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Impact Analysis of Environmental Degradation in Maiduguri Metropolis, Borno State, Nigeria

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Abstract: *The study examined the impacts of urbanization on environmental degradation in Maiduguri metropolis, Borno State. The study was design using Taro Yamane formula, the study sampled a total of 512 respondents. Data for the study was obtained through structured questionnaires and perceived environmental impacts based on local population's perception through administration of a questionnaire survey. The purpose of this study is to show that the consequences of urbanization has a serious impact on environmental conditions. Data collected for the study was subjected to statistical analysis using frequency distributions table, percentages and Pearson's correlation analysis using Microsoft Excel version 23.0 and Statistical Package for Social Sciences (SPSS) version 23.0. Based on the analysis, the study concluded that rapid urbanization led to air pollution, river water contamination, domestic waste and garbage dump, settlement along the floodplain, flooding and poor sanitary conditions and infrastructure overstretching, squatter settlements, and aesthetic degradation that have had negative impacts on man and other living organisms in the environment. Based on the findings, the study recommended quality housing structure, environmental sanitation and effective urban planning by Borno State Environmental Protection Agency and Borno State Urban Planning Development Agency to prevent and curtail further degradation of the environment. A case study of urbanization in Maiduguri has been carried out leading to conclude on the existing causes of damage to the environment due to urbanization.*

Keywords: *urbanization, environment, degradation, Maiduguri metropolis*

INTRODUCTION

Urbanization refers to general increase in population and the amount of industrialization of a settlement. It includes increase in the number and extent of cities. It symbolizes the movement of people from rural to urban areas. Urbanization happens because of the increase in the extent and density of urban areas (Uttara *et al.,* 2012). In 1950, the population living in urban areas was 30 percent, which increased to 55 percent by 2018. (United Nations, 2018). In 2050, it is projected that 68 percent of the world's population will live in an urban setting (Ritchie & Roger, 2018). The beginning of this increase was partially due to the fact that building projects could be carried out faster after the Industrial Revolution, which allowed for mass-produced building materials. Economic development and technological advancement enabled people to alter a landscape on a

grander scale. Later, it was possible for urban-mega cities such as Shanghai to be built in a matter of a few decades (Taylor, 2013).

In Maiduguri, uncontrolled urbanization has resulted in increased anthropogenic activities including uncontrolled or improper waste disposal, proliferation of pit latrines and agricultural activities (Bakari, 2014). The rapid urbanization has been identified as the cause of numerous environmental problems, which include and not limited to air, water, land and noise pollution, deforestation, local climate alteration, and traffic congestions. Due to uncontrolled urbanization within the city of Maiduguri, the rapid urbanization has led to negative environmental impacts, putting much pressure on social infrastructure in urban areas associated with rapid and unplanned urbanization such as flooding, solid waste problems, a proliferation of informal and unplanned settlements where houses are built along rivers, which pose a danger to the lives of these communities during flooding's event. Environmental degradation has become a "common concern" for humankind over the years.

Environmental degradation is an alarming issue in the planet. The main reasons behind the problem are population explosion and high demand of luxury items in the life. Presently, lack of proper education, awareness, knowledge and approach of people towards environment degrades the nature and its resources. Thus, sustainable development appears to be a doom stay approach for various countries across the globe. The argument on the impact of population pressure on environmental degradation and what can be the urgent solution to have sustainable environment and development (Hummel, 2009). Population is considered a valuable resource in the development and yet it is also a significant cause of environmental degradation when it exceeds the carrying capacity of the support system. UNISDR (2015) states that population increase affects the environment through the use of natural resources and the release of wastes.

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Anthropogenic population expansion remain a critical issue that is responsible for environmental degradation in the urban environment. More specifically, increase in the number of people in the urban environment is the leading cause of environmental degradation (Botkin and Keller, 2012). Because of this state of affairs, there is a need to control the increase in the population so that it can reach the number the earth can sustain. Maiduguri metropolis been the largest city in Northeastern Nigeria, is witnessing an unprecedented rise in demographic expansion in recent time. According to 2006 population census over 500, 000 people lives within the Maiduguri metropolis. The high influx of people into the metropolis from the rural areas to take advantage of the perceived opportunities offered by these urban centers, without adequate planning and effective management strategies to accommodate this influx by the government, results to serious pressure on both the socio-economic supporting infrastructure and the environment. Environmental degradation has been occurring very rapidly and causing many problems.

Apart from rapid population growth, Maiduguri metropolis, has also been expanding physically at a rapid rate. It has grown from 10.54km^2 in 1960 to a metropolis converting an area of 534km2 in 2006. This expansion is connected with the process of uncontrolled urban

development. Unplanned urbanization also results in property development in marginal areas and the unhealthy practice of dumping refuse into drains among others (Agobie, 2013). Sustainable use of environmental resources has been an issue of debate globally. Every individual on earth wants to develop. Human development in most cases has not integrated the environmental concerns. This has led to degradation of environmental resources which are meant to cater for both present and future generations. The value of environment has been slighted and hence man undertake development activities without giving attention to the impacts of his activities. This paper examine the impact of urbanization on environment focusing on environmental degradation.

This paper emphasizes on the effect of urbanization on environmental components mainly land and water resources, climate, ecological sphere. A case study of urbanization in Maiduguri metropolis have been carried out leading to conclude on the existing causes of damage to the environment due to urbanization and preventive measures to keep a check on them. Although it is impossible to restrict urbanization it has to be ensured that urbanization proceeds in the right path causing minimum impact on environment. Maiduguri is facing various challenges because of the rapid increase in population and urbanization (Dani *et al*., 2012). However, most of the studies that exists on the impact of urbanization on environmental degradation in this country have been conducted at national level. Research at national level is too large for the environmental improvement of urban areas in metropolitan areas. Thus, this paper attempts to investigate the impacts of urbanization on environmental degradation in Maiduguri metropolis, especially to identify the particular environmental problems inherent within the metropolis for sustainable development of metropolis,

Research Questions

From the above stated problem, the following questions were raised;

1. Does the population of Maiduguri metropolis increase in the last six decades?
2. What is the extent of urbanization in Maiduguri metropolis?
3. What are the effects of urbanization on environmental degradation?
4. What is the relationship between urbanization and environmental degradation?

Aim and Objectives

The aim of this study is to assess the impact of urbanization on environmental degradation in Maiduguri metropolitan council. This were achieved through the following objectives:

1. To identify the level of population increase in Maiduguri metropolis in the last 5 decades
2. To assess the level of urban Maiduguri metropolis expansion over the period of study
3. Identify the various environmental degradation common within Maiduguri metropolis.
4. To examine the relationship between urbanization and environmental degradation in Maiduguri metropolis.

LITERATURE REVIEW

There are various studies on urban environments as urban issues are becoming of critical importance around the world and urbanization is expected to continue with some cities now reaching unprecedented sizes (RCEP, 2005). According to Enger and Smith (2004), the United Nations estimates that the current world's population living in cities is expected to increase to

over 50 per cent by 2005 and reach 60 per cent by 2025. And a greater majority of the urban growth will take place in the less developed world. This growth has put severe pressure on urban infrastructures, services and shelter resulting in a situation of urban crisis and hence deterioration in the quality of urban environments,

Tasin (2010) reported that Nigeria has the highest population growth rate with an average of 2.54% population compared to other countries of the World. Population dimension of these concerns stressed in the final document of the United Nations International Conference on Population and Development (ICPD) held in Cairo on September 1994. Environmental degradation is today a global issue.

In Nigeria, (Mba et al., 2004) cited in (Daramola and Ibem, 2010) identified several types of environmental problems classified as ecological, poaching and habitat loss, increasing desertification and soil erosion. These are further subdivided into pollution, deforestation, global warming, slum development, etc. Nigeria's coastal regions are currently experiencing widespread contamination from petroleum exploration (gas flaring, oil spillage) while the general poor living conditions in urban areas in the country constitutes an affront to human dignity (Daramola and Ibem, 2010). These environmental problems continue to increase as the urban growth rate continues to rise.

According to Lema (1995) in Akanbi (2004), the accelerated urbanization and industrialization in Nigeria has been associated with various environmental problems ranging from poor housing, slums and solid waste generation, sewage and refuse disposal, urban flood, hazard and refuse and inadequate urban drainage, lack of proper facilities of disposal of all types, inadequate water supply, pollution of air, land and water resources in rivers, lagoons and oceans.
The National Population Commission (NPC, 1991) observed that most urban areas in Nigeria have grown beyond their environmental carrying capacities and existing infrastructure. For instance, data from the National Population Census (2006) revealed that most of the urban areas in Nigeria with small land mass have already exhausted or have extremely limited capacities to accommodate further increase in population (Federal Republic of Nigeria, 2007). With a population figure of more than 140 million and land mass of about 924,000 Km2, current estimates indicated that 10 per cent of the land area accommodated 28 per cent of the country's total population (Taylor, 2000). The implication of this is that there is disequilibrium between the population and the environment, and this has adversely affected the carrying capacity of the urban areas in the country; hence the increasing poor quality of the living conditions and the low livability index of urban areas in Nigeria (Daramola and Ibem, 2010).

Environmental Degradation and Urbanization
Environmental degradation is defined as the reduction or deterioration in the quality of natural and socio-economic variables including a decline in or loss of bio-diversity (Barau, 2004). Ahmad (1997) views environmental degradation as the tempering with the state and quality of the surrounding objects of land, water and air as an interdependent component of nature. Without be labouring on conceptual clarification, the environment is degraded if natural resources are depleted, ecosystems destroyed, leading to wildlife extinction, and pollution. Environmental

degradation is the process in which the ecosystem, the aesthetic landscape and other physical structures that support the lives of humans, animals and plants in different ways through the ecological value chain are disrupted resulting from natural and anthropogenic factors.

There are at least six main forms of urbanization-led to environmental changes: air and water pollution, ecosystems, solid waste, biogeochemical cycles, land use, and the global climate (Bai *et al.,* 2017). It starts from rural urban migration, resulting in population growth, formal and informal urban settlements, infrastructural development, demographic dynamics, socio-economic inequalities, air pollution, and changes in the local and global environments (Mc Phearson *et al.,* 2016; Zhang, 2021). However, different theories have different points of view to understanding these urban transitions.

The quantum of the urban population expansion, sloppy and unplanned growth of urban areas, and inadequacy of infrastructure are the main causes of such a situation. The rapid growth of urban population both through fertility and migration, has put heavy pressure on public utilities like housing, transport, water, sanitation, and health e.t.c. The impact of all this growth on environment and quality of life will be least, tremendous. The supply infrastructural facilities to meet the high demand such large population is lagging far behind as compared to level of urbanization. As a consequence, the urban environment, particularly within the metropolitan Maiduguri, degenerate very fast.

Causes of Environmental Degradation

According to Rajiv (2016) the major causes of the environmental degradation are modern urbanization, industrialization, over-population growth, deforestation etc. Environmental pollution refers to the degradation of quality and quantity of natural resources. Various types of the human exercises are the fundamental reasons of environmental degradation. These have prompted condition changes that have turned out to be hurtful to every single living being. The smoke radiated by the vehicles and processing plants expands the measure of toxic gases noticeable all around. The waste items, smoke radiated by vehicles and ventures are the fundamental driver of contamination. Spontaneous urbanization and industrialization have caused water, air and sound contamination. Urbanization and industrialization help to expand contamination of the wellsprings of water. So also, the smoke discharged by vehicles and ventures like Chlorofluorocarbon, nitrogen oxide, carbon monoxide and other clean particles dirty air. Neediness still remains an issue at the base of a few ecological issues.

Population and Urbanization

The rapid population growth is degrading the environment through the uncontrolled growth of urbanization, expansion and the destruction of natural habitats. One of the significant reasons for environmental degradation in metropolis Maiduguri could be attributed to rapid increase of population which is antagonistically influencing the natural resources and condition. The Maiduguri metropolis total urban area, composing of the urban cluster which refers to the continuous urban expansion of Maiduguri metropolitan Council (MMC) into some part of Jere and Mafa has population of 822,000 (Population projection, 2022). It is the most rapidly population expansion city in the northeastern region of Nigeria. The rapid population expansion urban and urban development have resulted in transformation of the farmlands, river flood plains and forests into settlements thereby causing urban land use changes. There is also proliferation of

slums due to informal and unplanned settlements. Houses are built along rivers, which pose a danger to the lives of the settlers during flooding events. The presence of informal settlers along the rivers and their tributaries also contributed to the constriction of the river channels within urban Maiduguri, have caused flooding during heavy storms. Population is an important source of development, yet it is a major source of environmental degradation when it exceeds the thresh hold limits of the support systems. Unless the connection between the multiplying population and the existence emotionally supportive network can be settled, improvement programs, howsoever, imaginative are not prone to yield wanted outcomes. Population impacts on the environment primarily through the use of natural resources and production of wastes and is associated with environmental stresses like loss of biodiversity, air and water pollution and increased pressure on arable land.

A review by United Nation State of the World Population report in 2007, by 2030, 40.76% of nation's population is required to dwell in urban zones. According to World Bank, Nigeria, alongside China, India and Indonesia and the United States, will lead the world's urban population surge by 2050. Urban population in Nigeria is growing rapidly, for example the total population of the country rose from 45.2 million in 1960 and was projected to rise to about 168 million in 2013 and over 200 million in 2020 (NPC, 2006). Most of the people are concentrated in urban areas. Lack of opportunities for gainful employment in villages and the ecological stresses is leading to an ever increasing movement of poor families to towns. Such fast and spontaneous extension of urban areas has brought about debasement of urban condition. It has extended the hole amongst request and supply of infrastructural administrations, for example, vitality, lodging, transport, correspondence, instruction, water supply and sewerage and recreational pleasantries, along these lines exhausting the valuable ecological asset base of the urban areas. The outcome is the developing pattern in decay of air and water quality, age of squanders, the expansion of ghettos and bothersome land utilize changes, all of which add to urban poverty and environmental health and sanitation are often compromised.

STUDY AREA AND METHODS

Study Area

Maiduguri, the capital of Borno State with a land mass of 137,356 square kilometers is located between latitudes 11° 46′ 18"N and 11° 53′ 21"N and longitudes 13° 02 ′23"E and 13° 14′ 19"E (Fig. 1). The study area has shown a continuous increase in population from 570,331 in 2006 to 822,000 in 2022. The urban Maiduguri has been rapidly urbanizing in the past few decades and was recognized as a major city in northeast region of Nigeria. The rapid population increase and urbanization of Maiduguri metropolitan council brings about expansion of the city into more land areas been occupied. The climate of Maiduguri is extreme continental in nature and experienced a single marked season. It consists of a long dry season (October to May) and a shorter rainy season (June to September). The rainfall pattern in the area generally shows spatial and temporal variability and has been characterized by single maximum, with a peak around August. Average rainfall in Maiduguri is over 600mm. In the dry period, the temperature over the area may go up to 48°C. During Harmattan it may be as low as 15°C. Humidity is generally low, except during the brief rainy season and potential evapotranspiration is high over the area

with an estimated annual average of about 2,300mm (Goni, 2006). Soil around Maiduguri urban environment is part of the brown and reddish brown hydromorphic alluvial soil of the entire Borno region. In consonance with soil and climate of the area, the vegetation is similar to Sahel savanna, surrounded by shrubby vegetation interspersed with tall trees woodland (Waziri 2009).

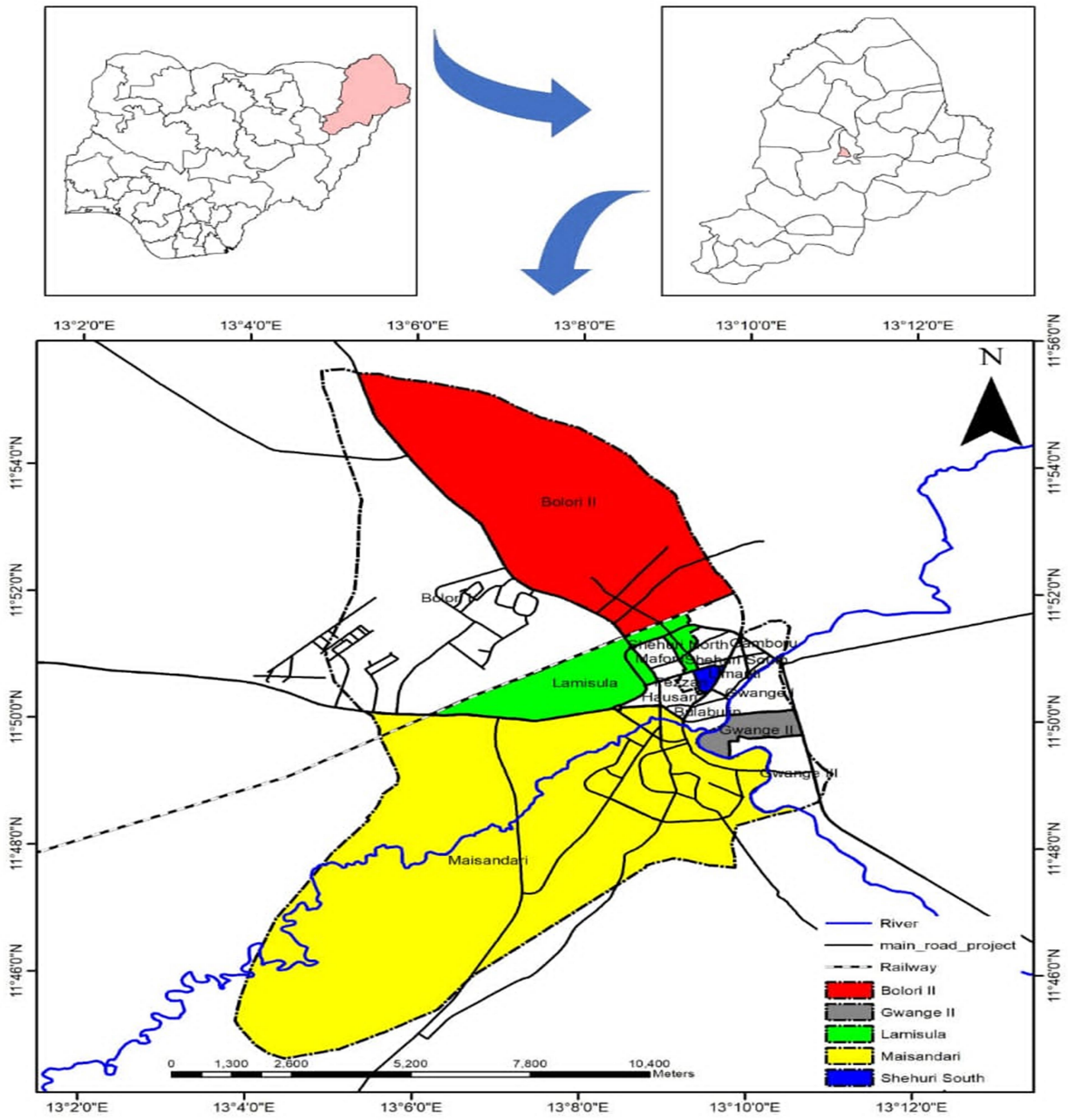

Figure 1 Map of Maiduguri Metropolis

Method

For primary data, a questionnaire survey was employed to obtain data on the level of awareness and reactions of the respondents to issues concerning the environment like waste, open defecation, noise and pollution in different wards of Maiduguri metropolis. A projected population of Maiduguri metropolis as at 2022 which is 822,000 was used to calculate the sample size using Yamani's Formula:

To determine the sample size of the population for the study, the Yamane's (1967) formula for calculating the size of the sample was adopted from the work of Teketel (2015). This is expressed as:

$n = N / N1+ (e)^2$

Where n = Sample size
N = Total population of the study
e = Margin of error

$$n = \frac{822{,}000}{1+ 822{,}000\ (0.05)^2}$$
$$= \frac{822{,}000}{1+ 822{,}000\ (0.0025)}$$
$$= \frac{822{,}000}{1+ 2.055}$$
$$= 2{,}506$$
n = 399.8 ≈ 400

Therefore, the sample size is approximately 400 out of the total population in the study area which takes consideration of only the household heads who may have vast knowledge of the study area for the past 20 years. The questionnaire is a structured one and it was administered to a sample of the population in the different wards. Simple random sampling technique was used to sample the five (5) wards out of the fifteen wards that make-up respondents, which are; Gwange, Lamisula, Maisandari, Shehuri South and Bolori. This was done by writing out the names of the fifteen (15) wards in Maiduguri metropolis on small sheet of papers. Five (5) respondents were asked to select one randomly. This was done until the 5th ward was selected. At the point of contacting the individual respondents within the selected wards, accidental sampling technique was used to sample respondents who were meet by chance.

The questionnaire was divided into three (3) broad categories. The first category (A) was made up of the demographic data of the respondents, namely; age, gender, Types of education, qualification, occupation and marital status Section (B) measured urbanization, while section (C) measured environmental degradation. Data collected from the field were analyzed with frequencies, percentages, pie charts, binary logistics regression and Pearson correlation statistics with the aid of Statistical Package for Social Sciences (SPSS) version 23.0. Also, data was obtained through interview to some officials of Borno State Urban Planning Development Authority (BOSUPDA) and Borno State Environmental Protection Agency (BOSEPA).

Statistical figures and records were collected from these agencies. Other secondary sources of data were collected from academic journals, magazines reports, conference papers, textbooks and the internet website.

RESULTS

This section present the data analysis derived from field study using questionnaire. The data are presented in frequency distribution tables, and pie charts. The study was carried out in five randomly selected wards in Maiduguri metropolis. Copies of questionnaire was administered to eight hundred (800) respondents which is the sample size representing the study population. Out of this lot, five hundred and twelve (512) copies of questionnaire representing (64%) were returned and found valid, while two hundred and eighty-eight (288) copies of questionnaire representing (36%) were not retrieved. Therefore, analysis of the study was based on the 512 copies of questionnaire retrieved and found valid for the study.

A. Demographic Characteristics of Respondents

Table 1: Age Characteristics of Respondents

Age	frequency	percent (%)
18 – 27 years	26	6.5
28 – 37 years	80	20
38 – 47 years	151	37.8
48 – 57 years	118	29.5
58 & Above	25	6.3
TOTAL	**400**	**100**

Source: Author's Field work, 2023

Considering the age of the respondents in the study survey areas is concerned, the age group 38–47 years has the majority with 37.8%, followed by age group 48-57 years with 29.5 % and 28-37 years with 20% respectively. The two age groups that constitute the least respondent are 18-27 and 58 years and above has 6.5% and 6.3%. This implies that, the dominant age group are those who fall within the 38-47 years.

Table 2: Gender Characteristics of Respondents

Wards	Frequency	Percent (%)
Male	374	93.5
Female	26	6.5
Total	**400**	**100**

Source: Author's Fieldwork, 2023

The analysis shows that 374(93.5%) of respondents are male while 26(6.5%) are female. It is evident from the findings that male represents the overwhelming majority than female in the study. This is because of the culture of the people in the study area in which male are mostly got in contact easily outside during the survey while women are mostly inside the houses.

Table 3: Education Qualification of the Respondents in the Surveyed Wards

	Frequency	Percent (%)
Primary	32	8
Secondary	281	70.2
Tertiary	77	19.3
Quranic	10	2.5
TOTAL	**400**	**100**

Source: Author's Field work, 2023

Educational characteristics of the sampled population shows (281) 70.2% of the respondents attended secondary education while (77) 19.3% attended tertiary education. The proportion of the respondents who had basic primary education is (32) 8% and (10) 2% had quranic education at the time of the study. It is evident from this results that majority of respondents had secondary qualifications. This result also shows that some respondents in the surveyed area pursue both Islamic and western education.

Table 4: Occupational Characteristics of the Respondents in the Surveyed Wards

	Frequency	Percent (%)
Civil Servant	96	24
Unemployed	199	50
Student	12	3
Trading	35	8
Farming / miners	58	15
TOTAL	**400**	**100**

Source: Author's Field work, 2023

As shown in table 4 the data pertaining to occupation of the respondents reveals (199) 50% of the respondents are unemployed while this followed by category designated as civil servant (96) 24 %, farmers / miners constitutes (58) 15%. Table 4 further revealed traders constitutes (58) 15% and students which has the least respondents (12) 3%.

Table 5: Marital Status of the Respondents in the Surveyed Wards

	Frequency	percent (%)
Married	291	73%
Unmarried	61	15%
Divorced	20	5%
Widowed	28	7%
TOTAL	400	100

Source: Author's Field work, 2023

From table 5, the result indicates the marital status of the respondents in the entire sample collectively. It reveals that, out of the total 400 respondents, (291) 73 % were married while (61) 15% were not married which means that youth in the study have no family and this has an impact on population pressure on the environmental degradation in the city of Maiduguri. The statistic further revealed (28) 7% were widowed while (20) 5% were divorced respectively.

Table 6 Monthly Income of the Respondents in the Surveyed Wards

Income	F	%

N40,000 and above	200	50
N21, 000 – 40,000	100	30
N11, 000 – 20,000	50	15
Below N10000		5

Source: Author's Field work, 2023

Furthermore, the average monthly income of the respondent's from table 6 shows that 50% earns above 40,000 Naira compares to 30% of those earning 21,000-40,000 Naira, 15% also makes between 11,000-20,000 Naira and 5% which is below 10,000 Naira. The poor condition of most low and moderate income residential environment can be attributed to socio-economic and occupational reasons. The persistence of the poor quality of environment in some of the settlements is largely due to the low income background and occupational status of the dwellers who cannot afford high rents associated with befitting houses.

B. Urbanization Changes from 1910 – 2023

Figure 1 showed that the population in the study area increased from 10,000 in 1910 to 845,000 in 2023. This trend indicates that population is one of the major factors of urban growth. The population of Maiduguri metropolis was 10,000 in 1910. This figure witness a noticeable change to 139, 965 in 1963. Population Census put the total population of the Maiduguri urban at 537,972 with a growth of 8,309 at 1.52% growth rate. In 2006 the population was increased to 625,229 with a growth of 9309 at 1.51 growth rate (Marissa and Katja, 2021). The current metro area population of Maiduguri in 2023 is 845,000, a 2.8% increase from 2022. The metro area population of Maiduguri in 2022 was 822,000, a 2.37% increase from 2021. The metro area population of Maiduguri in 2021 was 803,000, a 2.16% increase from 2020. This is due to provision and availability of essential services like water, electricity, education and health are also pull factors for rural populations that made them moving into the city searching for alternative forms of livelihoods. This trend indicates that population is one of the major factors of urban growth. The demographic data from the 2006 census estimates the population to be 748,123, which means Maiduguri is categorized as a 'medium' size city in the Nigerian urban. From this data above it is observed that population growth in Maiduguri was greatly expanding due administrative and economic opportunities it provided over the years. Also, this trend indicates that population is one of the major factors of urban growth. It was observed that the development of residential and commercial buildings were converted to educational use.

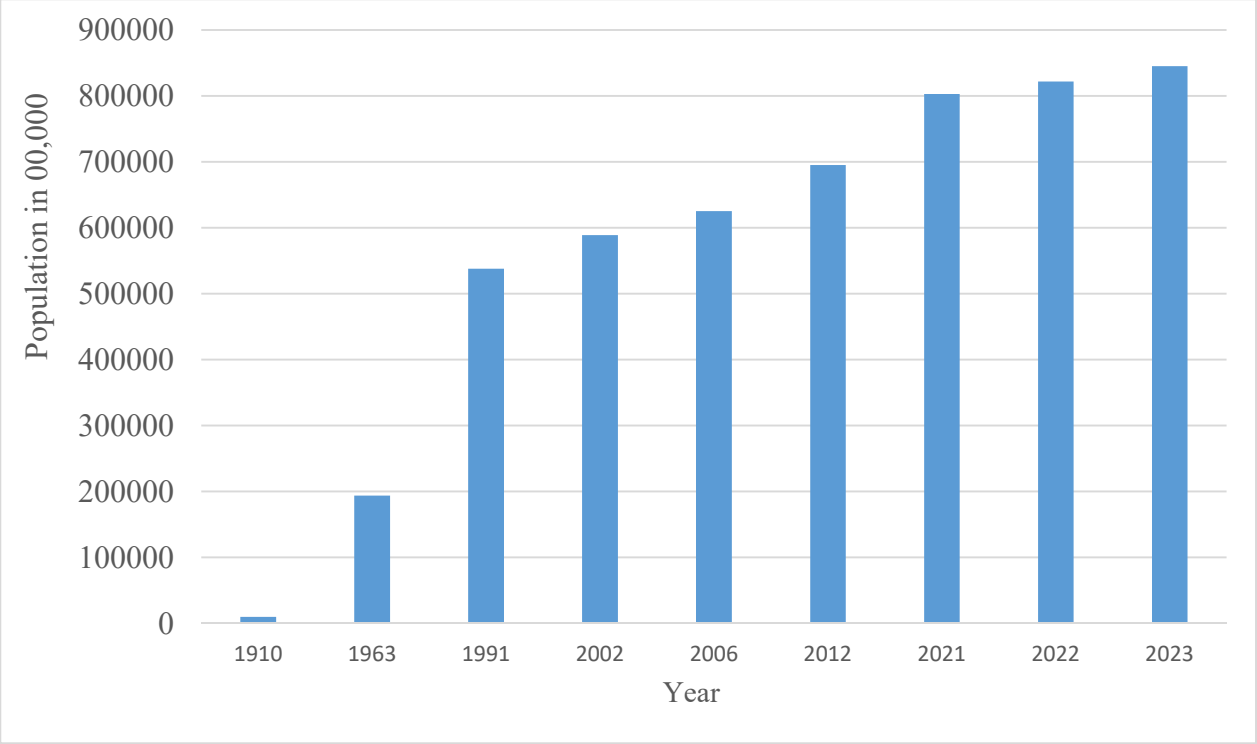

Figure 2 Trends in population change for Maiduguri

C. Impact of Urbanization on Environmental Degradation

The major cause of most environmental problems is the rapidly growing human population. From figure 2 above it can be seen clearly that population in the study area increased from 40,019 in 2006 to 301,429 in 2012 and to 545,219 in 2019. It showed that population is one of the major factors of urbanization growth. As a result, the built –up areas has tremendously increased from 73.5km2 in 1992 to 80.2km2 in 2002 and 84.89km2 in 2012 as well as 95.83km2 in 2022 respectively. As most of the residential houses were built without appropriately according to standard set down in urban Maiduguri master plan by Max-lock in 1979, hence proliferation of degraded urban environments. There are evidences every-where of rapid decline in environmental quality and human living conditions occasioned by rapid increase in human numbers. The unwise use of the natural environment due to overpopulation, urbanization and poverty amongst others has led to the degeneration of the environment. These negative impacts are referred to as environmental degeneration which implies “abuse of the environment” due to improper resources management. These impacts include:

Table 7: Respondents Perception's on the Impact of Urbanization on Environmental Degradation

Impact	Yes	No
Air Pollution	98	2
Water Contamination	95	5
Solid Waste	94	6
Flooding	82	15

Source: Author's Field work, 2023

From table 7 above, based on the responses from questionnaire about the relationship between urbanization and environmental degradation in the study area revealed 94% respondents agreed that urbanization led to generation of solid waste in the metropolis environment due to expansion of settlement as lands are turning to residential areas while 6% disagreed to that effect. Further the finding revealed 92% respondents also agreed that urbanization causes air pollution in the urban Maiduguri. This could be attributed to the utilization of various gas emission sources to meet the demands of fuel resources. However, 2% of the respondents disagreed that pollution of air in the urban environment doesn't have to do with urbanization. Disorganized urbanization of the metropolis has caused environmental damage. The spontaneous urbanization is completely without any rational planning, and this is not suitable for the development of built-up areas, leading to unequal population distribution between the urban areas. And this has made the living standards of people difficult to improve, adversely affecting the environment. The environment is polluted more and more seriously, especially the environment of air, water, and daily-life waste which has a very large volume every day and is thrown at the wrong place as discussed below:.

Poor Quality of Air from Gas Emission

The increasing population and rapid development of built-up areas has caused poor quality of ambient air in the metropolis. This is also gradually becoming a serious menace in Maiduguri especially in the metropolitan, inefficient energy combustion in the transportation system generated high levels of localized air pollution. The data from the Directorate of Motor Vehicle Administration (V.I.O) Borno State unit shows that motor vehicle emissions are one of the major sources of air pollution in urbanized areas. The total number of motor vehicles in Maiduguri metropolis showed exponential growth. By the end of 2020, there were 1,536,250 million vehicles registered in Maiduguri, compared to 2.627,500 million in 2021, and 3,492,500 in 2022 an increase of almost 1,091,250 million between 2020 and 2021 and 865,00 thousand vehicles between 2021 and 2022 respectively. Also, data from Borno State Traffic Maintenance Agency (BOTMA) shows 15,400 tri-cycles were registered in 2020 and 19,600 tricycles in 2021.These ever-increasing number of vehicles has become an important contributor to the increasing air pollution. Therefore, the increased NO2 concentration between 2020 and 2022 in the city of Maiduguri was mainly attributed to the huge increase in the number of vehicles.

Studies have shown that the concentrations of pollutants emitted directly by motor vehicles near large roadways are much higher compared to overall urban background concentrations (e.g.

Reponen *et al.,* 2003; *Kim et al.*, 2004; Baldauf *et al.,* 2008a). These higher amounts of concentrations generally occur within a few hundred meters of the road and may vary depending on the traffic patterns, environmental conditions, topography, and the presence of roadside structures (Baldauf *et al.,* 2009). These clearly shows that responses from the respondents conform to the most cited emissions from vehicle surpassed all forms of emissions from other sources. This result is consistent with responses from the respondents conform to the data obtained from Borno Transport Maintenance Agency (BOTMA) which shows a continuous increase in the number of vehicles into the study area and the quantum of such increase.

Water Contamination

Maiduguri is transverse by two rivers, Ngadda and Ngaddabul respectively. The Ngadda River being the major tributary channel is more like open sewer such that water flowing even during the long dry season due to the flow from Alau dam as well as household sewages. Sanitary facilities like sewers and toilets for home are known to be grossly inadequate and have worsened over the years due to rapid rate of urbanization Maiduguri metropolis. The lack of sanitation and sewerage systems has a dramatic impact on river Ngadda within the metropolis. From the questionnaire survey used indicates that contaminated water from this river accounted for 80% of water pollution within the communities along the river bank. The settlements at the river banks use the river channel to dispose of all their wastes from homes, and commercial businesses. Most respondents been asked affirmed to this. The overflowing toilets contaminate channel water and create a serious health risk in the urban Maiduguri. Wastewater from human settlements contains organic material and nutrients. These make the water unsafe for humans to use for many purposes including drinking and irrigation, as well as harming the fish and other animals and plants living in the water. The increasing accumulation of refuse within city forms breeding grounds for various diseases. The health hazards posed by rain water mixing with waste and percolating through porous soil are enormous, ultimately contaminating ground water which forms the prime source of drinking water for most communities. Any changes to the quality of surface water also affects groundwater because they are linked by the processes of the water cycle so pollutants from the surface will infiltrate down and contaminate soil and groundwater as well.

The solid wastes and household sewage which contaminate the water of the rivers Ngadda, making the use of the water in the streams for any purpose unfit without elaborate processing especially during the dry season when the water is at low flow. Waste disposal inside the river accounts for polluting the river water in the metropolis. The uncollected garbage goes into the river systems resulting in the clogging of waterways. This aggravates flooding in the metropolis. Children sometimes swim in these ponds, this is responsible for the reported cases of water-borne disease such as cholera as reported by Zakari (2014) and Yakubu *et al* (2016).

Solid Waste

The magnitude to which expansion of Maiduguri metropolis in some areas contributes towards degrading the environment of air, water and land, as such, declining the quality of the urban environment is demonstrated by daily anthropogenic activities in his quest for food and shelter. Settlements around Sabongari, Sabonlayi, and Fulatari in Gwange areas which settled in the flood plain of River Ngadda on daily basis dump refuse directly into the stream and now the

water is unfit for domestic consumption. This method of waste disposal has subjected the surface water and subsurface water to contamination. It has also immensely contributed to serious pollution of the Ngadda River as most of the residents choose to dispose of their excreta in the stream, and on land illustrating the life style of suburb urban.

Responses from questionnaires indicates that urban waste often ends up in illegal dumps on streets, open spaces, wastelands, drains or rivers. This is frequently a problem in peripheral urban areas, which are convenient for dumping wastes because of the availability of open space and ease of access from central urban areas. This has led to the pollution of surface waters which may be used as a source for drinking water. Sometimes the wastes are collected and taken to legalized waste disposal sites but these are not always properly managed to protect water bodies. The uncollected garbage goes into the river systems resulting in the clogging of waterways. This aggravates flooding in the metropolis. In many parts of the metropolitan Maiduguri solid waste management is lacking or inefficient. Solid waste management means the proper collection, transfer, recycling and disposal of all the solid material we throw away, including domestic garbage, plastics, paper and cardboard, food wastes, electrical waste, etc. It also includes industrial, hospital and institutional wastes which often contain pathogens as well as hazardous and toxic chemicals, which need special care.

Flooding

Integrated drainage system is lacking in some parts of Maiduguri metropolis, and where drainage network do exist as in Gwange and some parts of Maisandari areas, have been impeded by refuse and other wastes dumped into the gutters. Consequently, many areas of the metropolis and the streets in particular, become flooded during the peak rainy season. The flood events in Maiduguri Metropolis can be attributed to short but intense rainfall resulting from cumulus clouds mostly in the afternoon that generate excess runoff in gently sloping topography of the city. This coupled with anthropogenic activities such as: reduction in river channel capacity resulting from encroachment of houses, siltation from deforestation, and garbage, disappearance of small river channels, reduced infiltration due to urbanization, and loss of natural retention areas. Moreover, the drainage channels already clogged with rubbish is a major factor causing severe flooding in the metropolis. Also, water logging is a very common physio-hydrological phenomenon in Maiduguri metropolis due to relatively flat terrain in the area. Even after a minor downpour, the town experiences very disturbing water logging in its different parts. The main reason of water logging is attributed to the drainage congestion due to unplanned growth of structures and blockage of draining channels.

CONCLUSION AND RECOMMENDATION

Maiduguri metropolis a rapidly growing city is facing many environmental challenges as its urban growth rate continues to accelerate. Since Maiduguri became the state capital of northeastern states in the late 1970s, it has experienced rapid urban expansion. This phenomenon has been responsible, to a large extent, for various environmental degradations at the metropolis scale. The study concludes that the causes of urbanization which have negative effect such as traffic congestion, poor sanitary condition, proliferation of refuse dups, increase in crime, leading to poverty, overcrowding in the metropolis. Also, environmental degradation is caused by indiscriminate building of houses, indiscriminate waste disposal and exhaust gases from vehicles

as well as domestic and waste burning with such effects on residents as urban flooding, disease outbreak and increased death toll. Hence, there is a significant relationship between urbanization and environmental degradation. Hence, the study recommends the followings:

1. Enlightenment and education of people on sanitation and environmental matters the provision of facilities required for achieving good disposal systems are measures that favour preventive environmental decay.
2. It is recommended that quantifying the domestic sewage that enters into the different water bodies located in the city by government will help in planning effective sewage treatment plant and minimizing groundwater pollution by sewage.
3. The findings of the study suggest that policy makers need to create technological-friendly environment in order to overcome pollution, gradual population transfers from rural areas to urban areas is also essential, expansion of arable land or consistent utilization of existing arable land can also help to improve environment in a better way.
4. Serious attention should be given to the need for improving urban strategies, which promote efficiency in resource use. Urgent attention should be given to reduce the generation of solid waste at the sources through mandatory standards and regulation fee and tax incentives, and education and voluntary compliance. In case adequate steps are not taken to prevent pollution and to improve the quality of life by providing more social amenities, the life of the urban Maiduguri may become more miserable this may be the cause of health hazards and worst devastation.

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