

Flood Control in Kaduna South L.G.A, Kaduna State, Nigeria, Using the Ecohydrological Principles

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D.O.I: 10.56201/ijgem.v9.no5.2023.pg56.66

Abstract

This paper examined communities experiencing flooding yearly within the Kaduna South L.G.A of Kaduna State, which are; Barnawa, Down Quarters and Chanchang Layout, Kinkinaw, (Tudun Wada). The objective of the study includes; Identification of areas affected by flooding within the study area, generating records for developments affected by flooding within the study area, and stating the effects of developments and farming activities along the River Kaduna bank. The study revealed that the major cause of flooding within these communities annually during rainy season is as a result of rapid growth experienced within the Kaduna metropolis over time and lack of proper development control along the River Kaduna bank by the relevant authorities which have led to the encroachment of the River Kaduna bank. Discrete data were collected where exact number of developments and activities affected by flooding within the study area was generated and maps produced for the flood plain areas within the study area which analyses the extent of flood and total number of structures affected at each location through the use of ArcMAP and ArcGIS as tools. The study recommended that all developments along River Kaduna bank be removed. Also, the Kaduna State Geographical Information Service (KADGIS) alongside the Kaduna State Urban Planning and Development Authority (KASUPDA), should allocate a safer areas within the Kaduna South L.G.A to accommodate the entire population that will be moved from the affected areas by applying the Ecohydrological principles to maintain the Kaduna River bank.

Keywords: *Flood, Control, Echodrological Principles*

1.0 INTRODUCTION

The study examined flooding in Kaduna South Local Government Area of Kaduna State with a view to applying Ecohydrological Principles in solving the problem(s) caused by flooding within the study area. The objective of the study includes; Identification of areas affected by flooding within the study area, generating records for developments affected by flooding within the study area, and stating the effects of developments and farming activities along the River Kaduna bank. People all over the world are being confronted with the reality of climate change. For some, climate change is simply a matter of changes in weather patterns (things are a bit hotter, a bit colder, a bit more uncertain) etc. For others, it is already a matter of survival (too little water, or too much, not enough food to go around, risks to safety and security). The real injustice of climate change is that those who have contributed least to its causes are suffering most from its effects (UNEP, 2020).

According to Regional Center for Integrated River Basin Management (RCIRBM, 2023), There are two main drivers of climate change namely:

a. Natural Drivers: Due to variation of the orbital distance of the Earth from the Sun. This change is so slow that we do not easily notice (Each period lasts about 100,000 years). This leads to the cold-glacial and warm inter-glacial periods. Also Due to sun's activity which have solar cycle of 22 years.

b. Man Made Drivers (Anthropogenic):

Greenhouse gases, some land use changes, Urbanization, Aerosols, and Increase in the CO₂ predominantly due to burning fossil fuels, etc. all these activities distort ecological process which encourages environmental disasters such as flooding.

Several researchers have tried to profile solutions to this problem within the study area, for example, Ibrahim A.H, in 2016 “Flood Menace in Kaduna Metropolis, Impacts on residents”, analysed the flood plain and recommended that there should be a total removal of developments along the river bank but did not dwell on what should happen after that. No author to the best of my knowledge of critically looked at the prevention of flooding in the study area using the Ecohydrological principles.

2.0 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

A flood is an overflow of water that submerges land that is usually dry (UNEP, 2020).

Flooding may occur as an overflow of water from water bodies, such as a river, lake, or ocean, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries or it may occur due to an accumulation of rainwater on saturated ground in an aerial flood. While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, these changes in size are unlikely to be considered significant unless they flood property or drown domestic animals (UN office for Disaster Risk Reduction, 2021).

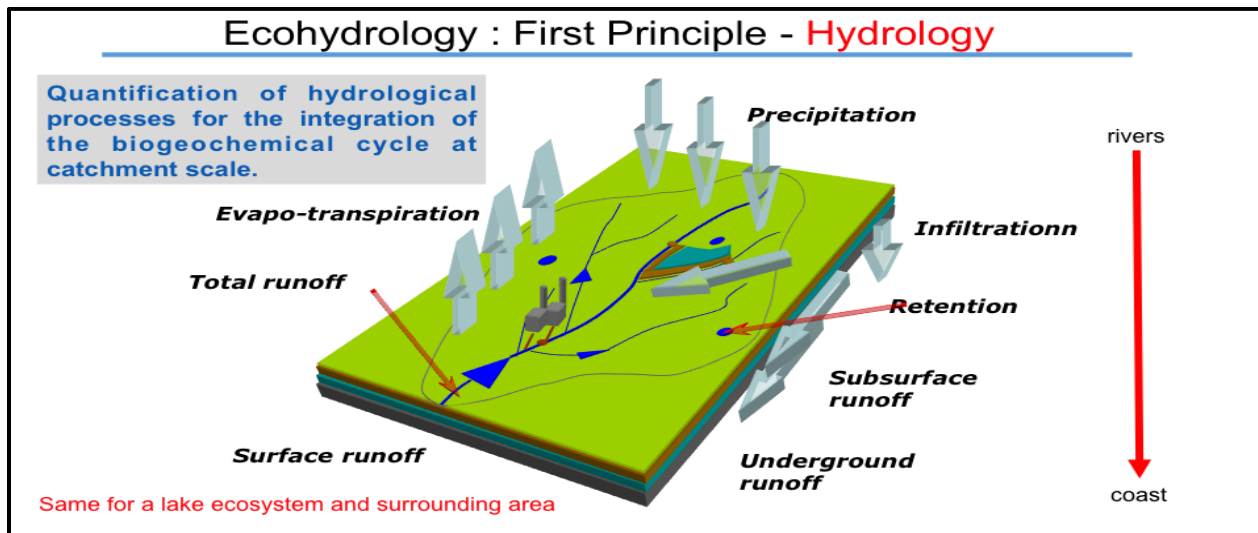
Ecohydrology (EH) is a sub-discipline of hydrology that focuses on ecological processes occurring within the hydrological cycle, and strives to utilize such processes to enhance environmental

sustainability and harmonized societal goals (Zalewski et al., 2007). It is an emerging integrative science that uses ecosystem properties as tools to meet water and related resources management goals.

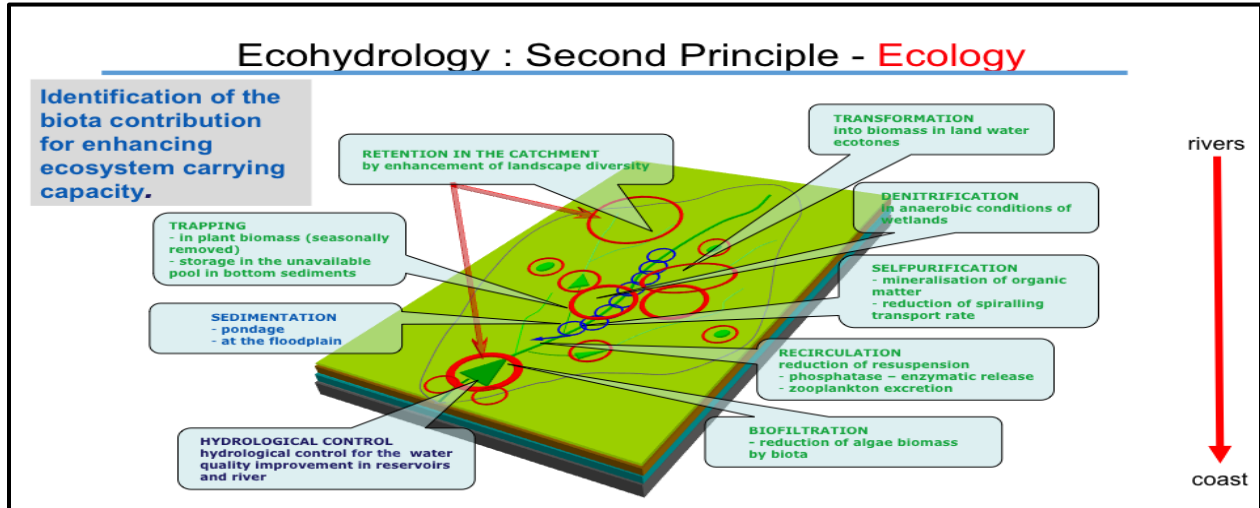
The increase in flood rate, observed at the global scale in developed and developing countries, has provided evidence that conventional approaches to water resource and flood management, based on application of engineering techniques, sectoral interventions and the elimination of direct threats such as point source of flooding, are important but not sufficient. Ecohydrology aims to find solutions that, rather than focusing exclusively on technical issues, better respond to sustainable water resource policies and promote social development with stakeholders' participation at all levels to make integrated water resource management (IWRM) successful (Garcia, 2007).

The principles of Ecohydrology as a framework for scientific investigation and problem solving are:

The Hydrological Principle: The regulation of hydrological parameters in an ecosystem or catchment can be manipulated in order to control biological processes. The quantification and integration of hydrological and biological processes at the basin scale is based on the assumption that abiotic factors are of primary importance and become stable and predictable when biotic interactions start to manifest themselves (Zalewski and Naiman, 1985).



The Ecological Principle: The shaping of the biological structure of an ecosystem(s) in a catchment can be achieved by regulating hydrological processes. The ecological principle is based on the assumption that, under intensive global changes, it is not enough to protect ecosystems against increasing human population and aspirations. It is necessary to regulate ecosystem structure and processes towards increasing their 'carrying capacity' (water quality, restoration of biodiversity, ecosystem services for society, resilience of a river ecosystem).



Source: UNEP, 2020.

The Ecotechnological Principle: Both types of regulation integrated at a catchment scale in a synergistic way can be used to achieve sustainable management of freshwater resources. The use of ecosystem properties as a management tool is based on the first and second principles of Ecohydrology. This principle features three steps of implementation:

- (a). Dual regulation' – biota shaping hydrology and, vice versa;
- (b). Integration at basin scale of various biological and hydrological regulations towards achieving synergy in order to improve water quality, biodiversity, freshwater resources and flood control.
- (c). harmonization of ecohydrological measures with necessary hydrotechnical solutions (dams, irrigation systems, sewage treatment plants, etc).

2.1 Flood Management Laws and Policies in Nigeria

Nigeria has put in place some flood management laws and policies and some of this laws and policies are examined as follows:

a. Policies

Nigeria's policy on environment was set up in November 1989 and christened National Policy on Environment. This was after the Koko Toxic Waste Dump incident of 1988 and no doubt that incident triggered the nation's desire to launch the policy. Following the emergence of new principles and concepts of international flavor in nature such as the Rio Declaration on Environment and Development together with the Rio Instruments of 1992, it became quite obvious that the Nigeria's National Policy on Environment needed a review to align with the prevailing circumstances across the globe. This idea gave rise to the revised National Policy on Environment in 1999 with the aim of factoring in those Rio concepts, principles and instruments in order for Nigeria to achieve sustainable development in the country (Okon, 2017).

The National Environmental Policy is the National Policy on Erosion, Flood Control and Coastal Zone Management which its purpose for enactment was to manage erosion, control flooding and coastal zone management, dams and reservoirs.

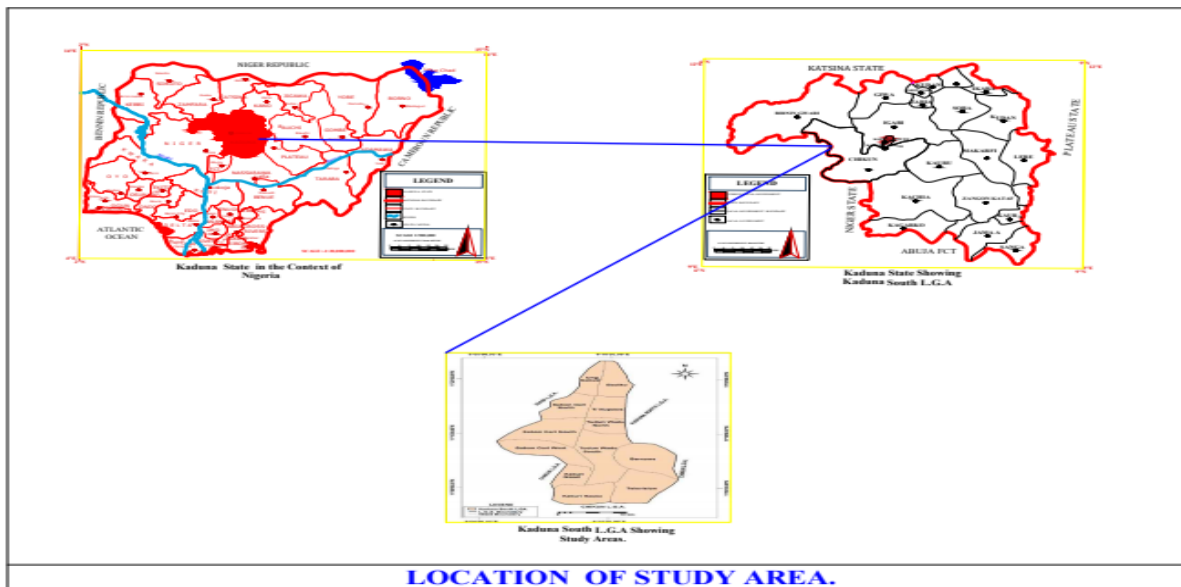
b. Laws

Following these policies, certain enactments were developed and among these laws include the National Environmental Standards and Regulations Enforcement Agency (Establishment, etc) Act. Another enactment relating to flooding is the National Emergency Management Agency (Establishment, etc) Act.

The Constitution of the Federal Republic of Nigeria as amended provides for the protection of the Nigerian environment. Flooding is an incident affecting the environment. This part of the provision in the Constitution mandates the State to protect and improve the environment and safeguard the water, air and land, forest and wild life of Nigeria (E.E. Okon, 2016).

2.1 Study Area

Kaduna South is a Local Government Area in the Kaduna Metropolis of Kaduna State, Nigeria. It falls within Latitude 10.4680 and Longitude 10.4680. It's headquarters is located in Makera. Other wards are Barnawa, Tudun Wada, Tudun Nupawa, Television, Kakuri, Ungwan Muazu, Kabala West, Sabon Gari, Badikko, Ungwan Sanusi and Kurmin Mashi. It has an area coverage of about 46.2 km² (KASUPDA, 2022).



Source: Arc Globe, 2023.

3.0 METHODOLOGY OF STUDY

The primary and secondary data collection methods were used for the purpose of accomplishing the research objectives.

The primary data was employed which involves data from field surveys. The Global Positioning System (GPS) was used in capturing of spatial data (affected developments and activities within the study area) which helped in the generation of maps and also creating a data bank for data captured. Residents within the study area were also engaged in interview to ascertain the extent of

farming activities and owners of the farms within the study area, while the secondary data were from literatures, Remote Sensing (R.S) and Geographic Information System (G.I.S) applications. The data collected were analyzed using descriptive statistics and presented using simple tables, maps and in textual forms.

4.0 RESULTS AND DISCUSSION

The following parameters are used in determining the results:

- i. Identification of areas affected by flooding within the study area.
- ii. Generating records for developments affected by flooding within the study area.
- iii. Analyzing the effect of these activities along the River Kaduna bank on the River.

Identification of Areas Affected By Flooding Within the Study Area and To What Extent.

Communities mostly affected by flood in Kaduna South Local Government Area, Kaduna State yearly are Barnawa, Down Quarters and Chanchang Layout, Kinkinau, Tudun Wada. Figure 1, 2 and 3 shows the map of these communities.

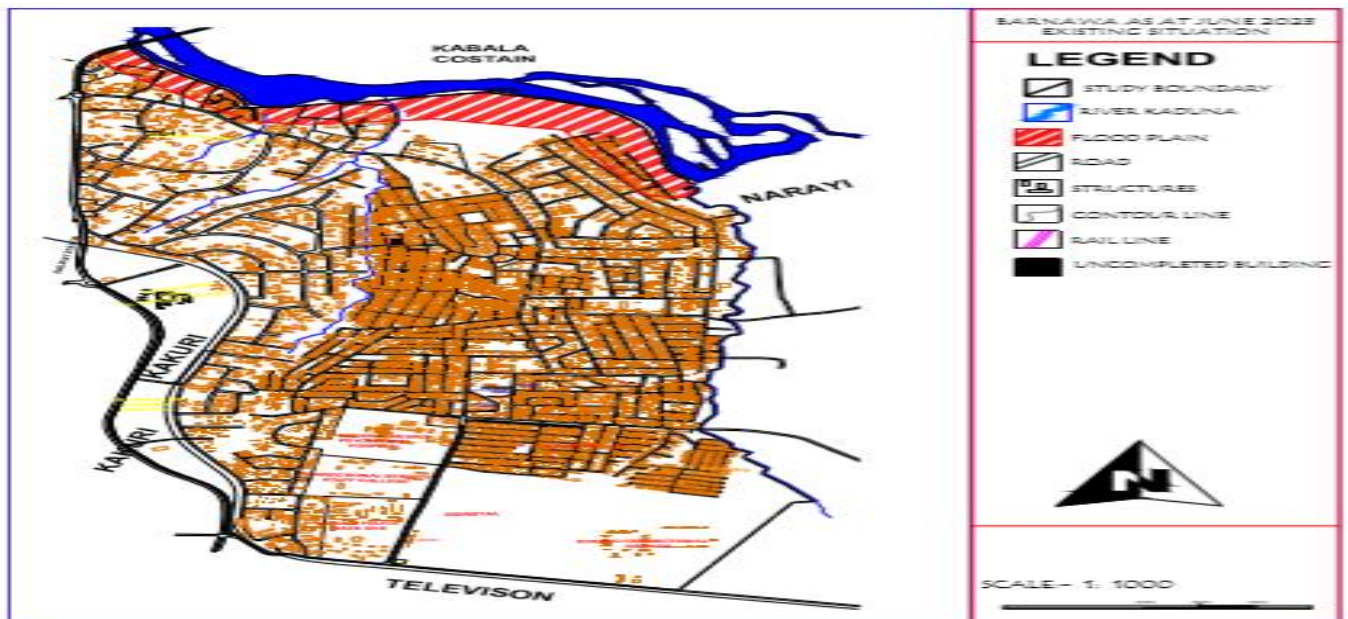


Figure 1: Existing situation of Barnawa, Kaduna South L.G.A, Kaduna State as at June, 2023.

Source: Arc MAP, 2023 and Authors Field survey.

Table 1: Developments affected in Barnawa, Kaduna South L.G.A, Kaduna State.

| LAND SE TYPE | NUMBER OF STRUCTURES | LEVEL OF DEVELOPMENTS | |
|--------------------|----------------------|-----------------------|-------------|
| | | Completed | Uncompleted |
| Residential | 103 | 94 | 9 |
| Commercial | 9 | 8 | 1 |
| Circulation | 4 | 4 | 0 |
| Public/Semi public | 2 | 2 | 2 |
| Farmland | 28 | 28 | 28 |
| TOTAL | 146 | 136 | 40 |

Source: Arc MAP, 2023 and Authors Field survey.

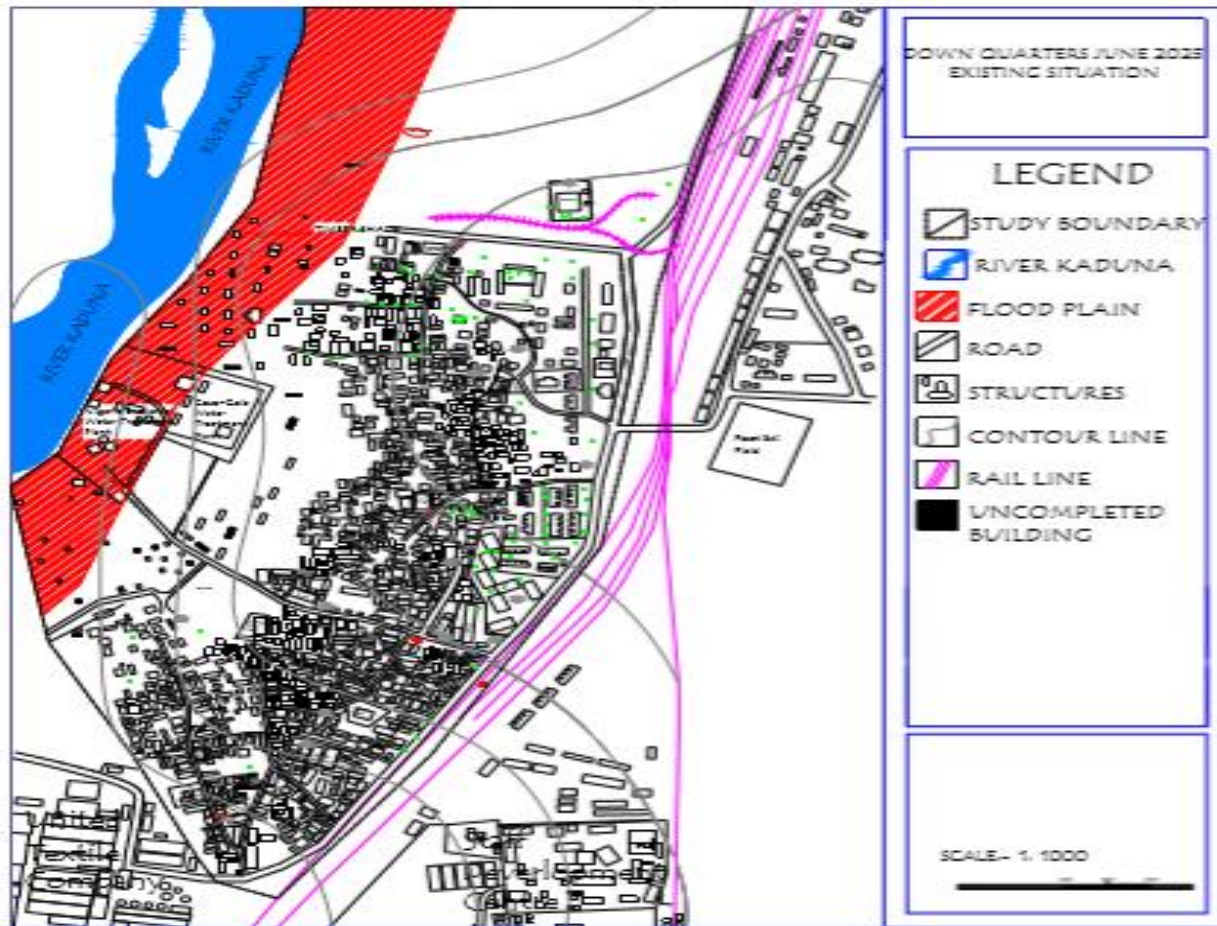


Figure 2: Existing situation of Down Quarters, Kaduna South L.G.A, Kaduna State as at June, 2023.

Source: Arc MAP, 2023 and Authors Field survey.

Table 2: Developments affected in Down Quarters, Kaduna South L.G.A, Kaduna State.

| LAND SE TYPE | NUMBER OF STRUCTURES | LEVEL OF DEV'TS | |
|--------------|----------------------|-----------------|-------------|
| | | Completed | Uncompleted |
| Residential | 36 | 28 | 8 |
| Industrial | 2 | 2 | 0 |
| Circulation | 3 | 3 | 0 |
| Farm Land | 11 | 11 | 0 |
| TOTAL | 52 | 44 | 8 |

Source: Arc MAP, 2023 and Authors Field survey.

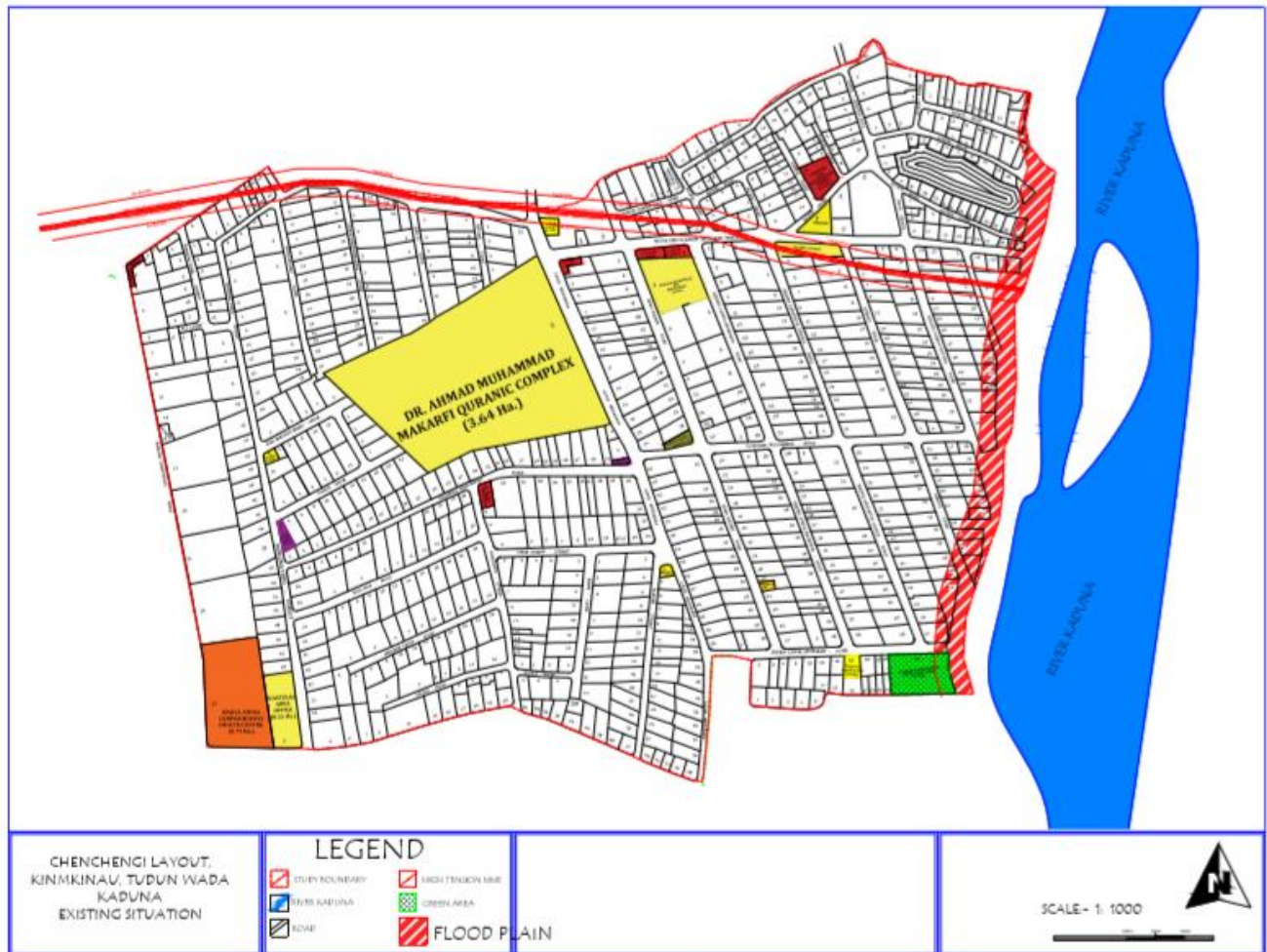


Figure 3: Existing Situation of Chenchengi Layout, Kinkinau, Kaduna South LGA, Kaduna State.

Source: KASUPDA, 2022.

Table 3: Developments affected in Chenchengi Layout, Kinkinau, Kaduna South L.G.A, Kaduna State.

| LAND SE TYPE | NUMBER OF STRUCTURES | LEVEL OF DEV`TS | |
|--------------|----------------------|-----------------|-------------|
| | | Completed | Uncompleted |
| Residential | 28 | 11 | 17 |
| Circulation | 5 | 5 | 0 |
| Farm Land | 51 | 51 | 0 |
| TOTAL | 84 | 67 | 17 |

Source: Author` field survey and Arc Globe

Generating records for developments affected by flooding within the study area.

Table 4 shows summary of various land uses affected by flood within the Kaduna South L.G.A, Kaduna State.

Table 4: Summary of Land Uses Affected by Flood within Kaduna South L.G.A, Kaduna State.

| S/N | LOCATION | COORDINATES 32N (MINNA). | TOTAL DEVELOPMENT AFFECED |
|--------------------|--------------------------|--------------------------|---------------------------|
| 1. | Barnawa | 328110.1, 1160362.7 | 146 |
| 2. | Down Quartes | 326169.5, 1160034.3 | 52 |
| 3. | Chenchengi (Tudun Wada). | 325516.6, 1160799.3 | 84 |
| GRAND TOTAL | | | 82 |

Source: Arc MAP, 2023 and Author`s field work

From field survey, using Remote Sensing/ Geographic Information System tools and oral interview, it was discovered that, 167 residential developments are affected by flood, about 23 hectares of land along the River Kaduna bank being divided among 90 farmers for farming activities, 12 access roads being covered by water during intensive rainfall, 2 industrial land use, 9 commercial development and 2 churches were being affected within the study area.

Analyzing the effect of the Development of Building and Farming activities along the River Kaduna bank on the River.

The effects of construction of buildings and farming activities along the River Kaduna River (right of way) can be categorized into;

i. Hydrological and Environmental issues: These gave room for Poor and fragmented watershed management, pollution and destruction of aquatic habitats, excessive and uncontrolled groundwater exploitation, and recurring floods within the study area.

ii. Socio-Economic issues: These has led to High and rapid growing population, Increasing urbanization, Inefficient agricultural/irrigation practices, and increasing poverty within the study area.

5.0 CONCLUSION AND RECOMMENDATION

Ecohydrology uses the understanding of relationships between hydrological and biological processes at different scales to improve water security, enhance biodiversity and further opportunities for sustainable development by lessening ecological threats and maximizing greater harmony within catchment processes. If effectively employed will go a long way in ending flooding issues within the Kaduna South Local Government Area.

It is therefore recommended that all developments / activities along the River Kaduna bank be stopped and removed. Developments and activities affected should be relocated to a safer areas within the Kaduna South Local Government Area by the Kaduna State Urban Planning and Development Authority (KASUPDA) and the Kaduna Geographic Information Service (KADGIS), thereby giving adequate room for the implementation of the Ecohydrological principles along the River Kaduna bank.

Also, it will very important that all the regulations put in place by Kaduna State Emergency Management Agency (KASEMA) be followed strictly by other regulatory bodies within the state.

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