The Application of Karnel Density tool in Determining Health effects Associated with Areas Inundated with Flood in Owerri Urban Nigeria

Sylvanus Iro[1*]; Ezedike C.E[1]; Prof Edith Pat-Mbano[2]

[1]Department of Geography and Environmental Management, Imo State University, Owerri Nigeria
[2]Department of Urban and Regional Planning, Imo State University, Owerri

A B S T R A C T

The study examined the perceived effects of saving mobilization scheme on women income status in Niger State, Nigeria. A sample size of 181 women were selected from the state using four-stage sampling technique. Structured questionnaire complimented with interview scheduled were used for data collection. Data were analyzed using descriptive statistics (means, percentages and frequency counts) and Pearson Product Correlation Analysis. The findings revealed that the mean age of women in the study area was 35 years. The mean household size and years spent in formal education were 5 and 6 years respectively. The major informal saving pattern utilized by the respondents are saving with "daily thrift contribution" (92.30%) which ranked (1st), "saving at home" (82.90%) (2nd) and "Esusu" (79.60%) which ranked (3rd) respectively. The semi-formal saving patterns adopted by the respondents include saving in "production and marketing cooperative" (85.60%) which ranked 1st, saving in "savings and credit cooperative" (67.40%) (2nd) while the use of commercial bank (83.40%) as formal means of saving was 1st. The most perceived effects of SMS on women income status where SMS has increased my prowess to secure investment loan $(\bar{X}=4.91)$ and SMS through informal and semi-formal sources failed to support my large investment $(\bar{X}=4.83)$. It is recommended that officials of SMS should educate women on their respective activities and state in plain terms what members stand to benefit by joining the scheme. This will help in reducing doubts, risks and uncertainties among the women thus enhancing capital accumulation in the scheme and enhance the income status of women.
.

***Corresponding Author**
Sylvanus Iro
Department of Geography and Environmental Management, Imo State University, Owerri Nigeria

INTRODUCTION

Floods are major disasters affecting many countries of the world annually especially in most flood plain areas. Floodsdo not only damage properties and endanger the lives of human and animals but also produce other secondary effectslike outbreak of diseases such as, common cold, cholera and malaria as well. Floods can potentially increase the transmission of the following communicable diseases: Water-borne diseases, such as typhoid fever, cholera, leptospirosis and hepatitis A. Vector-borne diseases, such as malaria, dengue and dengue haemorrhagic fever, yellow fever etc.Flooding can occur at any time of the year and can be due to many causes from heavy rainfall and blocked drains to burst water mains, tidal ingress and burst river banks, whatever the cause, flood water presents a general hazard to health. Flooding is commonly caused by heavy downpours ofrains on flat ground or areas liable to flooding, reservoir failure, volcano, melting of snow and or glaciers e.t.c. The inundation of flooding in Owerri Urban has been a source of worry to the residents of some part of Amakohia, Akwakuma, Dick Tiger Trans egbu and Bishiop Unegbu axis of works layout. These flood have been inundating the areas and has remained there even through the dry seasons.Following flooding inundation, indoor mould,hypersensitivity pneumonitis, malaria, cholera and thyphoid can causesignificant damage to residents around the flood area [1]. Flooding can be aggravated byimpervious surfaces or by other natural and man-made hazards which destroy soil, vegetation that can absorb rainfall [2]. Although flooding is a natural occurrence, man-made changes to the land can also be a factor. Development does notcause flooding but can make it worse [3]. In cities and suburbs, pavement and rooftops prevent some rainfall from beingabsorbed by the soil [4]. Thus can increase the amount of runoff flowing into low lying areas or storm drain system. When low lying areas are not proparly planned with good exit and control drainage channels, it can cause flood inundation which can breed a whole lot of diseases to residents living around.

Flood risk is not just based onhistory, but on a number of factors: rainfall, riverflow and tidal-surge data, topography, flood control measures, andchanges due to construction of building and development on flood plain areas.

Statement of the Problem

Recent floods and consequences all over the world are becoming too frequent and threat tosustainable development in human settlements [5]. Human anxiousness as well as quest to improve survival chances and gainbetter control over their environment has indeed succeeded through man'sconstant exploration, exploitation and alteration of the natural environment.This has enabled man to achieve urbanization, industrialization anddevelopment in general. These developments have not come without a veryhigh price due to the vindictive nature of the environment.The result or implication of human development is the evolution of seriousenvironmental problems such as deforestation, erosion, global warming,flooding, pollution and recently climate change etc. these environmentalproblems have prevailed more in the developed nations of the world and urbancenters in general. Flooding particularly has caused a lot of the both economic and health problems in the world. Thisresearch focuses on Determining Health effects Associated with Areas Innundated with Flooding in Owerri Urban. Floods may indirectly lead to an increase in vector-borne diseases through the expansion in the number and range of vector habitats. Standing water caused by heavy rainfall or overflow of rivers can act as breeding sites for mosquitoes, and therefore enhance the potential for exposure of the disaster-affected population and emergency workers to infections such as dengue, malaria and West Nile fever. It has been observed by health officials in Owerri that the complaint of malaria, typhoid fever, common cold and other flood prone illnesses by the citizens have been rampant. According to Federal Medical Centre Owerri, the number of these illnesses have been on the increase which could be attributed to illnesses caused by flood inundation. These problems have prompted this work into the use of Karnel Density tool GIS Methodology in Determining Health effects Associated with Areas Innundated with Flooding in Owerri Urban. This work will help to determine these illnesses if they have any link to the flooding sites by modelling the flooding sites and health complaints people living around the flood sites make.
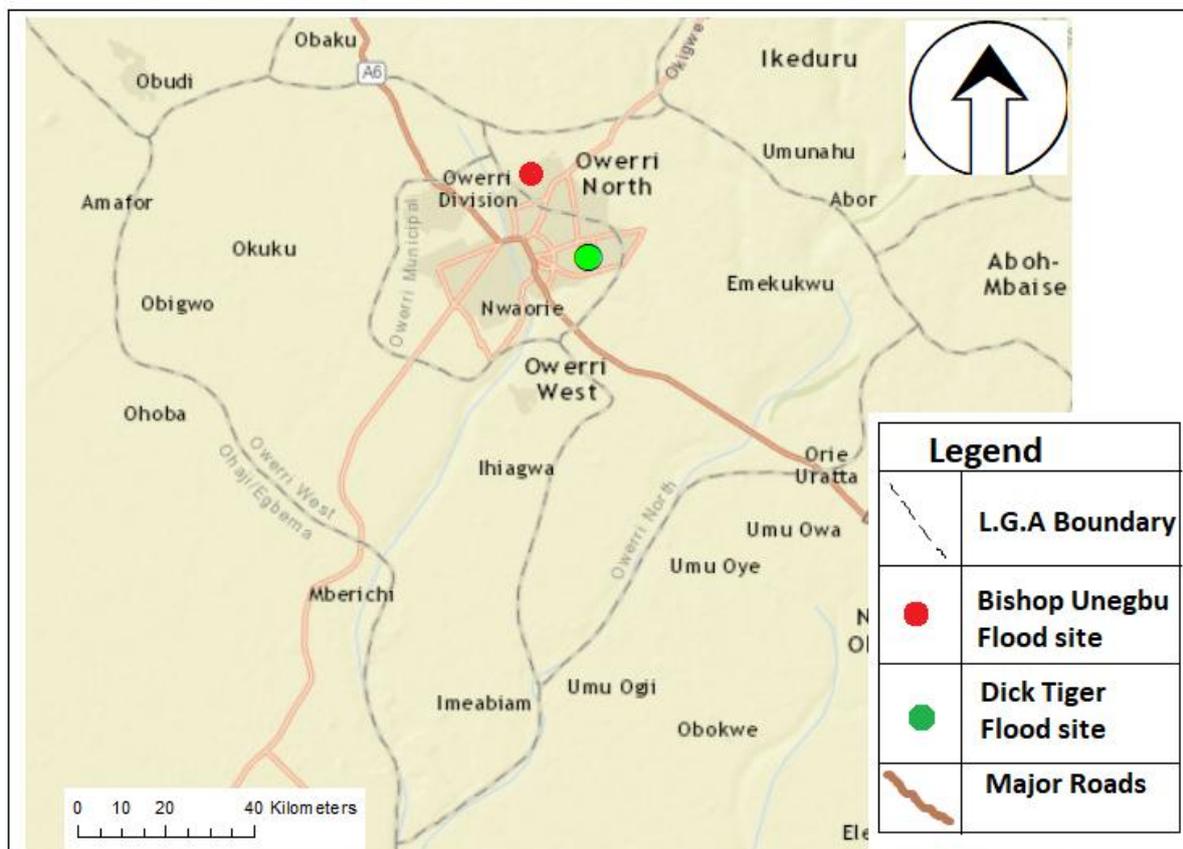
Study Area

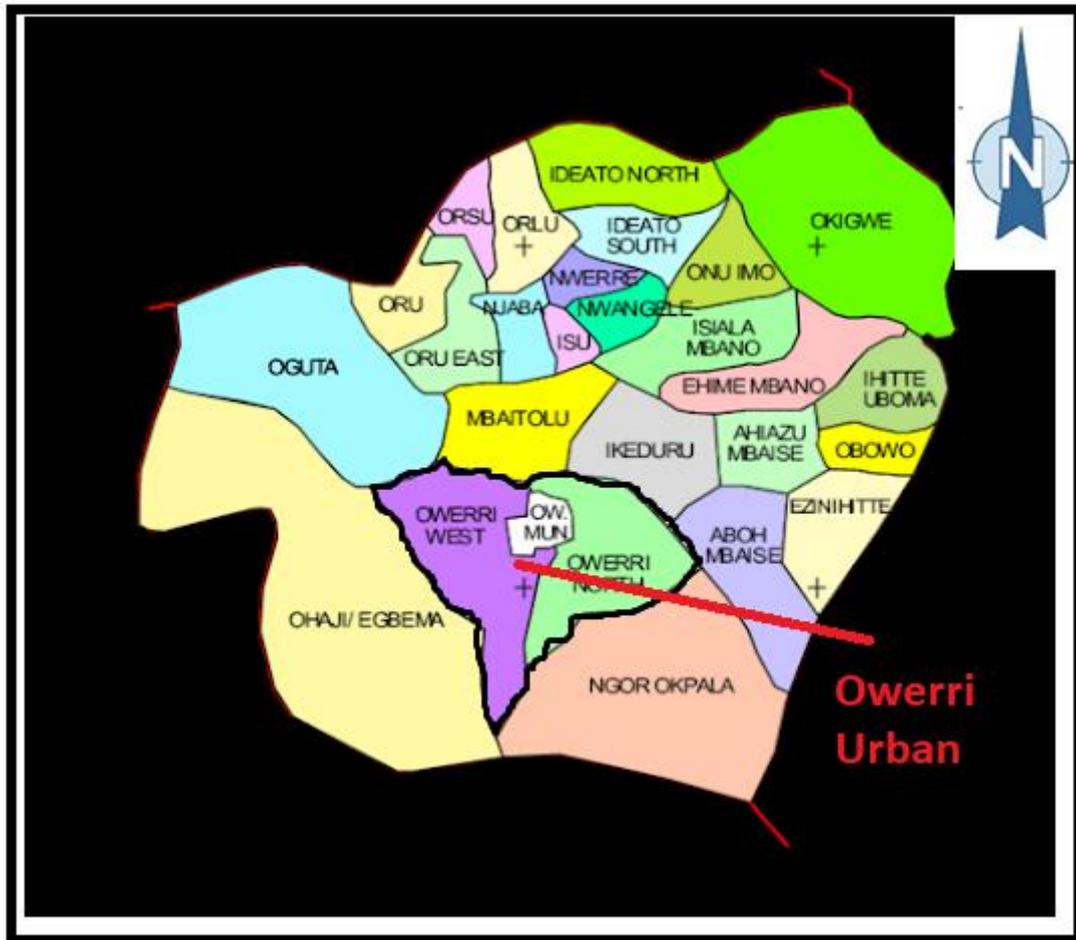**Figure 1: Owerri Urban with the two study sites [6]**

Figure 2: Study area outlined for context in Imo State Map [7]

Figure 3: Nigeria map showing Imo State [7]

METHODOLOGY

Floods have large social consequences for communities and individuals. As most people are aware, the immediate impacts of flooding include loss of human life, damage to property, destruction of crops, loss of livestock, and deterioration of health conditions owing to waterborne diseases.Flood water is a hazard to health and extremely dangerous when moving. Flooding can occur at any time of the year and can be due to many causes from heavy rainfall and blocked drains to burst water mains, tidal ingress and burst riverbanks. Whatever the cause, flood water presents a general hazard to health.

Studies such as Akintola and Ikwuyatum [8]; Odunuga [9] and Clement [10] have identified diseases such as malaria, typhoid fever, common cold etc as having strong link to inundated flood. This study is designed to make use of information acquired from the questions asked the residents living whithin 500 metres around the two main flood sites of Dick Tiger and Bishop Unegbu Streets in Owerri Municipal. Upto 50 residents each from the two flood sites were asked if they have illnesses such as malaria, typhoid fever, commom cold etc regularly. The 50 residents were chosen because of the number of people living around the flood sites. Majority of them have relocated to better side of the town because of the flood water that is constantly present in the areas. The geocodingwere residents where when they became sick that is their houses, business areas and other outfits were picked and coordinate point of the flood sites were also picked. A georeferenced cadarstral map of Owerri was acquired and overlay both the coordinate points of the residents and flood site. The ArcGIS tool known as Karnel Density was used to run the model. The Kernel Density tool calculates the density of features in a neighborhood around those features. It can be calculated for both point and line features.This approach has been used by some research works such as Spencer andGustavo [11] "Kernel density estimation as a technique for assessingavailability of health services in Nicaragua" and Guagliardo [12] "Spatial accessibility of primary care: concepts, methods and challenges". The karnel Density tool will be able to calculate the density of the resident who complained that they were sick within the 500metre radius around the flood water.

RESULTS AND DISCUSSION

The analysis reveals that residents that complain of these diseases linked to flood inundation are more concentrated around the flood sites. For example, it can be observed that in the Dick Tiger Streetflood site **Figure4**, The number of residents that complained of these ailments were more concentrated around the flood site and reduces as you move further away from the flood site. In **Figure4,** of the 50 residents asked about having those health chalenges linked to flood inundation, 28cases of the residents were found 100 sqm around the flood site, the Red colour area. At the Orange colour area, 200sqm around the flood site, the model identified 17 cases who complained of having these flood linked diseases often.The yellow colour area which is 300 sqm away from the flood site was linked with 5 cases that complained of these diseases that are linked to flood inundation. The light green and the green areas which are 400sqm and 500sqm around the flood site respectively, did not record any cases.
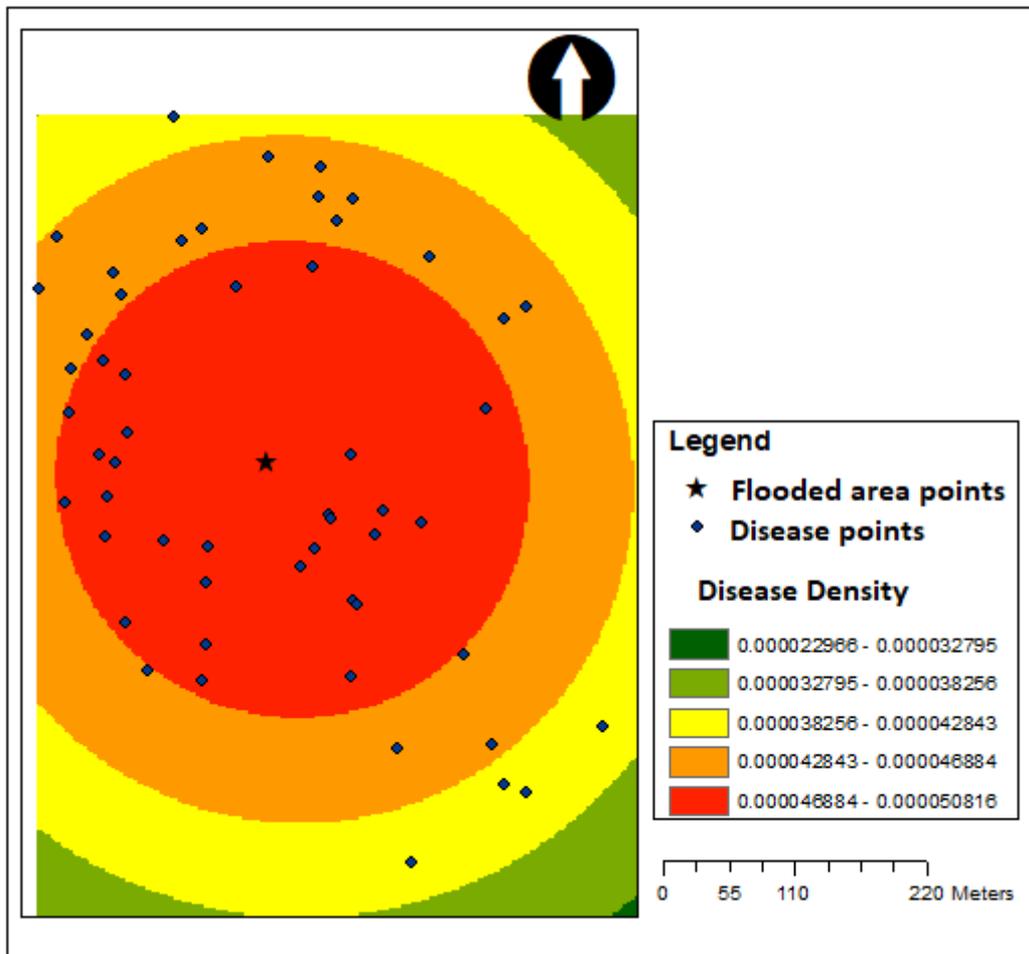

Figure 4: Model of Dick Tiger Street Flood inundation

The Bishop Unegbustreet flood **Figure5** indicates that out of the 50 cases, 22 cases were found 100sqm around the flood site which is the Red colour area. Immediately, after the red clour area, the light Red colour which is 200sqm around has 7 cases and other 21 cases are found to thin out to the white area showing more than 80% of the cases are located 300sqm around the flood site. This analysis has coloborated the work done by Krisp and Spatenkova, [13] "Kernel Density Estimations for Visual Analysis of Emergency Response Data". This studiesthe relationships between the incident distribution and the identification of high (or low) incident density areas which supports the general emergency preparedness planning and resource allocation. Also, the work of Kalinic and Krisp [14], "Kernel Density Estimation (KDE) vs. Hot-Spot Analysis - Detecting Criminal Hot Spots in the City of San Francisco" Kernel Density performance was used in detecting criminal hot spots in the city of San Francisc. This reveals that flood inundation has someindirect links to diseases such as malaria, commom cold and Thyphoid following the researchers methodology.
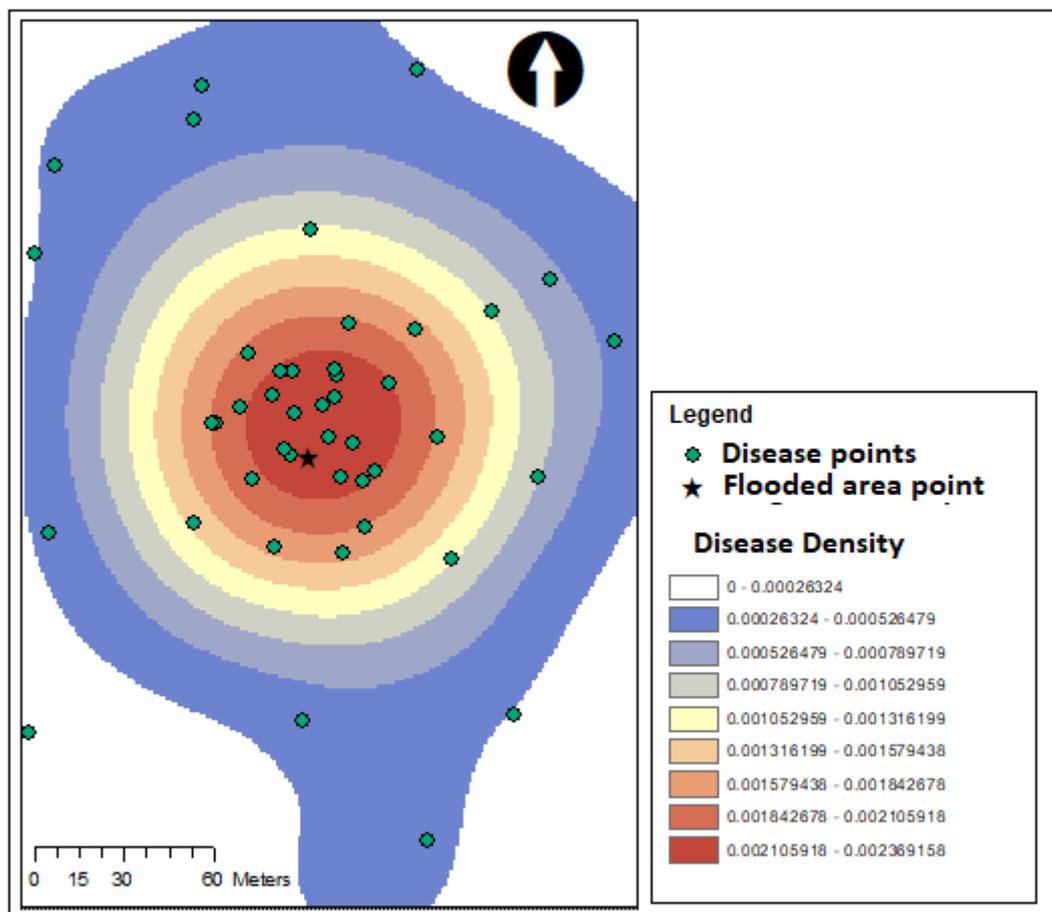
Figure 5: Bishop Unegbu Flood inundation

The health consequences of floods depend upon the vulnerabilityof the environment and the local population.Improved disaster management, including mitigation andpreparation has contributed to a reduction in flood-relateddeaths. Fewer people die from drowning, than indirectly related health issues from flood.

Floods vary greatly in their character and their impact,as does the vulnerability of the populations they affect. Areas at greatest risk are low-lying, near water, and located down stream dam or river mouth Fitzgerald and Hou[15]. The study of the two flood sites of Dick Tiger and Bishop Unegbu streets has revealed that people living near these flood inundated areas are prone to these diseases that are indirectly related to flooding. The health impacts of floods depend upon various factors, including the characteristics of the flood hazard, patterns of exposure, and underlying vulnerability of the population. These flood sites have been a source to these health problems such as malaria, thyphoid and commom cold. The indirect link from the module shows that over 80% of these health problems were located 300sqm around the two flood sites. This has suported the age long view that mosquitoes breed where there is stagnant water, thyphoid is as a result of conterminated drinking water or food. This could mean that the residents' drinkingwater has been conterminated by the flood water. The commom cold problem complained by the residents could be as a result of inundated flood water that has remained close to them through out the rainy season which lasts close to 8 to 9 months in a year.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Determining health effects associated with areas inundated with flooding in Owerri Urban Nigeria, was conceived out of the numerous complaints by residents of flood inundated areas of having indirect flood related ailments like malaria, common cold, typhoid etc. Floods can potentially increase the transmission of the following communicable diseases: Water-borne diseases, such as typhoid fever, cholera, leptospirosis and hepatitis A.Vector-borne diseases, such as malaria, dengue and dengue haemorrhagic fever, yellow fever, and West Nile Fever.

The survey from health centres and hospitals around the area confirms that the residents' files in the hospitals show that they have been having several visitations to the hospitals due to incessant complain of these flood related cases. Many researchers such as Emberga[16]; Nwoko[17]; Nkwunonwo, Whitworth and Baily[18], confirm that flood inundation has devastating effects which affect millions of people and caused fiscal losses amounting tobillions of US

dollars every year. These hazards were generally linked to poor urban planning and climatechange especially in increased frequency and intensity of rainfall. The direct and indirect impacts of floods inNigeria include mortality, physical injuries, widespread infection and vector-borne diseases, socialdisorders, homelessness, food insecurity, economic losses (mainly through destruction of farmlands,social and urban infrastructure) and disruption in telecommunication and power supply. Floods may indirectly lead to an increase in vector-borne diseasesthrough the expansion in the number and range of vector habitats.Standing water caused by heavy rainfall or overflow of rivers can act as breeding sites for mosquitoes, therefore enhance the potential forexposure of the disaster-affected population to infections such as dengue, malaria, and typhoid, common cold etc. An observation from **figure 4** and **figure 5** reveal that about 80% of the residents surveyed cluster around 300metres of the flood sites. This goes to confirm that these diseases are having indirect link to flood and, could be the reason these residents complain of these ailments. Malaria, typhoid, common cold epidemics in the wake of flooding are a well-known phenomenon in malaria-endemic areas world-wide. For instance, anearthquake and subsequent flooding in Costa Rica's Atlantic region in1991 and flooding on the Dominican Republic in 2004 led to malariaoutbreaks.Dampnessa term used to describe a variety of moisture problems, including high relative humidity, condensation, water ponding, and other signs of excess moisture is prevalent in residential housing. According to **Figure 4 and Figure 5,** this is linked to common cold and other sicknesses being complained by the residents. A cyclone and flooding in Mauritius in 1980 led to an outbreak of typhoid fever. It is recorded in this research work that typhoid disease was one of the sicknesses complained by the residents.

RECOMMENDATION

As a result of the findings of this study, 3 key recommendations are offered to help in future to mitigate flood inundation in low lying areas or areas prone to flooding and curtail the spread of those diseases on the two sites of (Dick Tiger and Bishop Unegbu) streets and also, in any region having similar environmental problems.

1. Good drainage system should be constructed from these roads (Dick Tiger and Bishop Unegbu) and the runoff channelled to rivers like Nworie and Otamiri. When this is done, flood inundation of these areas will stop and those diseases from inundated flood will be a thing of the past.
2. Those residents living around the flood water can be relocated and such places discouraged from human habitation to minimize the spread of such diseases.
3. Embarkments and bonds can be constructed around the area where runoff is entering the site to reduce the amount of runoff percolation on the area. This will wade off the runoff and the little one coming to the area can easily dry up or piped out after heavy rains.

REFERENCES

1. Douglas, L. (2008) Unjust waters: Climate change, flooding, and the urban poor in Africa. Environment & Urbanization: International Institute for Environment and Development (IIED)
2. Bizimana, J. P. and Schilling, M. (2010) Geo-Information Technology for Infrastructural Flood Risk Analysis in Unplanned Settlements: A case study of Informal Settlement Flood Risk in the Nyabugogo Flood Plain, Kigali City, Rwanda. In: Showalter, P. S. and Lu, Y. (Eds.) Geospatial Techniques in Urban Hazard and Disaster Analysis. Landon and New York: Springer, pp. 99-124.
3. Barroca, B., P. Bernardara, J.M. Mouchel and G. Hubert (2006) "Indicators for identification of urban flood vulnerability". Natural Hazards and Earth System Sciences 6, 553-561.
4. Veldhuis, J. A. E. (2010) Quantitative risk analysis of urban flooding in lowland areas. Enschede, the Netherlands: FSC
5. WHO (2010) Common Water and Sanitation-related diseases. World Health Organization(WHO).
6. Environmental Systems Research Institute. (2015). Tapestry Data Geodatabase
7. Iloeje, P.N. (2010). A New Geography of Nigeria. Longman Nigeria; Published by Longman, United Kingdom
8. Akintola FO, Ikwuyatum G. O. (2012). Issues in sustainable flood management in Nigeria. In Ivbijaro FA, Akintola FO. Editors; Sustainable Environmental Management in Nigeria. Ibadan, Oxford University Publishers.
9. Odunuga S. (2008). Urban land use change and the flooding in Ashimowu watershed, Lagos, Nigeria. University of Lagos, Nigeria.
10. Clement A. R .(2013). An application of Geographic Information System in mapping flood risk zones in a north central city in Nigeria. African Journal of Environmental Science and Technology7: 365-371.
11. Spencer J and A. Gustavo. (2007). Kernel density estimation as a technique for assessing availability of health services in Nicaragua. Health Serv Outcomes Res Method (2007) 7:145–157 DOI 10.1007/s10742-007-0022-7
12. Guagliardo, M.F. (2004). Spatial accessibility of primary care: concepts, methods and challenges. Int. J. Health Geogr. 3, 3
13. Krisp J. M and S Spatenkova. (2010). Kernel Density Estimations for Visual Analysis of Emergency Response Data; Geographic Information and Cartography for Risk and Crisis Management; DOI: 10.1007/978-3-642-03442-8_27, January.
14. KalinicJukka M. M and K. M. Krisp. (2018). Kernel Density Estimation (KDE) vs. Hot-Spot Analysis - Detecting Criminal Hot Spots in the City of San Francisco; Conference on Geo-information Science; Lund, Sweden, June

15. Fitzgerald G. and X Hou. (2010). Health Impacts of Floods; Article in Prehospital and disaster medicine: the official journal of the National Association of EMS Physicians and the World Association for Emergency and Disaster Medicine in association with the Acute Care Foundation · June

16. Emberga T. (2014). An Assesment of causes and effects of flood in Nigeria; Scientific research and essays Vol2 (7): 307-315, July

17. Nwoko A. U. (2013). Flooding in Nigerian Cities: Problems and Prospects: A Case Study of Aba Urban, Abia State, Nigeria; Geography and Planning Department, Abia State University Uturu, Nigeria

18. Nkwunonwo UC, Malcolm W, Brian B (2015) Flooding and Flood Risk Reduction in Nigeria: Cardinal Gaps. J Geogr Nat Disast 5:136. doi: 10.4172/2167-0587.1000136