
THE USE OF GEODATA AND QUANTITATIVE METHOD IN MEASURING THE EFFECTS OF FLOODING FROM DRAINAGE SYSTEM OUTFALLS ON THE SURROUNDING ENVIRONMENT IN BIRNIN KEBBI, KEBBI STATE

*Uwaezuoke Ifeanyichukwu Christian & Emenari Udochukwu .S

Department of Surveying and Geoinformatics
Waziri Umaru Federal Polytechnic, Birnin kebbi, Kebbi State

Email: bholakhan.apj@gmail.com

* Corresponding author

ABSTRACT

This research commences by definition flooding and drainage system outfall and reviewing literatures that are related to this work. A two way approach was adopted which entails, using geographic data and quantitative method to capture the response of respondent. A Topographic Survey was carried out by first conducting a reconnaissance survey which include office and field procedure. The instrument used was a Promark 3 Global Positioning System receivers and its accessory. The instrument was use in demarcating the boundaries of the drainage system outfalls and its surroundings in Bayankara and Tudum Wada areas. Other features determined on the terrain are drainage, buildings, trees and the likes. Also, the spot heights and were distributed so as to measure the socio economic effects of flooding within Birnin Kebbi out of which 393 were retrieved. However, special focus was place within the contours were randomly collected on the site using the receiver. The data obtained were process to calculate the area covered by the field work which is 12.95 hectare. A plan was produced showing a three dimensional wireframe and surface of the area by using AutoCAD 2007 and Carlson Civil 2008 software's for plotting of the boundary, details and spot heights while Surfer 10 software was use in plotting the contour. In quantitative method, a total of 402 questionnaires drainage system outfall why the distribution was done. The analysis done revealed that the effects of flooding are huge causing tremendous environmental impact. The Topographic survey carried out and plan produced shows that the occupants within the drainage system outfall are leaving in front of the outfall causing flooding whenever it rains. Conclusion and recommendation were giving and are tailored at advising the government on possible ways in which some of the challenges noticed from the responses of questionnaires can be managed.

Keywords: Flood, Drainage, Environment, Outfall, Topographic Survey

INTRODUCTION

Floods by nature are complex events caused by a range of human vulnerabilities, inappropriate development planning and climate variability. Generally it is attributed to global warming, climate change ocean swell/surge and torrential rains .Although floods are natural phenomena damage and loss from floods are mostly the consequences of urbanization without corresponding infrastructural restriction. Flooding from the international perceptive can be seen as an event that has catastrophically impacted on the lives and properties of citizen of various countries. Base on the statistics of Ministry of Civil Affairs of China from 2008.1.1 - 2010.9.23

there are over 4046 natural disaster and flooding are 1613 which is about 40%. Jing L I (2010). Not to mention the amount of money that will be expended on rehabilitating the quantum of infrastructural destructed, as result of this natural disaster. Another bad incident of flooding that occurred in the South China of 1998 took over four months in which twenty million people were heavily disrupted in their socio economic lives, thousands of inhabitants died and caused a physical loss and damage which was estimated to be twenty billion US Dollars Dano U.L et al. (2011). Similarly, in the United State of America floods is categorize as one of the second most common and widespread of all natural disasters killing about 225 people and damaging property worth \$3.5 billion in heavy rain and flood each year.

Likewise the flooding in Sukuiso, Japan on March 11, 2011, which occurred as a result of a magnitude-9 earthquake, shook the Northeastern Japan, unleashing a savage tsunami. Residents are still recovering from the disaster. Radioactive water was recently discovered leaking from the Fukushima Daiichi Nuclear Power Plant, which suffered a level 7 nuclear meltdown after the tsunami. Japan relies on nuclear power, and many of the country's nuclear reactors remain closed because of stricter seismic safety standards since the earthquake. Two years after the quake, about 300,000 people who lost their homes were still living in temporary housing, the Japanese government said. (<http://www.livescience.com/39110-japan-2011-earthquake-tsunami-facts.html>). This situation of disaster, though caused by a natural phenomenon of great magnitude, yet, this flooding it has caused great pains in the lives of people killing, displacing and destroying families. The continent of Africa has had its own share of flood as a review of change impacts on urbanization by the International Institute of Environmental and Development found that floods are already having severe impacts on cities, smaller urban centers and rural areas in many African Nations. Examples cited include floods in Mozambique in 2000, heavy rains in East Africa in 2002 that brought floods and mudslides and forced tens of thousands to leave their homes in Rwanda, Kenya, Burundi, Tanzania and Uganda. Dabara I.D et al. (2014).

In Nigeria, the situation is not different as Flooding is becoming an increasingly severe and more frequent problem. Unfortunately, the impact is more felt by the urban poor in such a way that recovery is unlikely to be achieved without external aid. In other words, urban poor are most vulnerable to impact of flood because they set up homes in the floodplains. Flooding is one of the most dreadful hazards that are likely to increase in many regions of the world partly due to global climate change and poor governance. Agbonkhese, O et al. (2014). To really emphasis on the impact of flood, the Osun Defender, (2012) states that the

great flood reduced Nigeria's crude oil production drastically by 500,000 barrel of oil per day (bpd) in the Niger Delta. Nwilo P .C et al. (2013). The common and recurrent phenomenon of flooding in Nigeria occurs on a regular perennial basis in some parts of the nation. However according to NEST (1991), the following geographical areas suffer from the hazard more than others in Nigeria:

- (1). Low-lying areas in the southern parts of the nation where annual rainfall is very heavy.
 - (2). The Niger Delta zone
 - (3). The floodplains of the larger rivers of the Niger, Benue, Taraba, Sokoto, Hadeja, Cross River, Imo, Anambra, Ogun, Kaduna etc.
 - (4). Flat low-lying areas around and to the south of Lake Chad which may be flooded during, and for a few weeks after the rain. Agbonkhese, O et al. (2014).
- Additionally, On August 26, 2011, the city of Ibadan the capital of Oyo state witnessed a torrential rainfall of immense proportions. The flood that it occasioned, according to the Red Cross, left about 102 people dead with about 1,500 others displaced. Many suffered injuries and property worth billions of naira were lost.



Plate 1.1-Victim of flooding in Ibadan: Source from Agbonkhese, O et al. (2014), *Flood Menace in Nigeria: Impacts, Remedial and Management Strategies*, Vol. 6, No.4, www.iiste.org

While this could be said to be a brief impact of flooding in Nigeria, it is important to add at this point that the capital of Kebbi State, Birnin Kebbi, which this research is focus on have its own share of the effects of flood. The areas mostly affected by the flood within Birnin kebbi metropolis include: Fati Lami Section of Sir Yahaya specialist Hospital, Rafin Atiku, Badariya, Adamu Aliero Quarters, Shiyar Sarakuna, Bayan Kara, Tudun Wada and Gesse phase one, with only Bayan Kara and Tudun Wada areas having a drainage system outfall. The National Emergency Management Agency, (NEMA) has been providing rapid relief materials worth millions of naira to the affected victims, even when the Government has admonish the residents of Bayan Kara, Tudun Wada and those living around the water ways for refusal to evacuate the area, following the flood that ravaged the state as a result of a heavy downpour that lasted for several hours. (<http://www.dailytrust.com.ng/daily/environment/32146-kebbi-flood-wazirin-gwandu-to-head-25-man-committee>)



Plates 1.2 showing 2014 flooding in Bayan Kara Residential area and Government house in Birnin Kebbi.

The result of the estimated flooded areas in Birnin Kebbi 2012 reveals that fadama agriculture (47.41%) and farmland (40.37%) are more affected by the flood. The impact of the flood is low on the settlement with only 0.12% being flooded. This is because the fadama agriculture areas and farmland are on lower elevation while the settlements are located on a higher elevation.

The Use of Geodata and Quantitative Method in Measuring the Effects of Flooding from Drainage System Outfalls on the Surrounding Environment in Birnin Kebbi, Kebbi State

Table showing estimated flood areas in birnin kebbi. Sourced from Analysis of Flood Risk Inundation Hazard in Birnin Kebbi Town, Kebbi State, Nigeria

LandUse/Land Cover	AREA (HA)	PERCENTAGE
WETLAND	49.94131558	1.988478836
SHRUBLAND	252.8545734	10.06773574
SETTLEMENT	3.228265093	0.128537599
ROCK	0.786584915	0.031318908
FARMLAND	1014.014174	40.37430121
FADAMA		
AGRICULTURE	1190.708765	47.40962771
TOTAL	2511.533675	100

Sourced from: Mohammed N.B in International Journal of Geomatics and Geosciences Volume 5, No 1, 2014.

If this is the describe as the effects of flooding in Birnin Kebbi, Kebbi State one maybe compel to ask what role are the drainage system outfall network playing in managing with the water flow within the city where they are available. An outfall is the discharge point of a waste stream into a body of water; alternatively it may be the outlet of a river, drain or a sewer where it discharges into the sea, a lake why a drainage system in urban and industrial areas, a facility to dispose of liquid waste. Below are plates showing the locations of drainage system outfalls in Birnin Kebbi metropolis;





Plater.3- Showing Drainage System Outfall in Bayankara and Tundu Wada

With this said, it is part of this research work to ascertain whether this drainage system outfall are serving the need for which they were constructed.

STATEMENT OF PROBLEM

In recent years the huge impacts of floods, which include river floods, flashfloods, and drainage system outfall locations has caused tremendous destruction of infrastructure, disruption of economic activities, increase in health related illness cause by the location of the outfall and the loss of properties worth of huge amount of money. In United State alone, an average of 225 is killed and more than \$3.5billion in property is damaged by heavy rainfall and flooding each year (<http://www.fema.gov/library>). However, Kebbi State according to National Emergency Management Agency (NEMA) and Red Cross (2012) report has a total number of 45,000 displace people ever since the beginning of flooding which adversely affected twelve local government areas of which Birnin Kebbi is one of them. Birnin Kebbi witness heavy flooding also in 2012, 2013 and 2014 which was as a result of heavy rainfall, haphazardly arranged building and non availability of functional drainage systems and outfalls. These flooding caused serious damage to both lives and properties. These and many other reasons and challenges has necessitated on why the researcher has decided to embark on this research so as to measure through scientific means the effect of flooding and drainage system out fall on the surrounding environment in Birnin Kebbi, Kebbi State, put forward its findings and proffer solutions

AIM AND OBJECTIVE

The aim of this study is to indicate through scientific means the effect of flooding and drainage system outfalls on the surrounding environment in Birnin Kebbi, Kebbi State. The specific objectives are;

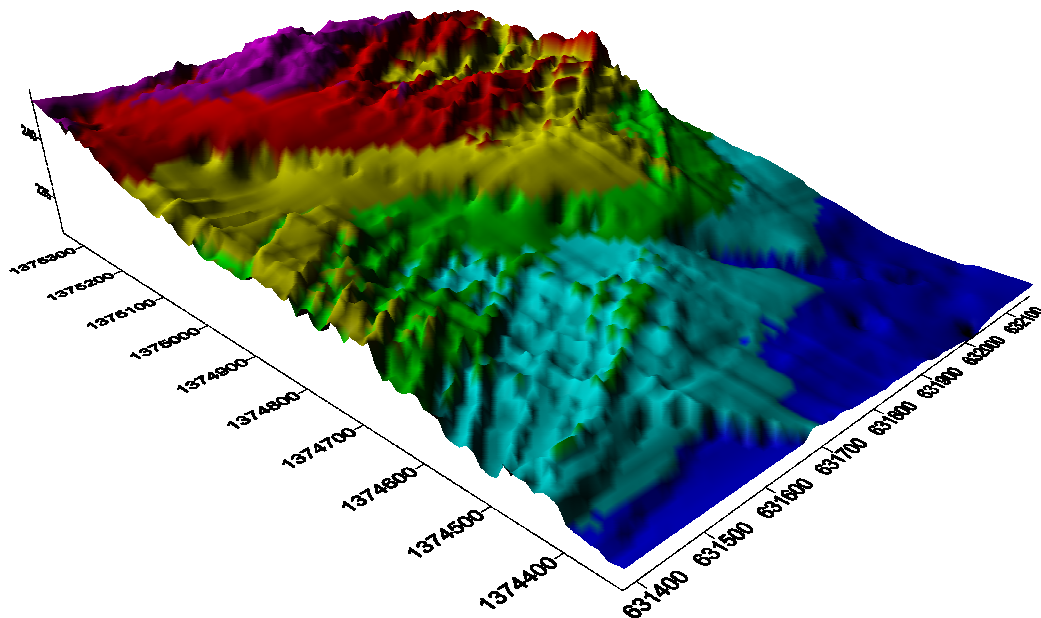
1. To review literatures involving the effects of flood effects of flooding and drainage system out fall on the surrounding environment
2. To distribute questionnaires and to carry out reconnaissance survey within the project areas that will guide in the execution of the study.
3. To carry out topographic survey of Bayan kara and TudunWada drainage system outfall using Promark 3 Global Positioning System (GPS) receivers
4. To collect and analysis the questionnaires distributed
5. To produce an accurate and Topographic plan of the Project area that will help to interpret the nature of the surrounding environment within the drainage system outfalls.
6. To make conclusions and recommendations base on Topographic survey and the analysis made from the questionnaires distributed to the respondents. .

STUDY AREA

Birnin kebbi, Kebbi State is a city located in North-western Nigeria and was created from former Sokoto State in 1991 is located between latitude of 10° N to 13° N and longitude 3° E to 6° E. It shares boundaries with Sokoto, Niger and Zamfara state and falls in Zone 31 and 32. It is the capital city of Kebbi State and headquarters of the Gwandu Emirate. As of 2007 the city has an estimated population of 125,594. Formerly it was the capital of the Kebbi Emirate, which relocated to Argungu after the conquest by Gwandu in 1831. However, Hausa is the major spoken language likewise Islam is the dominant religion. Agriculture is the main occupation of the zone especially in the area of subsistence farming and animal husbandry. In this research work, before the data acquisition procedure was initialed, a questionnaire was painstakingly prepared by researching or making reference to already researched works on effect of flooding from drainage system out fall on the surrounding environment in Birnin Kebbi, Kebbi State where they exist and other similar related topics. With this idea, a questionnaire was organized to suit the purpose of this study. In addition to this, a topographic survey was carried out in Bayan kara and Tudun Wada. Covering an area of about 12950.005m^2 (12.95 hectare). The former area is located opposite to the central market while the later is at the back of old prisons.

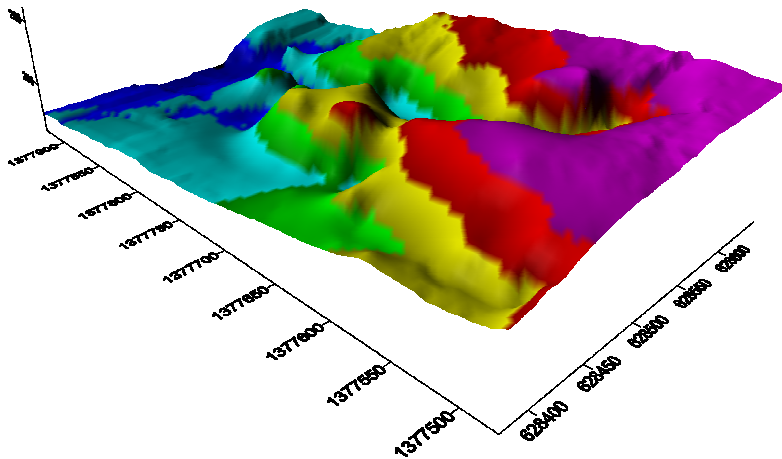
METHOD OF DATA ACQUISITION USING PROMAK 3 DIFFERENTIAL GLOBAL POSITIONING SYSTEM

In other to carry out the topographic survey, some basic principles of survey procedures were followed such as; carrying out reconnaissance, insitu check before observations are done. In addition, the differential GPS was use in demarcating the Boundary within the drainage system outfall, then, features such as Buildings, Drainage systems where applicable and a host of other topographic features were obtained. The contours or spot heights were obtained by randomly using the differential G.P.S to take the ground points. Below are the products of the Topographic Survey (3D Surface and 3D wireframe) 1st for Bayanka on page 7 and Tudun Wada on page 8);

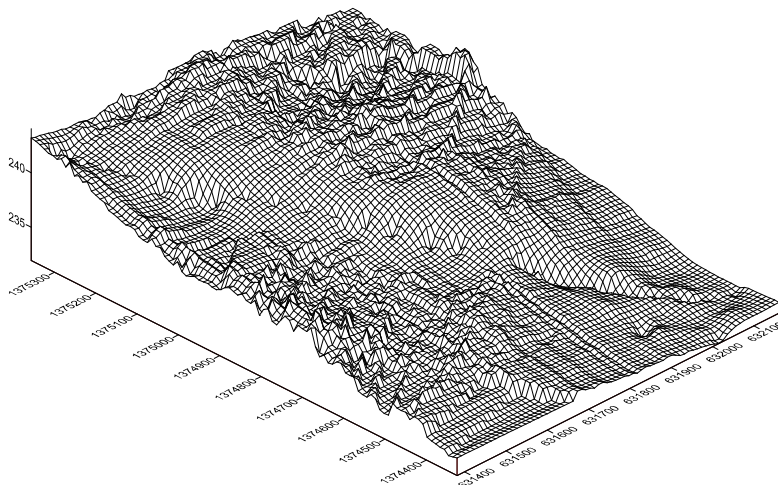


Three Dimensional Surface for Bayankara Area

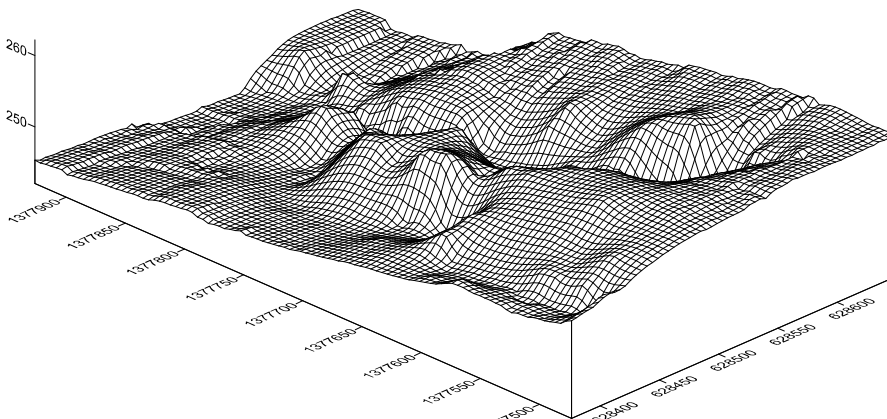
The Use of Geodata and Quantitative Method in Measuring the Effects of Flooding from Drainage System Outfalls on the Surrounding Environment in Birnin Kebbi, Kebbi State



Three Dimensional Wireframe for Bayankara Area



Three Dimensional Surface for Tudun Wada Area.



Three Dimensional Wireframe for Tudun Wada Area

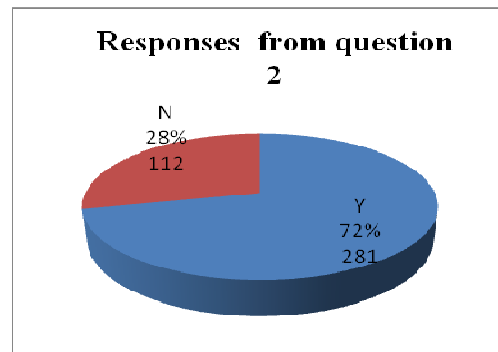
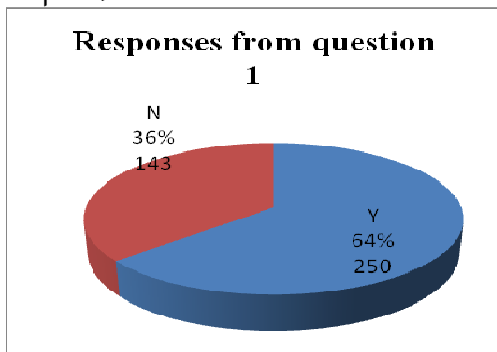
DATA ACQUISITION PROCEDURE WITH THE USE OF THE QUESTIONNAIRES

In measuring the socio economical impart of this research work, Simple random sampling method was use to distribute a total number of 402 (four hundred and two questionnaires). The numbers of questionnaires to be distributed were arrived at with the aid of a sample size calculator obtain via Creative Research Systems. (<http://www.surveysystem.com/sscalc.htm>).

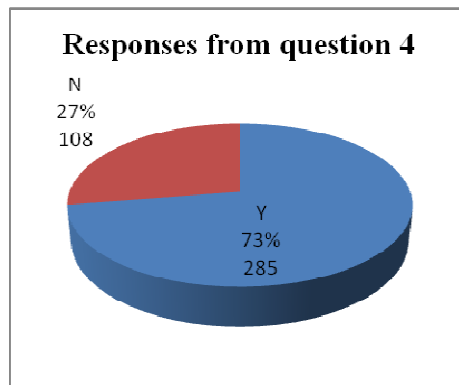
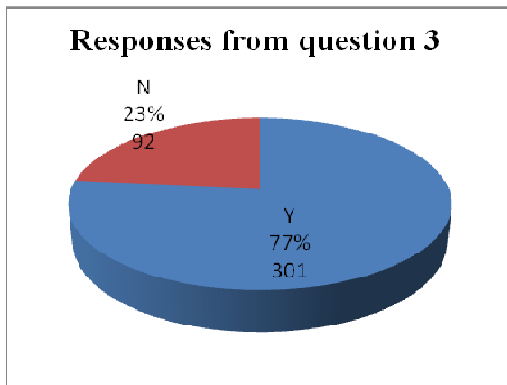
A total of 402 questionnaires were distributed, out of which 393 (three hundred and ninety three) were retrieved which represent 97.761% and 2.238% not retrieved which is 9 (nine).

DATA ANALYSIS FOR QUESTIONNAIRES DITRIBUTED

The following are the socio economic analysis of responses obtained from the respondents.

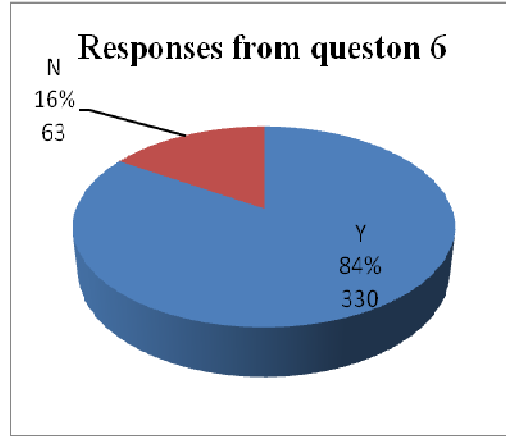
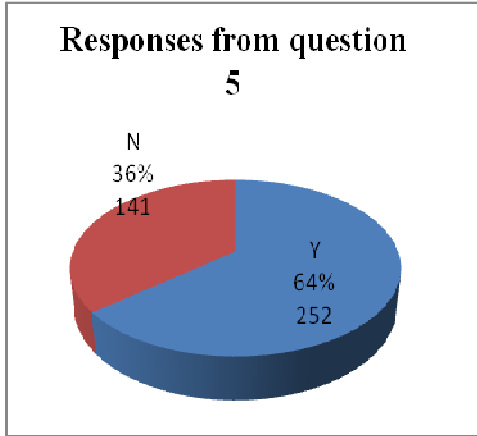


The responses of pie chat of question one and two above, indicates that 64% of the respondents live in flood prone areas while 72% saying that flooding and drainage causes disaster in their area.

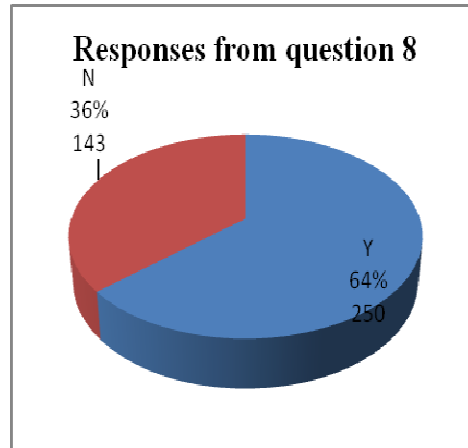
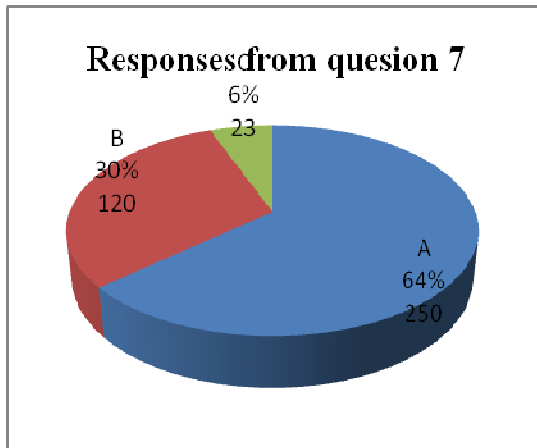


From the responses of question 3 and 4, 77% and 73% respectively says that flooding affects their building and causes destruction and also affect their environment during

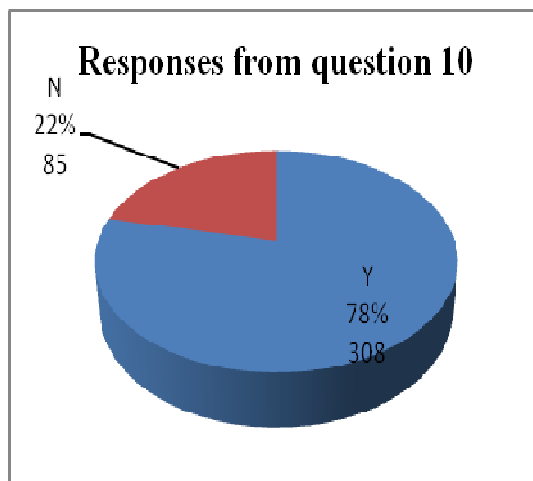
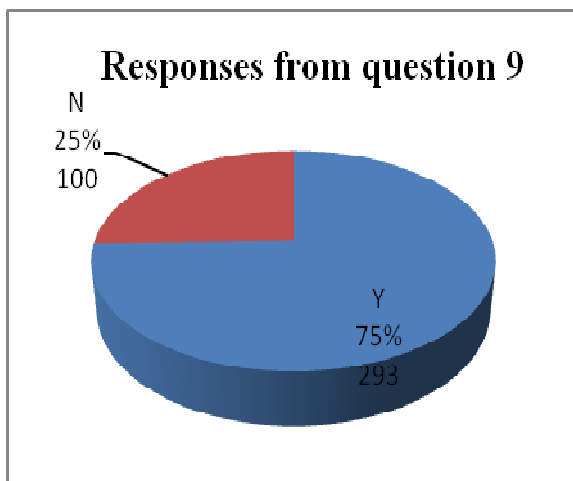
raining season. Showing that majority of the people is adversely affected by flood as compared to 23% and 27% responding otherwise.



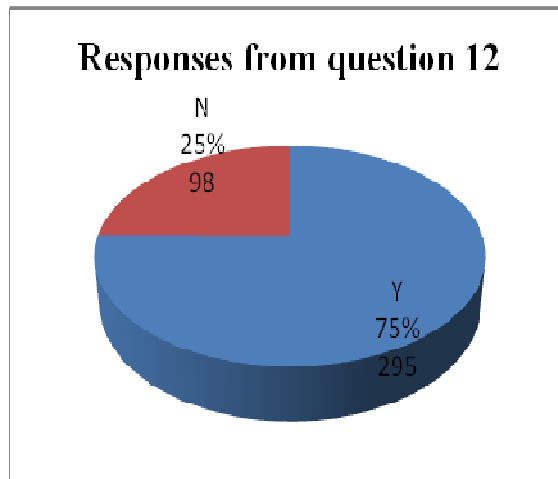
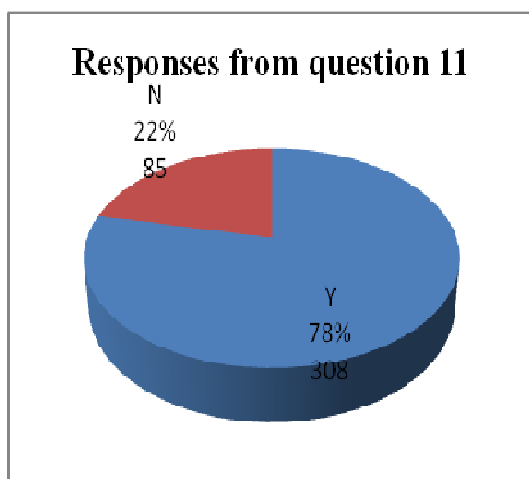
The pie chart of question 5 and 6 is intended to know if as a result of flood whether the available drainages help to carry away dirty and the health implication of the flood. The result show that 64% saying that it helps to carry away dirty and 84% which is very high indicating that the flood bring about an increase in mosquitoes and flies which will lead to increase in malaria and Typhoid, cholera and dysentery to mention but a few.



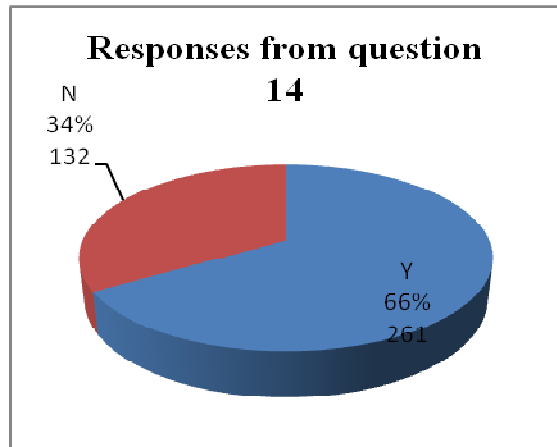
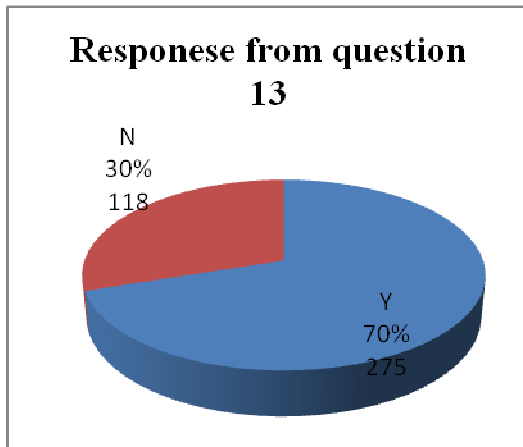
The pie chart showing the response of question 7 and 8 was asked with the intention of measuring the effects of the drainage outlets and to know if the drainage also help to channel human waste and the responses indicates that 64% says that it increases mosquitoes, 30% says that it bring in dirty to their environment and 64% of responses in saying that it helps to channel human waste which is not good for the state capital economically, pollution and surface water contamination.



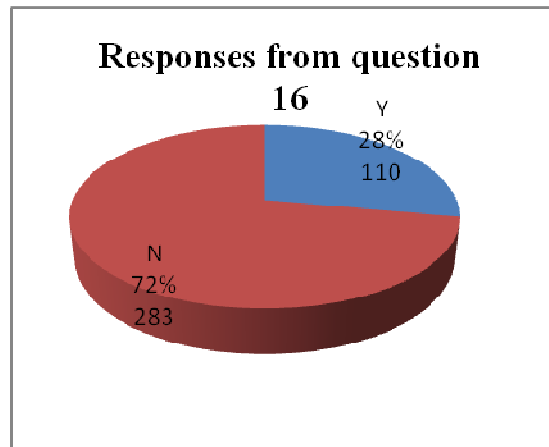
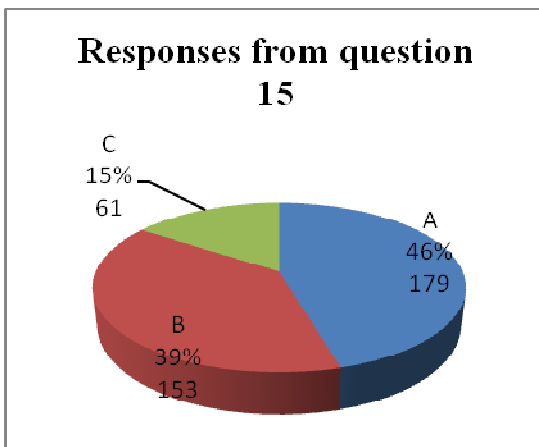
From the responses of question 9 it obvious that the presence of drainage where available stand as protection to buildings as 75% which is above average thick the yes option and in question 10 also, 78% shows that the manifestation of flood in their area has lead to a reduction in the value of land as against 22% .



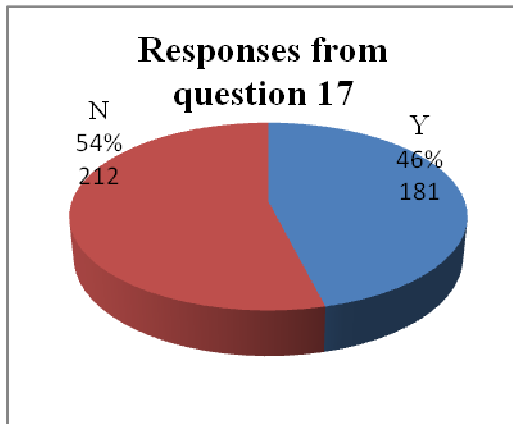
From the overview of the pie chart, the question from 11 and 12 intended to know if the presence of drainage help to make the road in the area last longer and reduced flooding and 78% as against 22% says yes in 11 and in question 12, 75% picks the option yes. This implies that more drainage should be constructed where they're not available to reduced flooding.



The responses from question 13 shows that 70% of respondents saying that their activities are affected during raining season as a result of flooding implying that this meant affect their economic power and answer from question 14 demonstrates that where there is drainage, 66% of respondent believe it is serving it purpose when compare to 34%.



From the responses of question 15, 46% of people affected by flood says that they've loss between #100,000 to #500,000, 39% loss #500,000 and #1million which suggest that as many as the number of people affected by flood have lost money probably repairing the damages cost by flood including their health. For question 16, 72% as against 28% of respondent who believe that the government is not doing enough to the curb the menace of flooding from the surrounding environment.



The pie chart showing the responses in question 17 was asked with the intention to know if the people affected by were pre-informed by way of a warning sign and the responses infer that 54% says that they were not warn while 46% says that they are warn. This suggest that majority of the people affected by flood are not aware that they will be affected, thus, leading to an increase in the number of people affected.

CONCLUSION

Base on the data collected and analysis made, it was realized that the effect of flooding from drainage system out fall on the surrounding environment in Birnin Kebbi, Kebbi State is quit huge as can be seen in the pie chart analysis of the socio economical effect and in addition the Topographic Survey of the drainage system outlet in Tundun Wada and Bayankara areas of, Birnin Kebbi, Kebbi State, which depict the nature of the terrain as well as the features such as houses built along and directly opposite the drainage outlet which is a flood prone area as in the case of Bayankara, thereby, leading to the destruction of houses and properties in millions of naira whenever it rains and there is flood.

RECOMMENDATIONS

1. That government should construct more drainage where they don't exist as seen in the advice giving by the respondent to the questionnaires and when building the drainage employ the help of professionals to ensure that any drainage constructed serving its purpose.
2. There is need to extend the drainage system outlet beyond the position it is in Bayankara and demolish the houses found to be obstructing free flow of water
3. Government should prevent the citizen through enlightenment and law enforcement from using drainage as a means of evacuating waste both in

human form to avoid any health hazards as noticed from responses from question 6, 7 and 8.

4. There should be further awareness to inform people living in flood prone area to live the place as this will reduced the number of people that will be affected by flood.

REFERENCES

- Adedeji, A. A. and Salami A W. Environmental Hazard: Flooding and Its Effects on Residential Buildings in Ilorin, Nigeria,
- Agbonkhese, O, Agbonkhese. E , Aka. E, Joe. J, Ocholi. M, Adekunle. A,(2014). Flood Menace in Nigeria: Impacts, Remedial and Management Strategies, available at www.iiste.org, Vol.6 No.4, pg 32-40
- Angela K.E (2011). The Devastating Effect of Flooding in Nigeria, FIG working week, bridging the gap between cultures, Marrakech, Morocco, 18-22 May, 2011, TS06) – Hydrography and the Environmental, pg 1-15
- Bannister .A and Raymond .S, (1995). Surveying 7th Edition (Education Low-priced Books Scheme, London)
- Dabara I.D, Gumnie R.J, Nwosu .A, Abdullazeez H.O, (2014). Analysis of the Relationships of Urbanization Dynamics and Incidences of Urban Flood Disaster in Gombe Metropolis, Journal of Environmental and Earth Science, Vol.4 , No.17, pg 158- 165
- Dano U.L, Abdul .N, Ahmad M.H, Imtiaz. A, Soheil.S, Abdu-lateef B, Haruna .A, (2011). Geographic Information System and Remote Sensing Applications in Flood Hazards Management: A Review, Research Journal of Applied Sciences, Engineering and Technology,3,(9) pg 933- 947
<http://www.dailytrust.com.ng/daily/environment/32146-kebbi-flood-wazirin-gwandu-to-head-25-man-committee>, <http://www.fema.gov/library>
<http://www.livescience.com/39110-japan-2011-earthquake-tsunami-facts.html>
- Jing L I (2010). Using ICT to Reduce Flood Risk in China, Astana Kazakhstan, UN-ESCAP Regional Workshop on ICT Applications for Disaster Risk Reduction and Sustainable Economic Development
- Mohammed N B, David N. J (2014). Analysis of Flood Risk Inundation Hazard in

Birnin Kebbi Town, Kebbi state, Nigeria, International Journal of Geomatics and Geosciences Vol. 5 No. 1, pg 119-131.

Olayinka L, Nwilo P. C, Adzandeh A.E (2013). From Catchment to Reaches: Predictive Modeling of Floods in Nigeria.FIG working week, on Environment for sustainability.pg 1-17

Paul.R.W, and Charles .D.G, (2006). Elementary Surveying, An Introduction to Geomatics 11th Edition (Pearson Prentice Hall, USA)

Supriyo .N, Flood in India – Disaster and Management, Member Center for Built Environment pg1-19

APPENDIX A QUESTIONS SECTION A

1. Sex male (...) or female (...)
2. Marital status.....

SECTION B

1. Do you live in a flood prone area
[A] Yes [B] No
2. Does flooding and drainage causes disaster in your area
[A]Yes [B] No
3. Does flooding affect the building and cause destruction in your area?
[A]Yes [B] No
4. Does flooding and drainage affect your environment during raining season?
[A]Yes [B] No
5. Does flooding and drainage help to control environmental sanitation?
[A]yes [B] No
6. Does flooding and drainage increase mosquito and flies in your area?
[A]Yes [B] No
7. What is the effect of drainage outlets to you to your environment?
[a] increases mosquito [b] brings dirty [c] causes sickness [d] others
8. Does drainage help to channel human waste in your surrounding?
[A]Yes [B] No
9. Does drainage stand as a protection to building in your surrounding?
[A]Yes [B] No

The Use of Geodata and Quantitative Method in Measuring the Effects of Flooding from Drainage System Outfalls on the Surrounding Environment in Birnin Kebbi, Kebbi State

10. Does flooding reduce the value of land in your environment?
[A] Yes [B] No
11. Does drainage make road in your surrounding last longer.
[A] Yes [B] No
12. Does drainage reduce flooding in your environment?
[A] Yes [B] No
13. Does flooding and drainage affect your activities during raining season?
[A] Yes [B] No
14. Is the drainage in your area serving its purpose by channelling water in your environment?
[A] Yes [B] No

15. If you're to cast the amount lost as a result off the effect of flooding, what will it be
[a] 100,000 to 500,000 [b] 500, to 1 million [c] 1 million and above

16. Do you think government is doing enough to manage the problem of flood in the environment?
[A] Yes [B] No

17. Was there any warning sign before the problem of flood affected your house and environment?
[A] Yes [B] No

18. Advice the government on flood can be manages in your area