

# Rapid Buildings Growth and Environmental Impacts in Kano Nigeria

**Hashim Abdullahi<sup>1,2\*</sup>, Gobi Krishna A/L Sinniah<sup>2</sup>, Ho Chin Siong<sup>3</sup> and Nur Shaheera Mohd Azman<sup>2</sup>**

<sup>1</sup> Department of Urban and Regional Planning, School of Environmental Science and Technology Federal Polytechnic Mubi, PMB, 35 Adamawa State NIGERIA

<sup>2</sup> Department of Urban and Regional Planning, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia UTM Skudai, 81310 Johor, MALAYSIA

<sup>3</sup> UTM Low carbon Asia Research Centre, Universiti Teknologi Malaysia UTM Skudai, 81310 Johor, MALAYSIA

\*Corresponding author: hashimabdullahi46@yahoo.com

**Abstract.** All Rapid building growth is one of the top environmental challenge especially in developing nations. Kano metropolis Nigeria is rapidly expanding that calls for in-depth study. The aim of the study is to assess the environmental impacts of buildings growth in Kano metropolis Nigeria towards sustainability. Carbon monoxides CO was sensed with the aid of device Gas Sensor by Crown Cone and water sampled was taken from the existing ponds and analysed in the laboratory considering physiochemical properties of suspended particles, salinity, colour and total hardness. Geographical Information System (GIS) was used for the location maps preparation. Both indoor and outdoor carbon monoxides was sensed and recorded in selected local governments. The Outdoor carbon monoxide records of the sampled local governments areas of Kano Metropolis shows that Tarauni and Kumbotso recorded exactly 012 ppm as the highest records and Tarauni local government area maintain the highest indoor carbon monoxide emission also. Dala and Fagge local governments' areas depicted 011 ppm as the second highest records with regards to outdoor carbon monoxides emission but Dala, Gwale and Fagge local governments portrayed proportionately equal amount of indoor carbon monoxides emission of 008Ppm. In addition, the results of water analysis reveals that suspended solid contents and the salinity level of Shema Pond being more contaminated with (248 mg/l and 25 mg/l) against Hauran Wanka Pond with (61 mg/l and 20 mg/l). Colour and t. hardness of Hauran Wanka Pond indicates 501 ml/g and 0.16 mg/l) which is higher than Shema Pond with (290 mg/l and 0 mg/l). It is strongly recommended to preserve and conserve both water and air resources in the metropolis for suitability.

## 1. Introduction

Urban and regional planning tends to promote environmental sustainability as well as minimize urban growth challenges in all ramifications. Urban planning views land distribution and equally safeguard land uses with sole objectives of fastening economic development, promotes and ensures quality life [1]. This is achieve through master plan zoning regulation, as well as development control. Urbanization is the prime factor responsible for degradable and destructive changing the hydrological processes [2]. These generate very serious predicament to the effective storm water management. Given storm water infrastructure a solution to the changes because it integrates eco-landscape and storm water management. It considered locations, portions, layout and protecting the natural hydrological processes.



Simulation nodes is intelligently used to prioritize watersheds objective and it effectively utilized the available natural resources which covers; flood and storm water control, runoff reductions quality of water preservation and protection and rain water utilization. The green infrastructure maintenance as integral service is the greatest challenges to urban centres sustainability. Urban planning therefore should have considered the complexity of ecological process at different times and at different scales considering the regional spatial differences. Four 4 integral urban planning sustainability approaches which include: holistic evaluation of ecosystem services demand at regional scale, assessing the planning needs of each specific area, evaluating to extend how planning solution could affect the desired services and appraising the entire planning area side effects to the adjoining land uses [3]. Regional planning should be effective within its scheme and without denying the authorities at the local levels freedom to exercise planning scheme within the areas of their jurisdictions [4].

### *1.1. Formatting Urban Management as Tool Effective Urban and Regional Planning*

Urban management as aspect of urban and regional planning solely aimed at safe guarding at achieving healthy or minimally pollution free society in terms of carbon emission, water quality among others. Information and communication technology (ICT) application in urban planning is essential. This is because effective land uses, infrastructural planning and land uses changes model application in urban studies are among the effective urban management strategies. Xue et al. [5] stated that the relationship between urban – rural concept could be traced to 1949 in China, this is to control high rate of industrialization. 1980's and 1990's reforms focused mainly on urban-rural linkages through the urban planning. Urban planning in China aims at developing sustainable city in terms of rural natural landscape elements and to balance the rapid economic growth and at the same time achieving environmental protections. Urban system consists of in-depth socio economic issues together with urban landscape and it consists four aspects as: special agglomeration and diffusion, change of centre periphery effect, acceleration growth of axis region and informing of the world and regional urban system [6]. Complexity cognition and the city, understanding complex system [7]. Basically, there are 2 broad objectives; (a) How fully prepared is the contemporary planning theory. (b) Expanding and frequencies of the multi-dimensional problems of socio-economic and with spatial policies and practices of neoliberal could not long be accommodated and sustained [8]. Why it is right time to discuss “resilience” within the context of planning practice reason are very obvious which include: dramatic increase in economic social and spatial vulnerabilities in cities natural landscape and its resource depletion necessitated the preservation and resource management. Eraydin and Tasan-kok [8] stated that ecological changes cause environmental degradation. This therefore calls for ecology consideration in urban planning. It is popular and attraction below: it promotes the comprehension of socio-economic and ecological systems, it helps to comprehend the adaptive capacity of the socio-ecological systems, dynamism of ecosystem comprehension, spelt out the factors affecting urban system, helps to coordinates spatial and ecological issues in an orderly manner. The research focuses on smart growth movement within its reliance of traditional central planning to attain its specific goals to the state-wide planning in Oregon, Florida and Washington state cases of examples. The research work focuses on the application of landscape planning [9].

### *1.2. Green Planning Technology Application in Urban Management*

Green planning is a strategy used in spatial planning in curtailing and resolving urban growth environmental predicaments. Interaction between human activities and the environment results to spatial configuration of urban landscape. Rapid urbanization is seriously altering urban landscape through changing urban planning practices [10]. Remote sensing and geographic information system (GIS) technologies allow spatial data on vegetation and land use pattern over large areas could be integrated. Dooling [11] comment that the research is a response to incorporation of humanity base researchers within the context of urban ecology with the view to achieving robust inter disciplinarily. Urban ecological framework provides solid foundation of detail studies of human interaction which include; social, cultural and political together with biophysical which covers climatological, hydrological and terrestrial as well as environmental and social changes. It is a statement between humanities and sciences. Vesa and Tari [12] opined that increasing in reduction of green spaces within urban areas is

because of rapid urbanization occurring and it is posing great threat to the biodiversity to the urban areas. Community could involve and participate in revised town planning among several professions such as: urban planners, economics, operation research, management science, and political science, public administration could have contributed dynamically to the present town planning processes [13]. Urban planning process should have covered; external variable selections, estimation qualitatively of the external value, definition of plausible external variables, definition of selected regional variables, reduction of workable scenario, preparation of quantitative estimate of regional attributes and development of plans [14]. Planning evaluation and regulation of ecological security (PERES) is highly essential after the translation and implementation of urban planning in China within the scope of its national strategic targets for intensive urbanization [15].

### *1.3. Application of Information Communication Technology (ICT) in Urban Management*

Growth of information and communication technology has received significant contribution in the context of spatial planning with regards to assessing and predicting urban growth challenges. Murgate et al. [16] stated that 30% of the available data are within the geo-referenced information. To analyse the spatial data therefore, special skills of the tools is highly essential which will promote right but precise decision making. Application of geo-computational in urban and regional planning, this is essentially categorized under three areas; (1) Spatial support system to spatial uncertainty, (2) Artificial intelligent application, (3) Spatial statistical techniques application. Computer aided planning techniques was initially development to solve related land-uses planning issues in the Malmo Region of Sweden. Models were formulated with the aid of mainframe computer. Land uses and infrastructure planning effective planning is a key in achieving sustainable development in the context of urban and regional planning with regards to urban management [17]. Land-use simulation effectively provides very useful information for regional spatial planning. This is achieved through precise application of land-uses models at different stages of development viz; water management, health and safety together with urbanization. Land uses changes simulation provides spatial regional information on 3 basic issues; (a) treatment of uncertainties, (b) confidence in planning initiatives and (c) infrastructure integration (d) land use scanner models and (e) Conversion of land use context CLUE-S, it is effective in small regional planning [18]. In addition, Liu et al. [19] stated that land use and land use cover changes (LUCC) was basically used to find out River-watershed of Huntaizi in Northern China with aid of remote sense of GIS. Christopher and Pullar [20] studied that the application and utilization of GIS was recently introduced in spatial planning. GIS is an important tool in solving spatial planning issues. Mattida [21] stated that aesthete justice and urban and planning who thought to have the right to design cities. The argument centred on 2 divergent approaches and views to urban planning. Urbanization is connected directly with consequential environmental impacts on water quality [22]. Urban pollution negatively alter the quality and usability of water in the urban areas [23].

## **2. Aim of the study**

The study aim is to assess the environmental impacts of buildings growth in Kano metropolis Nigeria with reference to two indicators air and water qualities with the views towards sustainability.

## **3. Methodology**

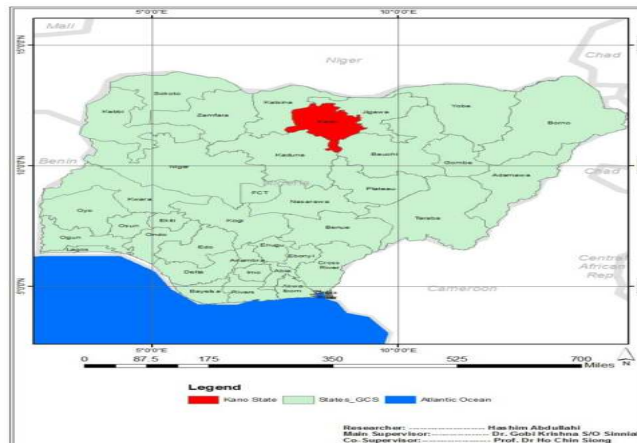
Primary data was gathered from field with the aid of carbon monoxide sensing device (Gas Sensor By Crown Cone)(Figure 1) and water sampled was taken from one of the historic existing pond and analysed in the laboratory with emphasis on physiochemical properties of suspended particles, salinity, color and total hardness was analysed. Geographical Information System (GIS) was used for the production of the location Maps. Both indoor and outdoor carbon monoxides was sensed in selected local governments based on the land uses interactions and 12 reading stations was sensed within the metropolis. The study also utilized secondary data obtained from available sources of majorly related secondary materials.



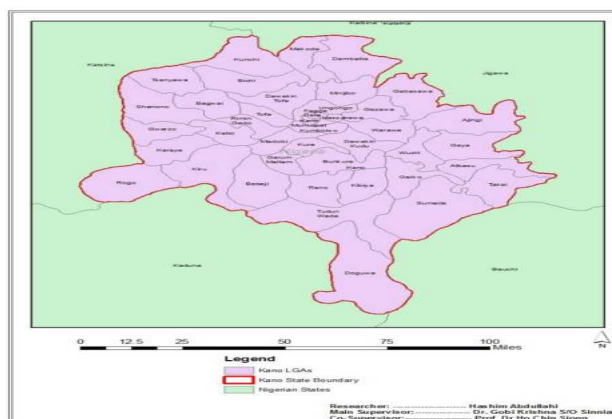
**Figure 1.** (a) carbon sensing, (b) carbon sensing device by Crown Cone.

**4. Study Area**

Kano Metropolis is geographically located in the Northern Nigeria within latitudes 12° 25<sup>1</sup> N to 12° 40<sup>1</sup> N and longitude 8° 35<sup>1</sup> E to 8° 45<sup>1</sup> E. The metropolis buildings is rapidly increasing in all directions and it is the most developing and urbanizing cities and commercial center of the entire Northern Nigeria. It has annual buildings growth rate of 3% and its projected population sum up to in 4.3 million according to 2018 census figure. It is highly crowded with 1000 people per square kilometre (km<sup>2</sup>) of its dwellers and its climate is wet and dry base on Koppen’s classifications. Its 1000 people per square kilometer makes it the most crowded and very densely populated Metropolis in the country [24-25]. Annual buildings growth rate in the study area between 1984 and 1998 is 1.67% while within 1998-2019 is 025% [26]. Figure 2 reveals map of Nigeria and its 36 states while Figure 3 portrays map of Kano State and its local governments.



**Figure 2.** Nigeria and its 36 states and FCT.



**Figure 3.** Kano State and its LGAs.

**5. Data Analysis**

Carbon monoxides was sensed and recorded together with its coordinates in the selected point while water sample was taken in the sampled pond and was analyzed in the laboratory. Table 1 shows indoor sensed carbon dioxides record within the sampled local governments. The table also portrays its coordinates of the individual stations. Table 2 on the other hand, contrarily depicts out door sensed carbon monoxides and its coordinates within selected sampled areas.

**Table 1.** Showing Indoor Sensed Carbon Monoxides and Its Coordinates.

Sites	Stations	Coordinates		CO ppm
		Northing	Easting	
Indoor	Dala	12.0268333	8.4998083	008
Indoor	Gwale	11.9907983	8.4963230	008
Indoor	Fagge	12.0038017	8.5282680	008
In door	Tarauni	11.9776670	8.5643830	012
In door	Nasarawa	11.9851817	8.5516667	003
In door	Kumbotso	11.9878000	8.5529760	006

**Table 2.** Showing Outdoor Sensed Carbon Monoxides and Its Coordinates.

Sites	Stations	Coordinates		CO ppm
		Northing	Easting	
Outdoor	Dala	12.0157833	8.5020500	011
Out door	Gwale	11.9831950	8.5084830	008
Out door	Fagge	12.1181667	8.5212900	011
Out door	Tarauni	11.9801859	8.5605283	012
Out door	Nasarawa	11.9901500	8.5316500	009
Out door	Kumbotso	11.9776330	8.4590006	012

The research with regards to the environmental impact of urban growth on water in Kano metropolis, two historical pond water samples was collected namely Shema and Hauran Wanki Ponds. Shema Pond depicted colour of 290 PtCoU while Hauran Wanka Pond 501 PtCoU. T. Hardness records of the ponds are 0mg/l for Shema ponds while 0.16 mg/l for Hauran Wanki Pond. In addition, Salinity records of the ponds was 25 mg/l was for the Shema Pond while 20 mg/l for the Hauran Wanki Pond. Suspended solid, the analysis depicted 248 mg/l was the record of Shema Pond while 61 mg/l was for the Hauran Wanka Pond. Figure 4 (a), (b), (c) & (d) demonstrates water sample taken and its colour in the study area.



**Figure 4.** (a), (b), (c) & (d) Shema and Hauran Wanki Ponds taking water sample for the study.

## 6. Conclusions

In conclusion, the outdoor carbon monoxide records of the sampled local governments areas of Kano Metropolis shows that Tarauni and Kumbotso recorded exactly 012 ppm as the highest out records among the sampled sensed and Tarauni local government area maintain the highest indoor carbon monoxide emission also similar to the outdoor emission. In addition, Dala and Fagge local governments areas followed with same trends of 011 ppm as the second highest records with regards to outdoor carbon monoxides emission but Dala, Gwale and Fagge local governments portrayed proportionately equal amount of indoor carbon monoxides emission of 008 ppm. Nassarawo local government area maintained the thirds position with 009 ppm while Gwale local government area depicted the least carbon monoxides records of the study with 008 ppm of the outdoor emission. It is least emitted carbon monoxide outdoors records of the study. Contrarily, the indoor records revealed different trends of the carbon monoxides emission within Kano metropolis, this is due to the culture and traditions of the dwellers with regards to the types of energy for domestics' energy sources together with level of income as well. Kumbotso and Nassarawo local governments' areas have 006 ppm and 003 ppm. In addition, the water analysis of the Ponds reveals that suspended solid contents and the salinity level of the ponds shows Shema Ponds being more contaminated (248 mg/l and 25 mg/l) against Hauran Wanka Pond with 61 mg/l and 20 mg/l but with regards to the Colour and T. Hardness Hauran Wanka Ponds indicates 501 ml/g and 0.16 mg/l which is higher than Shema Pond with (290 mg/l and 0 mg/l).

## 7. Recommendation

The recommendation is drawn based on the identified issues with the regards to the major indicators of the environmental impacts of the urban growth of Kano Metropolis of air quality and water quality indicators. Basically, three urban and regional planning strategies are considered as:(a) Effective urban management is highly essential in Kano Metropolis, this is because, the metropolis building sector is dramatically expanding in all directions as a result high population growth together with intensive commercial activities as reveal by the field survey conducted, 2019. The metropolis is significantly receiving government attention in term of roads construction, number of fly over are completed while few are under construction. This is great efforts, though the traffic flow is very high and congestion is high especially at the pick hours particularly in highly commercialized zones. The culture of people in relation to the types of energy used also affect the air quality within the metropolis. Although, the study reveals that there is slightly difference between outdoor and indoor carbon sensed for the study. (b) Effective land use planning with regards to this, Kano State Urban Development Authority (KANUPDA) should strengthen its development control mechanism, Zoning regulation should ensure that conversion of existing development in relation to change of uses follow the appropriate channel to avoid combining conflicting land uses together. For sustainable development to be achieved also in the metropolis, proper implementation of the present and future lay-out designs together with various plans implementation should take into consideration of all urban and regional planning rules and regulations. Planning campaign together with public participation are highly essential. This will go a long way in creating public awareness that may create environmental conscious among the dwellers of the metropolis. (c) Green planning technologies implementations by responsible bodies such as Kano State Urban Development Authority (KANUPDA), Kano State Geographical Information System (KANGIS), Ministry of Environment (Pollution Control Unit), Ministry of Work and Housing each has vital role in the context of mitigating the environment impacts of urban growth within Kano metropolis in relations to air and water pollutions. There are the strong needs in the creation of more green spaces with existing built up areas and the needs to safe guard the existing open spaces. It is to be make as part of requirement for development permit approval to make tree planting inclusive, tree planting campaign is to be promoted within the metropolis. The present conversion of open spaces and green spaces within Bayero University Road should be controlled by the appropriate bodies, this is because of its ecological contributions with regards to the air quality. In depth study is to be carry out to ascertain suitable policy regulation formulation on water and air pollution in the metropolis. Figure 5 indicates urban expansion elements flyovers and historic, traditional gates of old Kano city.



**Figure 5.** (a), (b) & (c) Showing flyovers and traditional historic gate of old Kano town.

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