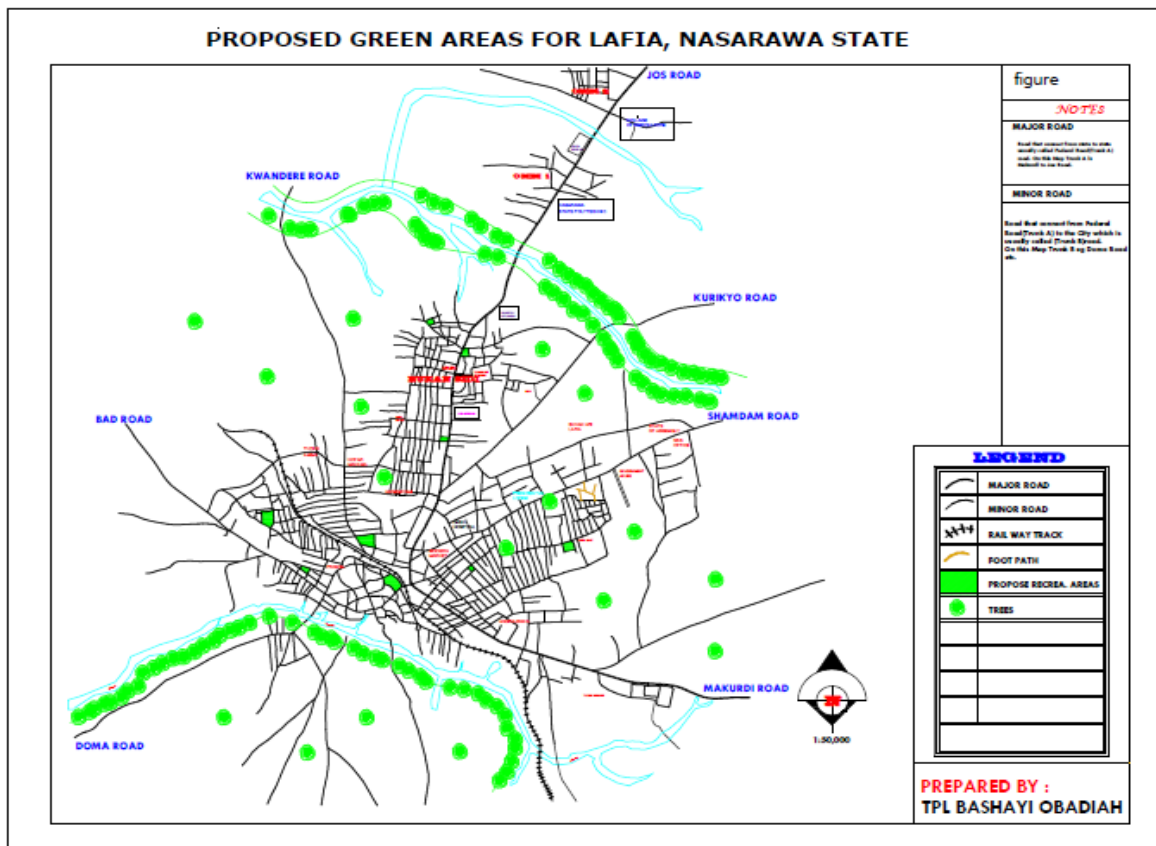
Figure 11: Proposed green spaces planning in Lafia Town

6.1 Strategies and way forward for Green Space Planning in Lafia town

- Create a long-term vision of a green city by the planning authority
- Establishment of local data on urban green spaces quantity and quality which can be used as a guide for equitable planning.
- There should be integration of urban green space infrastructure needs in urban master which will give considerations to green spaces within infrastructural projects like housing, transport, business parks, community and health facilities. The implementation of such plan will restore lost aesthetic beauty of the town. There should be a regulation applicable to individual developer to stipulate the percentage of the land that must be reserved for landscape and tree planting
- It has been established that planning for people is planning with people, it then means that community should be involved from the inception to the finishing so as to create urban green areas that is of great desired by the local residents.
- Engage the local community by creating sufficient time and funding to facilitate their engagement in the green spaces planning process as seen in the green spaces action cycle below
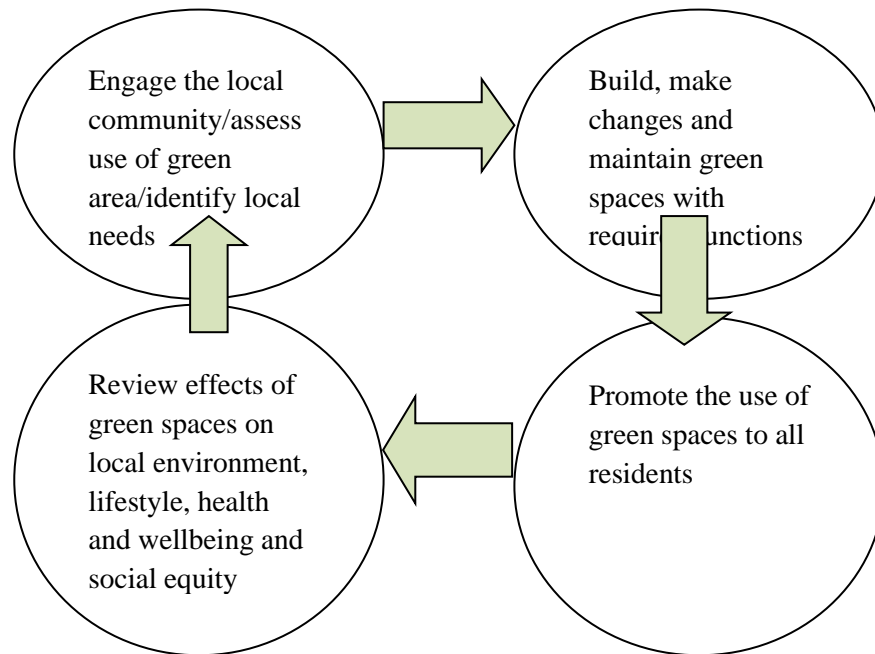
Fig. 12: Green space action cycle (WHO Regional Office for Europe, 2017)

7.0 Conclusion

The green space planning is one of the most effective strategies in city planning. Unfortunately it is not reflected in Lafia town. Population increase and rapid urbanization has resulted in the depletion of the natural vegetation. The development of green areas in Lafia town is faced with some challenges. These challenges are urbanization pressure, inadequate operational planning regulations guideline, lack of documented urban master plan, lack of political will on the side of those in authority, socio-economic status of the citizen resulting in the destruction of natural vegetation to source for alternative energy and lack of awareness and priority on green space planning. To deal with these challenges there should be joint effort by the policy makers, technocrats, urban planning authority, architects and the local communities to put more efforts in preserving the natural environment. This study will also be guide to treat green space planning in Lafia town with utmost priority considering the enormous benefits attached to it.

7.1 Recommendations

This study recommended three strategies that might be used by Policy Makers, Urban Planners and Local communities below:

7.2 Land Management and Plant Cover:

- Moreover, tree planting programmes should be introduced for all housing estates. Incentives and subsidies should be part of the long term planning.

- The use of weed killers such as herbicide should be discouraged rather it should be trimmed in order to maintain a green environment.
- The use of biodiversity in creating a diverse urban setting is essential. This should be done by planting of different species of trees.
- Green spaces and buffer strips of shrubs and trees can insulate residential areas from heat effective. The trees will serve as buffer against the sunrays and winds. Open spaces can be made an integral part of a sustainable and healthy environment in Lafia town through landscape planning and management. Open space when observed in building should be landscape with green flower or grasses. Most of these strategies can be achieved when the planning authority incorporate green space action cycle as seen below.

7.3 Town Planning Recommendations

The present pattern of land use allocation in Lafia town should be adjusted in order to accommodate more open space for green spaces. The average land use allocation for urban development in Lafia should be 30% of the total city area be given to residential. The next largest share (26%) is reserved for open space, primarily green spaces as clearly defined above. Streets cover more than 20% of the city area. Community facilities and industrial and commercial land should share approximately 20% as been practice in America cities and other places of the world. For future urban development in Lafia town, the 26% of the open space should be distributed fairly well over the city. About 40% of the open area should consist of parks, playground, and golf courses for recreational purposes. The remaining 60% is undeveloped land that is bare land or woodlot.

The 30% of the residential development should also be distributed fairly over the city. Where 55% of the space should be plots layout and the current practice of the housing plot size should be adjusted in order to have enough plot size for building and green areas (landscaping) within the residential plot.

7.4 Existing Space Standards for Urban Development in Nigeria

Table 5.0 Land allocation for urban master planning

Land uses	Percentages
Residential	40-50
Commercial	3-5
Industrial	5-10
Roads and streets	25-35
Railways	4-6
Outdoor recreation	8-10
Public utilities and community facilities	10-15

Source: Obateru (2003)

7.5 New Recommended Standard for Urban Development in Lafia Town

Table 6.0 Proposed Land allocation for urban master planning

Land use	Percentages

Residential	30
Commercial	3
Industrial	7
Roads and streets	24
Open spaces	26
Community facilities	8
others	3

7.4 Green Open Space Planning Recommendations

The following is recommended for good green spaces planning in Lafia town:

- Establish street greenery, urban gardens and green trails in close vicinity to urban residents and use public open space for greenery Tree planting programs should be reinforced in the urban area and incentives and subsidies should be part of the long term planning for Lafia town.
- Urban planning authority should make sure that building plans include site plan that has detail landscaping and should be monitored to ensure compliance during plot development.
- Green space should not be 300metres away from each other for optimum cooling. According to Asaeda and Abu (1998) a 100metres green space cools to a distance of 300metres. Also, vegetation and trees provides shade from direct sunlight radiation.
- Urban dwellers should be able to access green spaces of at least 0.5 – 1 hectare within 300 metres linear distance (around 10 minutes walk from their homes).
- There should adequate access to green spaces of good quality for all the population groups and users.
- There should be greening opportunities in other sectors and projects within the urban settings (For example greening of schools, business areas, shopping areas, housing estates) and also promote private green areas

References

Aldous, D. E., (2005). Education and training opportunities for turf management in Australia. Acta Horticulturae, 672, 71-7.

Asaeda, C.V.T., & Abu, E. M. (1998). Reduction in air conditioning energy caused by a nearby park. energy build, 29(1), 83-92.Available at: https://doi.org/10.1016/s0378-7788(98)00032-2.

Bilgili, C. B. (2009). Urban green space system planning. Bartin University, Bartin, Turkey.

Baycan-Levent, T., Vreeker, R., and Nijkamp, P., (2009). A multi-criteria evaluation of green
spaces in european cities. European Urban and Regional Studies, 16(2), 193-213.

Cilliers, S., Cilliers, J., Lubbe, R., and Siebert, S., (2012). Ecosystem services of urban green

spaces in   African Countries: Perspective and Challenges. Urban Ecosystem, DOI 10.1007/s11252-012-   0254-3.

Debnath, A. K, Chin, C. H, Haque, M. M and Yuen, B., (2014). A methodological framework

for benchmarking smart transport cities, Available at htts:/doi.org/j.cities.2013.11.004.

Dunnett, N., Swanwick, C., and Wooley, H., (2002). Improving urban parks, play areas and

green spaces. London: Department for Transport, Local Government and the Regions.

Ebuga, E. A., Angbo, Y. B., and Bashayi, O. (2021). Impact of heat island on human comfort in Lafia urban area of Nasarawa State, Nigeria. International Journal of Research and Innovation in Applied Science (IJRIAS) |Volume VI, Issue XI, November 2021|ISSN 2454-6194

Ebuga, E. A., Datukun, H.L., and Bashayi, O. (2023). Evolving green areas planning strategies as a means of mitigating urban ueat island in Lafia Town, Nasarawa State, Nigeria. International Journal of Latest Technology in Engineering, Management And Applied Sciences (IJLTEMAS) Volume XII, Issue VIII, August 2023/ISSN 2278-2540

Fam, D., Mosley, E., Lopes, A., Mathieson, L., Morison, J., and Connellan, G., (2008). Irrigation of urban green spaces: A review of the environmental, social and economic benefits. CRC for Irrigation Futures Technical Report No. 04/08.

Fratini, R., and Marone, E., (2011). Green-space in urban area: Evaluation of the efficiency of public spending for management of green urban areas. IJED 1 (1), 9-14.

Greater Lafia Master Plan (1998): Prepared by Savanah Landev Consult Ltd, Zaria for Nasarawa state government, Nigeria.

Grimm, N. B., Faeth, S. H., Golubiewski, N. E., Redman, C. L., Wu, J., (2008). Global change and the ecology of cities. Science. 319 (5864), 756–760.

Haq,   S.M.A (2011). Urban Green Spaces and an Integrative Approach to Sustainable

Environment. Journal of environmental protection. 2(5).

Jim, C.Y., and Chen, S. S., (2003). Comprehensive green space planning based on landscape ecology principles in compact Nanjing city, China. Landscape Urban Plan. 65, 95–116

Jim, C.Y., and Chen, W. Y., (2006). Recreation-amenity use and contingent valuation of urban green spaces in Guangzhou, China. Landscape and Urban Planning, 75, 81-96.

Kit Campbell Associates, (2001). Rethinking open space—open space provision and management: A way forward. A Report for the Scottish Executive Central Research Unit, Edinburgh, the Stationary Office.

MacHarg, I. L., (1971). Design with nature. New York: Doubleday, Garden City.

Manlun, Y. (2003). Suitability Analysis of Urban Green Space System Based on GIS, University of Twente, Netherlands, pp 90

McDonald, R. I., Forman, R. T. T., and Kareiva, P., (2010). Open space loss and land inequality in United States' cities, 1990-2000.PLoSONE,5(3), e9509.doi:10.1371/Journal. Pone. 0009509.

Mensah, C. A., (2014). Urban Green Spaces in Africa: Nature and Challenges. International Journal of Ecosystem 4(1): 1-11 DOI: 10.5923/j.ije.20140401.01

Obateru, I. O. (2003): Space standards for urban development. Penthouse press, Ibadan.

Oduwaye, L., (2013). Globalization and urban land use planning: The case of Lagos, Nigeria. A

Paper presented at the 18th International Conference on Urban Planning, Regional Development and Information Society. Rome, Italy, 20 – 23 May.

Sandström, U. F., (2002). Green infrastructure planning in urban Sweden. Planning Practice

Research, 17(4), 373–385.

Swanwick, C., Dunnett, N., and Woolley, H., (2003). Nature, role and value of green space in towns and cities: an overview. Built Environment, 29(2), 94-106.

United Nation Habitat (UNH). 2005

United Nations Department of Economic and Social Affairs, (2019). World Urbanization Prospects: The 2018 Revision. United Nations Publications.

WHO Regional Office for Europe (2017). Urban Green Spaces: A brief for Action

Yu, Z. W., Gao, J., Wang, L., Vejre, H. (2019). Suitability of regional development based on ecosystem service benefits and losses: a case study of the Yangtze river delta urban agglomeration, China. Ecol Indic. (2019)107:105579. doi: 10.1016/j.ecolind.2019.105579

Zitkovic, M., (2008). Managing green spaces for urban biodiversity. Brussels: Countdown 2010 Secretariat.