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- ❖ The title page should contain the title of the article, name of author(s), and institution of affiliation.
- ❖ Assessment fee = N5000, Publication fee = N15, 000
- ❖ Full manuscript should be submitted as attachment to:

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TABLE OF CONTENTS

1. PERFORMANCE INCENTIVE AND THE ISSUE OF WELFARE IN HEALTH SERVICES: POSSIBILITIES AND CHALLENGES. <i>Steve Metiboba</i>	1
2. COMPARATIVE ANALYSIS OF WATER QUALITY USING PHYSICO-CHEMICAL PARAMETERS IN OFU MINI-EARTH DAM OGANAJI- ANYIGBA AND OFEJIJI DAM, DEKINA LG A. <i>Musa S.D., A, & Stmon D</i>	6
3. ADOLESCENTS' RISKY SEXUAL BEHAVIOUR: THE NEED FOR HEALTH PROMOTION INTERVENTION PROGRAMMES IN NIGERIA. <i>AdebolaOlukemi, Owoyemi, Julius & Metiboba, Steve</i>	16
4. INSTITUTIONAL QUALITY AND FDI INFLOW IN NIGERIA. <i>Sani A. I., Esseyin,F. &Maji</i>	25
5. HUMAN RESOURCES MANAGEMENT AS A CATALYST FOR ACADEMIC GROWTH AND DEVELOPMENT <i>S.S Avidime</i>	32
6. A GEOGRAPHICAL ANALYSIS OF THE EFFECTIVENESS OF DRAINAGE NETWORK ON FLOOD IN ANYIGBA, KOGI STATE, NIGERIA. <i>Ogunkolu A.B, EnecheP.S.U, Ogbole M, Oyetunji A.B. and Shaibu J</i>	40
7. APPLICATION OF GEO-INFORMATICS IN ANALYSING THE IMPLICATIONS OF LAND USE . CHANGES ON FOOD SECURITY IN ANYIGBA, KOGI STATE. <i>Ocholi, Isaac & Matthew, Audu</i>	53
8. AN EVALUATION OF PULL-PUSH FACTORS IN FAST DEVELOPING COMMUNITIES OF KOGI EAST, KOGI STATE, NIGERIA. <i>Tokula A. E & Abalaka, L. D</i>	65

9.	UTILIZATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES FOR ECONOMIC-EMPOWERMENT AMONG YOUTHS IN LOKOJA 'METROPOLIS, KOGI STATE. <i>James Dada Mohammed, Anderson A. Unwuchola & Abba Issa Auwalu</i>	73
10.	PATTERN OF FAMILY PLANNING UTILISATION IN ID AH TOWN, KOGI STATE, NIGERIA. <i>Moses Monday Moses Ogbale, Omanyo Lilian Ochijenu</i>	82
11.	PERCEIVED CHANGING NORMS, OCCUPATIONAL STATUS AND ATTITUDE TOWARDS CORRUPT PRACTICES IN SELECTED LAW ENFORCEMENT AGENCIES KWARA STATE. <i>Aina M Joseph, Fagbamila D.Olumide, Adojo Emmanuel Abode</i>	94
12.	SOCIO-DEMOGRAPHIC CORRELATES OF UNPLANNED PREGNANCY AMONG WOMEN OF REPRODUCTIVE AGE IN DEKINA LOCAL GOVERNMENT AREA OF KOGI STATE- NIGERIA. <i>Venatus .V. Blkisu A Musa</i>	100
13.	PATTERNS OF SOIL EROSION IN KOGI STATE UNIVERSITY ANYIGBA, KOGI STATE. <i>Kekere, A. A, Jimoh. & Abubakar, U.T</i>	107
14.	INFLUENCE OF SOCIAL MEDIA ON YOUTH PERCEPTION OF IGALA CORE VALUES. <i>Ogwo, Comfort Ajuma</i>	116
15.	INTERNET PORNOGRAPHY AND THE SEXUAL BEHAVIOUR OF KOGI STATE UNIVERSITY STUDENTS. <i>Mohammed Shaibu Onakpa</i>	125
16.	A REVIEW OF POVERTY ALLEVIATION STRATEGIES AMONG RURAL FARMING HOUSEHOLDS IN NIGERIA. <i>Awarun Olabode & Opeyemi Gbenga</i>	132
17.	ASSESSMENT OF SPATIAL DISTRIBUTION OF EDUCATIONAL FACILITIES IN KABBA TOWN, KOGI STATE. <i>Balogun G. Ahmed, A. & Williams, O.J</i>	141
18.	IMPACT OF INTEREST RATE LIBERALIZATION ON INVESTMENT IN NIGERIA. <i>Hitlar Inedu</i>	148

19. HEALTH CARE EXPENDITURE AND NATIONAL PRODUCTIVITY IN NIGERIA: AN EMPIRICAL INVESTIGATION. <i>Alehile, Kehinde Samuel & Yusuf, Alih</i>	158
20. AN ANALYSIS OF THE INFLUENCE OF LOCUS OF CONTROL ON WORKPLACE DISHONEST BEHAVIOUR AMONG CORPORATE ORGANISATIONS IN IBADAN, NIGERIA, <i>Thaddeus Umoru</i>	167
21. MALE CHILD PREFERENCE AND ATTITUDE OF MOTHERS TOWARDS CHILD SPACING IN RURAL KANO, NIGERIA. <i>Maimuna Bintu Hussain, Fagbamila David Olumide & Aina, M. Joseph</i>	179
22. CORRUPTION AND LEADERSHIP CRISIS IN NIGERIA: IMPLICATIONS FOR NATIONAL DEVELOPMENT. <i>Omale Theophilus Ocholi & Agagwu Samuel S</i>	189
23. INFLUENCE OF THE NEW MEDIA ON SERVICE DELIVERY OF ACADEMIC STAFF OF UNIVERSITIES IN EDO STATE, NIGERIA. <i>Ottah. G. Alhassan & Agbo, Chioma Charity</i>	197
24. IMPACT OF PUBLIC RELATIONS AND MEDIA RELATIONS IN BENUE STATE. <i>Fidelia Otebe & Artum Victoria</i>	207
25. ANALYSIS OF THE EFFECTS OF COMMUNITY DEVELOPMENT ASSOCIATIONS (CDAs) ON RURAL INFRASTRUCTURAL DEVELOPMENT IN DEKINA LGA, KOGI STATE. <i>Idakwoji, M.L. & Simon D</i>	221
26. RETHINKING INTERNATIONAL MILITARY ALLIANCE AND THE WAR AGAINST BOKO HARAM INSURGENCY IN NIGERIA. 2013-2018 <i>Sekpe, Sheneni Samuel & Joseph orih Innocent</i>	230
27. EFFECTS OF CORRUPTION CRISIS ON GOOD GOVERNANCE AND NATIONAL DEVELOPMENT IN NIGERIA. <i>Patrick Ukwumonu Okeme, Olumorin, M. Olukemi & Isyak, I. Ogrima</i>	243

BOOK REVIEW

28. CAPITALISM AND MODERN SOCIAL THEORY: AN ANALYSIS OF THE WRITINGS OF MARX, DURKHEIM AND MAX WEBER BY ANTHONY GIDDENS (LOW PRICE EDITION, CAMBRIDGE, CAMBRIDGE UNIVERSITY PRESS, 1997)

Ajibade David.....250

A GEOGRAPHICAL ANALYSIS OF THE EFFECTIVENESS OF DRAINAGE NETWORK ON FLOOD IN ANYIGBA, KOGI STATE NIGERIA

¹Ogunkolu A.B, ¹Eneche P.S.U ²Ogbole M, ²Oyetunji A.B ¹Shaibu J

¹Department of Geography and Environmental Studies,
Faculty of Social Sciences,

Kogi State University Anyigba, Kogi, Nigeria

²Department of Geography, Faculty of Arts and Social Sciences, Nigeria
Defence Academy

Abstract

The study examined the effectiveness of drainage networks on floods in Anyigba, Kogi state, Nigeria. The specific objectives included; to examine the frequency and intensity of flood, evaluate the geometry of selected drainage channels, determine of the relationship between drainage width and depths on floods and determine the effect of flooding on the people within the study area. The dumping of wastes in the drainage channels has led to the rapid increase in flood incidences in Anyigba as the available drainage channels cannot contend with the volume of storm water. In view of this, the study established gauging stations for the measurement of drainage run off using measuring tape and copies of questionnaire were administered to 400 households purposively to the four areas (Ogana-aji, Abuja area, Eti Aja area and kaduna-efekpe area), the results from the findings were subjected to statistical analysis using SPSS version 20.00 for descriptive and inferential statistics tools to give an assessment and understanding of the variables. The results from the findings revealed that 74.1% of the respondents agreed that drainage network in the study area are inadequate, 22.9% agreed that government negligence is the major cause of inadequate drainage in the study area. The study further revealed that 32.7% agreed that erosional activities cause distortion in the beauty of the environment while 51% of the respondents are of the view that drainage system in the study area are not well designed. The study concluded that building on storm water drainages, poor physical planning, inadequate drainage channels, heavy rainfall, dumping of waste on drainage networks and nature of the terrain are the major factors responsible for poor drainage network in the study area. The study therefore recommended that proper planning of the area is needed and also building on drainage channels should be avoided.

Keywords: Drainage Networks, Drainage Channels. Flood Incidences. Physical Planning and Terrain

Introduction

Flooding activities especially in developing countries such as Nigeria have caused people to be displaced from their natural harbours, lead to loss of lives and properties worth millions of naira, loss of agricultural lands and product and as well as famine and hunger in areas affected. Poor planning by government and policy makers, vulnerability of urban population to flooding events due to high disregard to developmental plan are most likely the contributory factors. Flood usually occur due to heavy rainfall on flat surfaces, reservoir failures and are usually based on factors such as rainfall, topography of the soil, inadequate flood control measures, river overflow, tidal surge and improper planning before building and development on flood plain areas.

Major disasters affecting many countries of the world today is due to flooding, which occurs annually especially in most flood plain areas. According to Ifatimehin and Musa (2009) the effects of these floods are always devastating, properties are lost, human and animal lives are endangered too. Other effects like outbreak of diseases such as malaria and cholera also comes to play.

Flooding is a natural disaster that happens due to man-made impact on the Environment, flooding has been identified as a major factor that prevent Nigeria growing population of city dwellers from escaping poverty and stands in one way of united goals of achieving significant improvement in the lives of urban slum dwellers, Action Aid, (2006) and Ndoma (2006). In most Nigeria cities, poor drainage systems or networks causes a lot of environmental problems leading to loss of lives and properties to people living where drainage system are non-functional. It is alarming seriously in events of flood across Africa. Natural disasters may not be controlled by humans but can be managed or reduce their effects by adopting

appropriate planning and management system.

As population increases, it brings along with it a lot of developmental challenges such as demographic trends for employment, water supply, shelter and sanitation especially (liquid, electronic and solid waste) (UNCED, 1992). Therefore, urbanization is believed to be connected with level of development in terms of industrialization and economic growth (Tettey, 2005). One major challenge facing Nigeria today is the level of physical planning of infrastructure and its management of her urban areas. Thus, as urbanization gathered pace in most cities in Nigeria, the challenge of infrastructural services and deteriorating urban centers became enormous (Sule 2009) and this is in line with Arimah (2002), where he noted that poor housing conditions, poor drainage network, inadequate infrastructural development, squatter settlement are issues that always arise from urbanization.

Flooding has been a major challenge to residents of Anyigba and its environs due to heavy rainfall, the nature of topography as well as the poor drainage system within the community. Therefore, appropriate and adequate knowledge of drainage network within the study area will be key to maintain a viable economic and development growth as well as healthy living.

A lot of studies have been carried out on flooding and its adverse effects. For instance, Arimah I (2002), Aderamo (2008), Afangideh, Ekpe and Offkmg (2012) all examined the implication of changing rainfall pattern on building laws and IfPHMS of flood incidence at different times and Kjimtkms. However, none of these studies measured the dimension of drainages and their DM* to flood events, it is in this note that the study

seeks to determine the frequency and intensity' of floods, evaluate the geometry of selected drainage, determine the effects

of flooding within the study area and the effect of width and depth of drainage on floods within the study area.

The mean annual rainfall ranges between 250mm - 1600mm.

Study Area

Anyigba is a town in Dekina Local Government Area of Kogi State, Nigeria. The town is located between Latitude $7^{\circ}27' - 7^{\circ}31'N$ and between Longitude $7^{\circ}09' - 7^{\circ}12'E$ (See Figure 1) Anyigba is situated in the eastern limb of Udi plateau. It has a gently undulating landscape to a flat and minimum rugged landform surface with an average elevation of 380m above sea-level. Anyigba is underlain by sedimentary rocks of upper Cretaceous Age which is mainly made up shale, sandstone, sand, and clays. The whole region consists of deeply weathered regolith which accounts for the great depth of water table (aquifer) which in most cases approaches 204 - 300m (Iji, 2007). The drainage of the area is not very complex. Anyigba does not contain a well-developed valley formation which contributes to the absence of many rivers in the area. The rivers flow from the base of the highlands to the surrounding lowlands. Among the few rivers that are found in the area are Ogane-aji River in the Northern part of the town and Abu-uja Lake at Ojofu covering an area of about 400m² (Iji, 2007). Other rivers around Anyigba area are Imabolo River, Ofu River and Okura River, they are mostly perennial but with a reduction in volume during the dry season (Iji, 2007). Anyigba is located within the tropical area, thus the climate is governed by the processes that controls the tropical climate. However, it can be described as tropical wet and dry (Aw) climate using the Koppen's classification system. The wet season spreads over a minimum of seven months and it extends from late April to October with the dry season spanning from November to March, i.e. an approximate of five months. Rainfall is highly seasonal and the area enjoys double maxima rainfall with July and September being the rainiest months.



Figure 1: Anyigba the Study Area

Source: Department of Geography, Kogi State University Anyigba (2019)

The soil of Anyigba is of the laterite type with lateritic iron pan layer. It is red-yellowish in colour due to excess oxides (sesquioxides) on the surface. The soils are highly weathered with soil texture of medium to coarse type (Iji, 2007). Anyigba is located within the southern guinea savannah and the vegetation can best be described as a tropical woodland savannah. Because of the absence of (continuous) heavy rainfall, Anyigba is dominantly made up of green shrubs, trees and short to tall grasses averaging about 1.6 to 2 meters in height.

Methodology

A Reconnaissance survey of Anyigba was undertaken to identify areas with poor drainage system, from the survey the study identified areas that are often flooded whenever it rains. The reconnaissance assisted in the determination of suitable location for the establishment of the measurement points. At the end, a distinct area with well-defined boundaries was identified. Therefore, as result of poor drainage system, flooding locations were identified which includes ogane aji, abuja area, kaduna efekpe, eti aja. Questionnaires were administered to residents of the areas in accordance with the guide outline in the procedure for data collection. Therefore, the data required for this study include; Data on the socioeconomic characteristics of the respondent, data on flood frequency and intensity, Data on drainage characteristic, data on width and depth (by direct measurement), data on the causes of flooding within the area and data on effects of flood on the environment. The data were sourced from both primary and secondary sources. A random sampling technique was used in the administration of questionnaire on household heads per housing units, selected the streets of the sample residential districts. Random sampling techniques involves the picking of members of a sample at a predetermined regular space/time interval. Apparently, the first element is picked randomly from the first

five house to determine the starting point of questionnaire administration, and others are then picked at regular interval predetermined by the research (every ten houses). This way every relevant household must given a chance of been picked and non repeated. The copy of questionnaire were distributed purposively within the study area and such in Abuja and

Eti Aja Area 105 copies of questionnaires were distributed each while in Oganeaji and Kaduna Efuekpe Area 95 copies of questionnaires were distributed each making a total of 400 copies of questionnaire using Yamane formular of sample size determination. The dimension of the drainage were measured directly from the field with a measuring steel tape and the volume of flood water was measured using stop watch method (Velocity of flow). Seven areas were purposively sampled. Along a given street a number of measured point were established along the drainage paths. The values obtained were further subjected to statistical analysis to determine depth to width ratio.

Discuss Results

Frequency and Intensity of Flood within the study area

Area

Table 1 shows that out 95% respondents presenting ogane-aji, 86% agreed on that they experience flooding in recent times while 9% did not, out of 101 % respondents representing Eti-aja, 40% agreed that they experience flooding in recent times while 61% did not, out of 105% respondents representing Abuja area, 52% agreed that they experience flooding in recent times while 53% did not, out of 87% respondents representing kaduna-efekpe, 64% agreed on that they experience flooding in recent times while 23% did not. The findings from the study is in line with Ishaya, Ifatimehin and Obaje (2009) where they noted in many part of the world flood seems to be

occurring more often and seems to increasing in size. Human activities, however, sometimes exacerbate them. The state of the drainage (with regard to the prevalence of the flood incident can not be overemphasize because of the poor observant of frequent flooding in the area. It was observed that most of the building especially the illegal structures are built either on the drainage channel path or too close to the drainage.

This is a common feature in almost ail the sampled am More so, it was observed that during rainfall streets like Ogana-Aji area are often strewed with all kinds of waste including human excreta. The presence of human excreta on streets pose" serious health hazards to the people around these areas.

In general, during heavy rainfall which usually leads to flooding of low land areas because the waste dumped along the drainage channels obstruct the flee flow of storm water. The drainage channels cannot therefore accommodate the flow of the fast running storm water hence it spills into streets and houses (Sule, 2009). Flood incidence is further compounded by the fact that most buildings were built right within and in the right of way of storm water as indicated by majority of the respondents who confirmed that building on drainage channels was another factor that often leads to flooding in their neighborhood and other people interviewed attributed flooding to other factors.

The respective views on the quality of die drainages across the sampled areas clearly points to the fact that the drainages are in poor state. Plate 2 is an evidence of what one can easily find in most of the streets in the sampled area. As the plate indicates, the persistent rain couple with the poor materials and engineering works has made these gutters to look like rabbit holes.

Table 1: Experience of Flooding Recently within the Study Area

	Yes	No	Total
Ogane Aji	86(90.5%)	9(9.5%)	95(100%)
Eti Aia	40(39.6%)	61(60.4%)	101(100,0%)
Abuja Area	52(49.5%)	53(50.5%)	105(100,0%)
Kaduna Efekpe	64(73.6%)	23(26.4%)	87(100.0%)
Total	242(62.4%)	146(37.6%)	388(100,0%)

Authors Field Survey (2019)

The findings of this study was earlier corroborated elsewhere by Ab*|e and Oiwa (2007) who in their study reported that the increasing frequency of flood goes beyond heavy rainfall as urbanization rate and poor land use planning are the main precursors to flood episodes in most Nigerian cities.

	Severally	when it rains	uncountable times	many times	Total
ogane aji	17(17.9%)	40(42.1%)	19(20.0%)	19(20.0%)	93(100.0%)
eti aja	16(15.8%)	54(53.5%)	17(16.8%)	14(13.9%)	101(1000%)—
abuja area	28(26.7%)	47(44.8%)	18(17.1%)	12(11.4%)	105(1000%)
kaduna efekpe	17(19.5%)	39(44.8%)	17(19.5%)	14(16.1%)	87(100.0%)
Total	78(20.1%)	180(46.4%)	71(18.3%)	59(15.2%)	388(100.0%!
Chi-Square -7.983 ¹ df=9 p~ 536					

Authors Field Survey (2019)

Table 2 shows that out 95 respondents in ogane-aji area, 17% agreed that they experience flooding severally, 40% agreed that they experience flooding when it rains, 19% agreed on uncountable times, and 19% agreed on many times they experience flooding last year. These findings are in line with the work of Taiwo (2008) where they observed that residents of Makurdi were thrown out of their residences and their farmlands left impoverished after two days of heavy down pour of rainfall. It was described as veiy disastrous, He also reported in this day (August 18) that at least five hundred people were rendered

homeless and properties worth several millions of Naira were destroyed when the flood, occasioned by torrential rainfall ravaged Babura, a town in Jigawa State in a period of two days. 101 respondents representing Eti-aja, 16% agreed on that they experience flooding severally, 54% agreed on when it rains, 17% agreed on uncountable times, and 14% agreed on many times. 105 respondents representing Abuja area, 28% agreed on that they experience flooding severally, 47% agreed on when it rains, 18% agreed on uncountable times, and 12% agreed on many times. 87% respondents representing Kaduna-

efekpe , 17% agreed on that they experience flooding severally, 39% agreed on when it rains, 17% agreed

the respondents in Abuja area have experienced flooding last year. These respective views point by the

on uncountable times, and 14% agreed on many times. This shows that majority of

respondents to the high incidence of flood in Aiiyigba can be traced largely to nonconformity to land use.

Table 3: Effects of Flood on Lives and Properties within the Study Area

	loss of properties	loss of properties	loss of lives	distortion of the beauty of the environment	blockage of road	Total
Ogane Aji	9(9.5%)	50(52.6%)	9(9.5%)	10(10.5%)	17(17.9%)	95(100.0%)
Eti Aja	23(22.8%)	0(0.0%)	1(1.0%)	42(41.6%)	35(34.7%)	101(100.0%)
Abuja Area	24(22.9%)	3(2.9%)	1(1.0%)	47(44.8%)	30(28.6%)	1050
Kaduna	21(24.1%)	5(5.7%)	1(1.1%)	28(32.2%)	32(36.8%)	87(100.0%)
Efereke	77(19.8%)	58(14.9%)	12(3.1%)	127(32.7%)	114(29.4%)	388(100.0%)
Total						

Authors Field Survey (2019)

TALBE 3 farther revealed that out of 95 respondents representing Ogané 9.5% agreed on that the HUmatation of the effects of flood on lives and properties are loss of properties, 52.6% agreed on SK \$£ Nves and properties, 9.5% agreed on loss of lives, 10.5 % agreed on distortion of the beauty Of the environment, 17.5% agreed on blockage of HH| 101 respondents in Eti-Aja area representing It.1% agreed that the effects of flood is on properties, 1% agreed on loss of lives,42.6% agreed on distortion of the beauty of the environment, 34.7% agreed on blockage of fOt&105 respondents representing Abuja area H.1H agreed on that the estimation of the effects of flood on lives and properties are loss of properties, 2.9 % agreed on loss of lives and properties, 1% agreed on loss of lives,44.8% agreed on distortion of the beauty of the environment, 28.6 % agreed on blockage of road, ,101 respondents representing Kaduna Efekepe , 21% agreed on that the estimation of the effects of flood on lives and properties are loss of properties, 5% agreed on loss of lives and properties, 1% agreed on loss of lives,28% agreed on distortion of the beauty of the environment, 32% agreed on blockage of road. This is in line with Adedeji (2012) where he observed that similarly that flooding is a phenomenon that sometimes has devastating effects on human livelihoods.

Geometry of Selected Drainage Channels within the Study Area

Table 4 presents the geometry of the drainage channels and runoff estimation in the study area as observed and measured. The drains consist majorly of channels with open trenches, which are rectangular in shape with concrete lining and some without concrete lining and but only a few was covered; however, most of the drainage channels in the interior of the city are left open. It can be seen from table 4 that the drainages are characterized by different dimensions. For example, the width of the drainage channels ranges from 2.53-0.3m and the total mean width of the drainage channels is 1.3m. For the depth of the drainage channels, it ranged from 2.0-0.2m with a total mean depth of the measured drainage channels been 1.3m. Similarly, the range of runoff 2.0-0.6m.

Area.

Table 4: Evaluation of the Geometry in the Study

Ogane-Agi									
	lat	Minutes	seconds	Long					
point 1	7	31	7.5	7					
point 2	7	31	7.6	7					
point 3	7	31	4.43	7					
Eti^Aja									
	lat			Long	10	44.34	width	Depth	
point 1	7	30	34.6	7	10	44.26	0.3	0.2	0.2
point 2	7	30	36.19	7	10		0.3.1	0.3	0.3
point 3	7	30	35	7	minutes	Seconds	width	Depth	Run off
					10	19.2	2.5	2.1	2.0
					10	18.6	0.8	0.7	0.7
					10	13.1	0.7	0.7	0.6
Kaduna Efekepe									
	lat			Long	10	22.55	2.49	2	2
point 1	7	29	44.95	7	10	30.97	2.47	1.9	1.9
point 2	7	29	47.75	7	10	23.5	2.5	2	2
point 3	7	29	46.8	7					
Abuja Area									
				Long					
	17	29	20.63	7					
	17	29	26.41	7					
	17	29	24.1	7					

Source: Authors Survey (2019)

On the relationship existing among the three variables drainage width, depth and runoff volume, it is clear that drainages that are wide tend to contain larger volume of runoff, but this was not consistent across the sampled drainages. Little variations were recorded in some areas. According to plate 1 sediment, stones, pebbles and refuse dumps on water ways may contribute to the shallowness of the drainage and render such drainage ineffective. From the study, it was shown that the drainage dimensions vary from one study zone to another. However, the general observation is that of the sampled zones are narrow as exemplified by frequency flood episodes. Jimoh (2008) made a similar observation in a study of drainage dimension in Ilorin Nigeria. In the study it was reported about 31.5% of the respondents were of the view that one of the effects of drainage channel problem is the incidence of temporary street flooding. In addition, in a study by Daniel et.al, (2012) in Gombe also observed that 42.5% of the respondents agreed that lack of drainage facilities constitutes the major factor that « causing flood in Gombe.

Plate 1: Drainage Network in Ogani-aji, Source: Authors Fieldwork (2019)

In the study sites, it was evidenced that the drainages were not wide and deep enough to contend with the high volume of water that pass through them hence the regular incidences of floods. This was particularly observed in areas like ogana-Aji, Abuja area and Eti Aja where even after days of heavy rainfall stagnant water can still be seen on the area.

Environmental State of Drainage Networks on Flood within the Study Area

Table 5 shows that out of 95 respondents representing Ogane-Aji, 9% agreed on that the quality of drainage is very narrow, 9% agreed on not well designed, 0% agreed on not plastered, 19% agreed on highly fractured, 101 respondents representing Eti-Aja, 2% agreed that the quality of drainage is very narrow. 47% agreed on not well designed, 7% agreed on not plastered, 14% agreed on highly fractured, and 9% agreed on not present at all 22% agreed on others.



105 respondents representing Abuja area, 1% agreed that the quality of drainage is very narrow 44% agreed on not well designed, 3% agreed on not plastered, 15% agreed on highly fractured, and 28% agreed on not present at all 14% agreed on others. 87 respondents representing Kaduna Efekpe , 5% agreed on that the quality of drainage is very narrow 40% agreed on not well designed, 2% agreed on not plastered, 25% agreed on highly fractured, and 3% agreed on not present at all 12% agreed on others. This is in line with Arimah (2002), where he noted that poor housing conditions, poor drainage network, inadequate infrastructural development, squatter settlement are issues that always arise from urbanization.

Table 5: Quality of drainage network within the study area

	very narrow	not well designed	not well plastered	highly fractured	not present at all	others(specify)	Tota
Ogan	9(9.5%)	67(70.5%)	0(0.0%)	19(20.0%)	0(0.0%)	0(0.0%)	95(100.0%)
aji	2(2.0%)	47(46.5%)	7(6.9%)	14(13.9%)	9(8.9%)	22(21.8%)	101(100.0%)
Abuja	1(1.0%)	44(41.9%)	3(2.9%)	15(14.3%)	28(26.7%)	14(13.3%)	105(100.0%)
Kaduna	5(5.7%)	40(46.0%)	2(2.3%)	25(28.7%)	3(3.4%)	12(13.8%)	87(100.0%)
efekpe	17(4.4%)	198(51.0%)	12(3.1%)				388(100.0%)

Authors Field Survey (2019)

Table 6 shows that out 95 respondents representing ogane-Aji, 9% agreed that they have adequate drainage while 86% did not, out of 101 respondents representing Eti-Aja, 28% agreed that they have adequate drainage while 73% did not, out of 105% respondents representing Abuja area, 40% agreed that they have adequate drainage while 65% did not, out of 87% respondents representing kaduna-efekpe23% agreed that they have adequate drainage while 64% did not. This is in line with Aderamo (2008) were he observed that poor waste

disposal technique, developmental problems, river channels encroachment and cultural belief are major causes of street flooding in most Nigerian cities. In fact, waste management among most residents is rather too poor. Refuse and other wastes are usually dumped into available open spaces, including drainage channels and river plains and valleys. This practice has led to the blockage of the drainage channels at various points.

Table 6 Adequate drainage networks within the study area

			Total
	Yes	no	
Ogane aji	9(9.5%)	86(90.5%)	95(100.0%)
Eti aja	28(27.7%)	73(72.3%)	101(100.0%)
Abuja area	40(38.1%)	65(61.9%)	105(100.0%)
Kaduna Efekpe	23(26.4%)	64(73.6%)	87(100.0%)
i	100(25.8%)	288(74.2%)	388(100.0%)

Source Authors Survey (2019)

Table 7 shows that out of 95 of respondents representing Ogun-Aji, 30% agreed that the cause of this inadequate drainage networks is government negligence, 9% agreed that the cause of this inadequate drainage networks is inadequate funding, 4% agreed that the cause of this inadequate drainage is low level of technical knowhow, 10% agreed that the cause of this inadequate drainage network is poor monitoring and evaluation, and 8% agreed that the cause of this inadequate drainage networks is lack of information and communications on the state of drainage facilities. 34% agreed that the cause of this inadequate drainage networks is all of the above. 101 respondents representing Eti-Oja, 27% agreed that the cause of this inadequate drainage networks is government negligence, 8% agreed that the cause of this inadequate drainage networks is inadequate funding, 19% agreed on low level of technical knowhow, 23% agreed on poor monitoring and evaluation, and 12% agreed on lack of information and communications on the state of drainage facilities. 12% agreed on all of the above. In general, during heavy rainfall which agreed on inadequate funding, 13% agreed on low level of technical knowhow, 15% agreed on poor monitoring and evaluation and 21% agreed on lack of information and communication and the state of drainage facility. 23% agreed on all the above. 87% of respondents representing Kaduna State, 15% agreed on government negligence, 9% agreed on inadequate

funding, 5% agreed on low level of technical knowhow, 15% agreed on poor monitoring and evaluation, 4% agreed on lack of information and communications on the state of drainage facilities. 2% agreed on all of the above. This is in line with Sule (2000) where he noted that the major challenge facing Nigeria today is the level of physical planning of infrastructure and the management of her urban areas. Thus, as urbanization gathered pace in most cities in Nigeria, the challenge of infrastructural services and deteriorating urban centers became enormous,

Table 7: Cause of Inadequate networking within the study area

Table 7: Cause of inadequate drainage networks within the study area							"Total
	! oriiWTi irrrwarair - * is V1 JUHuSfUrUMU	IlOfe ZkSOkL ki »<t	low level of technical	poor %* momtonn g and	lack of information and communications on	all of the above	
Ogane Aii	30(31.6%)	9(9.5%)	•M-2S)	10(10.5%)	8(8.4%)	34(35.8%)	95(100%)
Eti Aja	27(26.7%)	8(7-9%)	19(18.8%)	23(22.8%)	12(11.9%)	12(11.9%)	101(100%)
Abuja Area	17(16.2%)	16(15.2%)	13(12.4%)	15(14.3%)	21(20.0%)	23(21.9%)	105(100.01%)
Kadu na	15(17.2%)	9(103%)	5(5.7%)	15(173%)	14(16.1%)	29(33.3%)	87(100.0%)
	89(22.9%)	42(10.8%)	5	1	55(14.2%)	98(25.3%)	388(100%)

Chi-Square = 4.504* df=15 p<0.000

Authors Field Survey (2019)

Table 6 show's tits out of 95 of respondents representing Ogane-Aji, 43% agreed on that the main causes of poor drainage systems in streets is poor drainage connectivity, 9% agreed on the drainages are not wide enough 0% agreed on heavy rain and 23% agreed on ail of the above 0%agreed oo others. Jim oh (2008) made a similar observation in a study of drainage dimension in Ilorin Nigeria. In the study it was reported about 31.5% of the respondents were of the view that one of the effects of drainage channel problem is the incidence of temporary street flooding 101 respondents representing Eti-Aja, 16% agreed on that the main causes of poor drainage systems in streets is poor drainage connectivity, 10% agreed on use of substandard materials for construction 23% agreed on the drainages are not wide enough 13% agreed on heavy rain and 2%

agreed on all of the above 0%agreed on others.. 105% of respondents representing Abuja area 20% agreed that the main causes of poor drainage systems in streets is poor drainage connectivity, 11% agreed on use of substandard materials for construction 8% agreed on the drainages are not wide enough 26% agreed on heavy rain and 14% agreed on all of the above. 87% of respondents representing Kaduna Efekepe, 28% agreed that the main causes of poor drainage systems in streets is poor drainage connectivity, 4% agreed on use of substandard materials for construction 11% agreed on the drainages are not wide enough 9% agreed on heavy rain and 15%. This is in line with Babatolu; (1997) where he noted that, excessively heavy and prolonged rainfall is the commonest universal cause of flood.

Table 8: Cause of poor drainage system within the study area

	poor drainage connectivity	use of substandard materials for construction	the drainages are not wide enough	heavy rain	all of the above	Total
Ogane Aji	43(45.3%)	0(0.0%)	9(9.5%)	0(0.0%)	23(24.2%)	95(100.0%)
EtiAia	16(15.8%)	10(9.9%)	23(22.8%)	13(12.9%)	2(2.0%)	101(100.0%)
Abuja Area	20(19.0%)	11(10.5%)	8(7.6%)	26(24.8%)	14(13.3%)	105(100)
Kaduna Efekepe	28(32.2%)	4(4.6%)	11(12.6%)	9(10.3%)	15(17.2%)	87(100.0%)
	107(27.6%)	25(6.4%)	51(13.1%)	48(12.4%)	54(13.9%)	388(100.0%)

Source: Authors survey (2019)

Table 9 shows that out of 95 of respondents representing Ogane-Aji, 49% agreed that the environmental effects of poor drainage systems in streets is flooding 4% and 42% agreed on all of the above, 101% of respondents representing Eti- Aja, 29% agreed on that the environmental effects of poor drainage systems in streets is flooding 38% erosion 5% agreed on the silting of streams 11% distortion of the beauty of the environment and 18% agreed on all of the above 0% agreed on others, 105% of respondents representing Abuja area 15% agreed on that the environmental effects of poor drainage systems in streets is flooding 40% erosion 12% agreed on the silting of streams 15% distortion of the beauty of the environment and 22% agreed on all of the above 1% agreed on others. 101% of respondents representing Kaduna Efekpe, 40% agreed that the environmental effects of poor drainage systems in streets is flooding 11% erosion 2% agreed on the silting of streams 3% distortion of the beauty of the environment and 39% agreed on all of the above. This is in line with Taiwo (2008) where he noted that at least five hundred people were rendered homeless and properties worth several millions of Naira were destroyed when the flood, occasioned by torrential rainfall ravaged Babura, a town in Jigawa State in a period of two days. Daniel et.al, (2012) in Gombe also observed that 42.5% of the respondents agreed that lack of drainage facilities constitutes the major factor that is causing flood in Gombe.

This study further revealed that factors of flood occurrence in the sampled area is linked to building on water channels, poor physical planning, inadequate drainage channels, heavy rainfall, nature of terrain, dumping of refuse on drainage channels. However, different weighted responses were given in the respective factors of flood occurrence. Other factors like poor planning, inadequate drainage channels, heavy rainfall, nature of terrain, dumping of refuse on drainage channels, only aided the incidence of flooding in tropical urban

areas of Nigeria. This has been confirmed by several studies (Abam 2006; Etuonovbe, 2011; Aderogba 2012). It is therefore important that in the construction of drainages the authority should take note of the fact that Anyigba is located within the tropics characterized by prolong and intense rainfall to avert or reduce flood events that has become a recurrent decimal in today. However, in a study by Ole (2013) in Bombay India, floods were observed to be mainly caused by inadequate existing drainage paths and their improper operation and maintenance.

Plate 2: Drainage Network in Ogana Aji
Source: Authors Field Survey (2019)

Table 10 shows that out of 95 of respondents representing Ogane-Aji, 73% agreed that Building setback from the river plain is 1-10m 6% agreed on 1 1-20m, 8% agreed on 20-30m, 4% agreed on 31-40m, 4% agreed on 40m above, 101 respondents representing Eti-Aja, 8% agreed that Building setback from the river plain is 1-10m 39% agreed on 1 1-20m, 22% agreed on 20-30m, 14% agreed on 31-40m, 18% agreed on 40m above, 105 of respondents representing Abuja area. 3% agreed on that Building setback from the river plain is 1-10m 21% agreed on 11-20m, 22% agreed on 21-30m, 22% agreed on 31-40m, 37% agreed on 40m above, 101% of respondents representing Kaduna Efekpe, 15% agreed on that Building setback from the river plain is 1-10m 9% agreed on 11-20m, 12% agreed on 21-30m, 25% agreed on 31-40m, 26% agreed on 40m above this is in line with Jimoh and Alao (2009) where they noted that the high amount of sediment yield is directly related to the amount, duration and intensity of rainfall, as well as stream discharge, which often increases the river water level and finally causes flooding in die basin area in Ilorin. All too often, drains and culverts cannot cope and localized flash flooding occurs. These flash floods happen suddenly, with little lead time for warning; they are fast-moving and generally violent, resulting in threat to life

and severe damage to property and infrastructure; and they are generally small in scale with regard to area of impact.

Table 10: Building setback from the river plain within the study area

Meter	1m-10m	11m-20m	21m-30m	31m-40m	41m and above	Total
Ogane Aji	73(76.8%)	6(6.3%)	8(8.4%)	4(4.2%)	4(4.2%)	95(100.0%)
Eti Aja	8(7.9%)	39(38.6%)	22(21.8%)	14(13.9%)	18(17.8%)	101(100.0%)
Abuja Area	3(2.9%)	21(20.0%)	22(21.0%)	22(21.0%)	37(35.2%)	105(100.0%)
Kaduna Efeke	15(17.2%)	9(10.3%)	12(13.8%)	25(28.7%)	26(29.9%)	87(100.0%)
Total	99(25.5%)	75(19.3%)	64(16.5%)	65(16.8%)	85(21.9%)	388(100.0%)

Source: Authors Field Survey (2019)

Table 11 shows there is a significant and direct relationship between the width and depth of the drainages in the study area, ($r = 0.896$, $p < 0.05$). There is therefore a positive and significant relationship between the width and the depth imply that a successful increase in the depth of the drainages will lead to a corresponding increase in the

width of the drainages across the study area. The study revealed that places with wider drainage network have less flood problem when compare to areas with smaller width and depth. Even when we have a wider drainage, sediments and people's attitudes towards management of drainage network are poor and may contribute significantly to blockage of drainage in the study area.

Table 11: Correlation between the width and the depth of drainage

		Width	depth
Width	Pearson Correlation	1	0.896**
	Sig. (2-tailed)		0.000
	N	12	12
Depth	Pearson Correlation	0.896**	1
	Sig. (2-tailed)	0.000	
	N	12	12
**. Correlation is significant at the 0.01 level (2-tailed).			

Source: Authors Computation (2019)

Conclusion and Recommendation Waste management among most residents is rather too poor. Refuse and other wastes are usually dumped into available open spaces, including drainage channels and river plains and valleys. This practice has led to the blockage of the drainage channels at various points which could account for the various households interviewed agreeing that flooding is usually a product of such blockages. Many properties have been destroyed, lives lost and this has subjected the people to unquantifiable trauma. Flood increase as a result of incipient and prolong weather conditions. This study shows that flood has impacted on both social and economic activities in the study area in a number of ways including displacement of families, migration of people, poor health condition, loss of lives and properties, loss of farmlands, loss of income, loss of household and structural properties, destruction of infrastructure like roads. Many factors were identified as being responsible for flood occurrence. Some of them include building on storm water drainages, poor physical planning, inadequate drainage channels, heavy rainfall, dumping of waste on drainage networks and nature of the terrain. This flood causing factors have created series of environmental and socioeconomic problems in Anyigba. Some of which include flooding of streets, loss of life, pollution of domestic water sources, distortion of the beauty of the environment, prevented from going out among others. The study therefore recommended that Building without plan approval in every part of Anyigba should be unacceptable. In fact, all structures built on drainage right of way should be demolished to reduce the carnage caused by flood and Government should contract a competent company for the construction of underground drainages covering the entire Anyigba as surface drainages have created many problems to the resident including the loss of lives, the present drainage systems should be cleared with shove on regular basis to allow for the

free flow of storm water. The study further recommended that refuse dump and other wastes should not be dump on drainage network.

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