RESEARCH ARTICLE OPEN ACCESS

Building Development Practice in Flood Prone Area: Case of Ogbaru Council Area of Anambra State Nigeria

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ABSTRACT
This study examined the practice of building development in flood prone areas and how it has contributed to the menace of flooding in Ogbaru Council Area of Anambra State Nigeria. It was a survey research where questionnaires were distributed to heads of the selected households, in addition to physical observations on buildings within the selected households. Four towns out of sixteen towns that made up Ogbaru Council Area of Anambra State were purposefully selected. From these towns, 96 households each were randomly selected and a total of 384 questionnaires were administered to the head of each household or their representative, whereas 242 copies were completed, returned and found useful, thus, giving a response rate of 62.92%. The study found that siting of buildings on waterways, flood channels/plains, inadequate/lack of drains in the compounds, lack of planning restriction/developmental control, size of the building/area occupied by the building among others contribute greatly to the incessant flood menace in the study area. The study therefore deduced that some building practices such as those identified above have the ability of exacerbating the velocity and rate of flooding in the area which turned into natural disaster, and thus, recommended strict enforcement of building and urban development laws and control in the state to reduce indiscriminate erecting of building structures on waterways, including planlessness of our emerging urban centres.

Keywords - Building Development, Development Control, Flooding, Flood Prone Area, Urban Centres

I. INTRODUCTION

Despite the prevalence of policy and engineering measures to reduce the adverse impacts of floods, flooding remains one of the greatest threats to the property and safety of human communities in the world among all natural hazards [1]. Accordingly, Schramn and Dries [2] argue that flooding is number one natural disaster hazard that is becoming a greater threat than a constant or declining one. Each time flood occurs, a lot of damages are incurred. These damages range from extensive loss of lives, economic losses, destruction of the built and natural environment, disruption of local institution to livelihood, and disempowering of the local community thereby hindering nations from achieving their developmental goals [3], [4]. Therefore, these damages have environmental, economic, social, demographic and psychological dimensions.

Corresponding, Brody et al. [1] states that the economic consequence of floods is estimated to be in billions of dollars per annum. Ezigbo [5] and Centre for Human Security of the Olusegun Obasanjo Presidential Library Foundation (CHSOOPLF) [6] report that Nigeria suffered property and business losses valued N2.6 trillion from the 2012 flooding that ravaged more than 2/3 of the states in Nigeria. Specifically, in flood prone areas of Anambra State, flooding occurs almost every raining season. Ajaero and Mozie [7] found that flood comes yearly in about 36% and comes after a long spell of safety in about 64% in Ogbaru, 13% and 83.7% respectively in Onitsha South, 40% and 30% respectively in Anambra East, 3.3% and 96.7% respectively in Ayamelum, 30% and 66.7% respectively in Awka North and 6% and 96% respectively in Anambra West council areas of Anambra State.

In 2012 for instance, the raging 2012 national flood disaster submerged several communities. About 8 Local Government Areas were affected in Anambra State, including Ogbaru, Anyamelum, Anambra West Anambra East, Awka North, Onitsha North, Onitsha South and Ihiala LGAs, i.e. areas of the lower Niger River basin. Anambra State Government (ANSG) [8] reports that at the peak of the crisis, a total of 125,000 people were internally displaced, numerous buildings and industries were fully or partially submerged for more than four (4) months. In all these, it was reported that Ogbaru Local Government Council of Anambra State was one of the council areas mostly hit by the disaster (Anambra State Emergency Management Agency ANSEMA) [9]. Ajaero and Mozie [7] further reveal that about 96.70% of Ogbaru LGA was affected while about 81.70% was very severely damaged.

These losses according to Brody et al. [1] are exacerbated by increased development of residential, commercial and tourist activities buildings, particularly along the riverfront/coastal margins which invariably increases the population of people living in such area. These rise in population within coastal areas coupled with the increment of impervious surfaces, alteration of hydrological systems (i.e. watersheds), and diminished capacity of these systems to hold and store surface run-off naturally resulted to increment of communities vulnerability to flood risk.

More so, the current building construction practice as a result of innovation in building technology and building owners and developers' quest to maximise the use of any available land space in Ogbaru, Anambra due to its closeness to the commercial city of Onitsha has been suspected to be contributing to the ugly incidence of flooding.

To this end it is pertinent to examine the building development practice in Ogbaru and to establish how construction works and/or built environment has aggravated the incidence of flooding or otherwise, within the study area. This is because most studies had focused on the impacts of flood disaster in the area [7], [10]; while others have looked at other causes of flood disaster without considering the building development process and practice in the [11], [12]. Therefore, the aim of this study is to examine the building development practice in the flood ravaging area of Ogbaru local government area of Anambra State Nigeria. It also examines the contribution of construction works and/or built environment to the menace of flooding in the area.

II. LITERATURE REVIEW

2.1. Flood and Built environment

The Global Mean Sea Level (MSL) is increasingly rising. According to Linham and Nicholls [13] this is caused by the thermal expansion of sea weather caused by increase in sea surface temperature (SSTs) and water input into the ocean from melting land-based ice; and global warning as a result of climate change. Hence, this thawing of these glacier lands coupled with other human factor give rise to this raging flooding.

More so, Adedeji, Odufuwa and Adebayo [14] surmise that the unprecedented rate of flooding in recent years implicate increasing rainstorm due to on-going global warning and climate changes. Other factors according to Schramn and Dries [2], are damn and levee failures; torrential rains of hurricane; snow thaws, (i.e. floes blocking a river and burst water main). Nwilo [15] adds that flooding occurs when the carrying capacity of the water courses is exceeded and when there is blockage of the water course and drainage channels.

Thus, Adedeji et al. [14] describe flooding as a natural hazard, which human influence on the urban modification and alteration in the urban space or area can exacerbate the problem, while the disastrous consequence are dependent on the degree of human activities and occupancy in the vulnerable areas. This human influence in urban modification can however, led to deltaic wetland losses either by direct destruction or rapid changes to the natural delta environment. This generally will reduce the adaptive capacity of the delta to cope with SLR (Sea Level Rising) and other climate change impact [13].

On the other hands, Waziri [16] describes the built environment as human made surroundings that provide the settings for human activities, ranging from buildings and parks or green space to neighbourhood and cities which include their supporting infrastructures such as water supply and energy works. That is to say that it is the products of human activities. Summarily, built environment involves physical alteration of the natural environment, from hearths to cities, through construction by human.

Haigh and Amaratunga [17] had identified the main characteristics of the built environment, however, each of and the entire built individual element contributes either positively or negatively to the overall quality of the environment. Thus, when the product of the built environment is not properly designed and built it could turn natural phenomena into a human and economic disaster. For instance; conversion of agricultural and forest lands to urban areas diminishes hydrological system's i.e. ability to store and slowly release water, resulting in more severe flooding [1].

Whereas the impacts of extreme rainfall are exacerbated by major components of urbanisation, contributors to flood occurrence are the increase in impervious surfaces brought about by high concentrations of impervious surface, infrastructure, buildings, property and people [1], [3]. As the area of impervious surface coverage increases, there is a corresponding decrease in infiltration and a rise in surface run-off [1].

The built environment bears the brunt of the damages from disaster of all kinds because, constructed items cannot be move even when natural disaster is accurately predicted [18]. Meanwhile, [2], [14], [15], [17] and [19] identify disruption of economic growth and hindrance to a person's (or nation's) ability to emerge from poverty, inability of the society to function-economically and socially, extensive loss of lives particularly among vulnerable member of the community, economic losses hindering achieving developmental goals, destruction of the built and natural environment, increasing vulnerability and widespread of disruption of local institution and livelihood, and disempowering of the local community as the consequence of flooding on built environment.

2.2. Construction Practice and Flood Disaster

The United Nations Environment Programme (UNEP) [20] acknowledge that human activities are contributing to climate change and maintain that buildings are responsible for more than 40 percent of global energy used, and as much as one third of global greenhouse gas emissions, both in developed and developing countries. Invariably, it has long been recognised that built areas can have Urban Heat Islands (UHI) that may be up to 5–6°C warmer than surrounding countryside [21].

Furthermore, UNEP [20], state that urban centres are known for creating their own microclimates as a result of clustering of hard surfaces that are heated by sunlight and channel rain water into the underground ducts. This makes city weather to be hotter, windier and cloudier than the weather in the surrounding areas. Hence, built environment according to Waziri [16] is increasingly contributing significant share of urban energy consumptions and related emission.

Also, the physical constituents of built areas and human activities within urban centres also interact with other climate drivers. For example, runoff from impervious surfaces can have dramatic effects on downstream risks of flooding and erosion as well as modifying river temperatures and water quality via uncontrolled discharges of storm water [21]. In view of this, Ezeabasili and Okonkwo [3], argue that commercial buildings are at greater risk of flooding than other houses, mostly due to their urban location, being surrounded by impermeable surfaces, and the likelihood of urban storm water drainage systems being overburdened.

Moreover, changes in land-use associated with urban development affect flooding in so many ways. Removing vegetation and soil, grading the land surface, and constructing drainage networks increase runoff to streams from rainfall and snowmelts. As a result of the peak discharge, the volume and frequency of flood increases in nearby streams. Changes to stream channel during urban development can limit their capacity to convey floodwaters. Roads and buildings constructed in flood prone area are exposed to increased flood hazards, including inundation and erosion as well as new development continues. Also, the construction of buildings and road often remove vegetation, soils and depression by from the land surface. The impermeable surface such as roads, roofs, parking lots, and sidewalk that store little water, reduces infiltration of water to ground. Dense network of ditches and culvert in cities reduce the distance that runoff must travel overland; once water enter drainage, it flow faster than either overland or subsurface flow.

With these, Ofori [18] avers that construction process itself can lead to disasters while maintaining that the preparation of the land for construction can destabilise land formations, leading to landslides, mudslides or rockslides consequently trigger off other disasters. Further still, poorly planned development can turn a natural phenomenon into a human and economic disaster. For instance, allowing floodplains to be densely populated, using poor or inadequate building codes in earthquake zones, not enforcing the regulations, or allowing the degradation of natural resources, building close to river bank without providing protection (from disaster) to settlements and communities, location of items (zoning); the intensity of development (density) the heights of constructed items (massing), and the distances of the items from one another (setbacks) all exacerbates flooding in one way or the other (World Bank cited in [18]).

III. METHODOLOGY

The study area covers the Ogbaru Local Government Area of Anambra State. Ogbaru Local Government Area of Anambra State is one of the 21 Local Government Areas that make up the State. Towns that make up the local government are Atani, Akili-Ogidi, Akili-Ozizor, Amiyi, Mputu, Obeagwe, Ohita, Odekpe, Ogbakugba, OchucheUmuodu, Osomala, Ogwu-aniocha, Umunankwo, Umuzu, Okpoko, OgwuIkpele. Ogbaru has its headquarters at Atani.

It is located between latitudes 6° 02’ N and 6° 38’ N and longitudes 06° 37’ E and 06° 59’ E. The average climatic conditions are wet (from March to October) and dry (from November to February) seasons. The highest rainfall is recorded from June to September with little break in August. The average annual rainfall ranges between 1800 metres and 2000 metres. The temperature pattern has mean daily and annual temperature as 30°C and 27°C respectively, while the average relative humidity ranges between 60-70% and 80-90% in January and July respectively [22], [23].

The area is surrounded by River Niger and floods during the rainy season and dries up completely at dry seasons. The aquifers are quite shallow with average elevation of 25m above sea level. The climate lies within the tropical rainy climate zone {AF} in accordance within Koppens climate classification and under the influence of Tropical Continental (CT) and Tropical Maritime (MT) air masses with the convergence zone (ITCZ) shifting seasonally with pressure belts and isotherms.

The population of this study constitutes all the households in the area. According to the 2006 National Population and Housing Census, the population of persons in Ogbaru LGA of Anambra State was 223,317 [24], while the number of households in the area was 49501 [25]. The distribution of households by type of housing unit in the area is presented in TABLE 1.

Table 1: Distribution of Households by Type of Housing Unit in Ogbaru LGA of Anambra State

Type	Number
House on a separate stand or yard	16151
Traditional/Hut structure made of traditional material	3402
Flat in block of flats	5281
Semidetached house	4012
Rooms/Let in house	12769
Informal/Improvised dwelling	948
Others	6938
Total	**49501**

Source: [25]

Using a population growth rate of 2.83% as recommended by National Population Commission for Anambra State [26], the population of Ogbaru LGA in 2014 would be 279,181. Therefore, the population of this study is 279,181 persons.

Strategies for determining sample size according to Israel [27] are using: census for a small population, sample size of a similar study, published table or formula to calculate the sample size. However, Cochran's sample size calculation procedure was employed to determine the appropriate sample size in this study. To do this, Cochran's return sample size formula is first determined using the formula presented in equation 1 [28]:

$$n_o = \frac{(t^2) \times (p)(q)}{(d^2)} \quad (1)$$

Where t = value of selected alpha level usually 0.025 in each tail of a normal distribution obtained as 1.96 (the alpha level of 0.05 indicating that the risk the researcher is willing to take that the true margin of error exceed the acceptable margin of error is 5%).
(p)(q)= this is the estimate of variance given as (0.5)(0.5) = 0.25
d= acceptable margin of error for proportion being estimated given as 0.05 (this is the error level the researcher is willing to expect).

Hence, after calculating the Cochran's return sample size $\boldsymbol{n_o}$ (see Equation 1), we shall employ the Cochran's correction formula to obtain the appropriate or final sample size and the formula is given in equation (2) as:

$$n_1 = \frac{n_o}{(1 + n_o / population)} \quad (2)$$

However, to obtain the sample size using the procedure discussed, equations 1 and 2 would be applied. Then, we shall calculate $\boldsymbol{n_o}$ first as given:

$$n_o = \frac{(1.96^2) \times (0.5)(0.5)}{(0.05^2)} = 384$$

Thus, the Cochran's correction for population of 278,680 was given as:

$$n_1 = \frac{384}{(1 + 384 / 279{,}181} = 384$$

Therefore, the sample size of the respondents for this study is 384. Likewise, using the same formula, the sample size of households selected is 384.

In choosing the population frame for the respondents and households, purposeful sampling technique was employed. 4 town of Atani, Okpoko, Odekpe and Akili-Ozizor out of the sixteen towns that make up the council area were purposefully selected because other towns could not be easily accessible as at the time of carrying out the field survey, and then 96 households were randomly selected from each of the 4 selected towns. Meanwhile, 96 copies of questionnaires were administered to the head of each household or their representative in each of the selected town, on issues regarding the factors contributing to flooding in the area. Multi-stage sampling is particularly useful with clusters that are homogeneous with respect to the target variable.

Data were collected through structured questionnaire administered to the selected households, physical observation of the buildings and the use of photographs. Accordingly, a total of 384 questionnaires administered to the selected respondents within the chosen households and only about 242 were completed, returned and found useful. This corresponds to response rate of 62.92%.

Nevertheless, respondents were asked to indicate their level of agreement on identified factors responsible for flooding and variables associated with building construction practice in the area on 5-point likert scale, where 1 = strong disagreement (SD) and 5 = strong agreement (SA). Based on this, mean score index of each variable was computed and subsequently ranked accordingly. Also buildings in each of the selected household were physically observed and assessed based on the location of the building (proximity to flood channel/plain), landscaping, roof type, building size and rain collecting apparatus.

The choice of the method used for a particular research depends on the data collected and the type of research [29], [30]. Being a descriptive research, tables, charts, and histogram were used for data presentation. In addition, pictures of some of the physical observations were presented in plates.

IV. RESULTS AND DISCUSSIONS

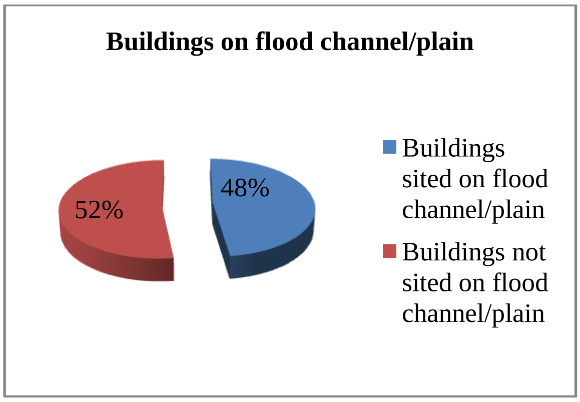

Figure 1: Buildings on flood channel/plain

Fig. 1 showed that 183 (about 48%) of the buildings surveyed were sited on the water ways and plain, while 199 representing about 52% were not (See plates 1-3). This is an indication that the entire area is almost laying on the flood plain. This condition has led to increment in the volume of flooding within the study area on yearly basis.

Plates 1-3: Siting of building on flood plain/channel

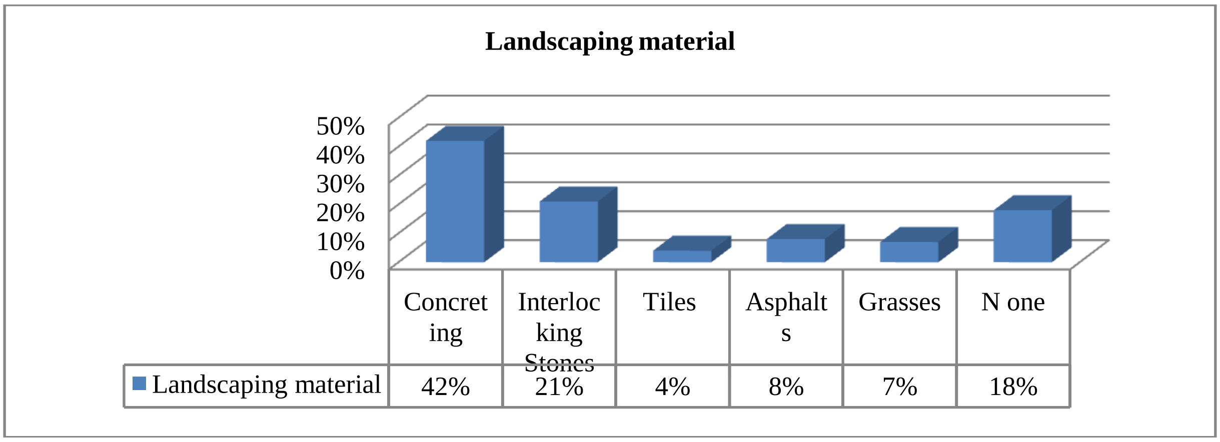

Figure 2: Landscaping material

Fig. 2 showed that landscaping with concrete materials top the list of materials used for landscaping in the study with about 42% the households been landscaped with concrete. Interlocks with 21% came second. Further enquires and observations however, revealed that the interlocks were placed on concrete base or a layer of impermeable materials to prevent weed from growing on them and prevention of rising damp. Thus preventing percolate from taking place after rain (See plate 4).

Plate 4: Concrete pavement

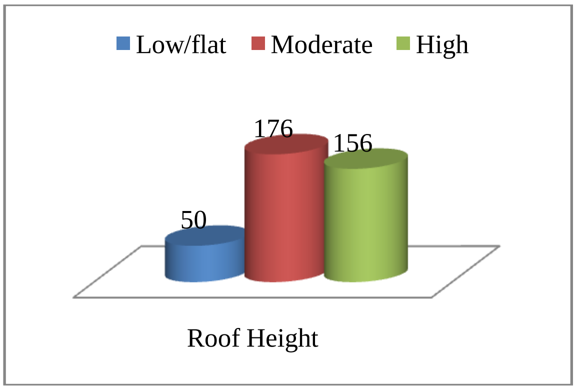

Figure 3: Height of roof

Fig. 3 showed that about 46% (176) buildings in the study area were with moderate roof height, 41% (156) were with pitched roof or very high roof (commonly called "send down rain" in the area) while about 13% (50) were with flat or low roof height. This condition actually exacerbates the velocity/volume of the rain water runoff in the study area (see plate 5).

Plate 5: Roof height

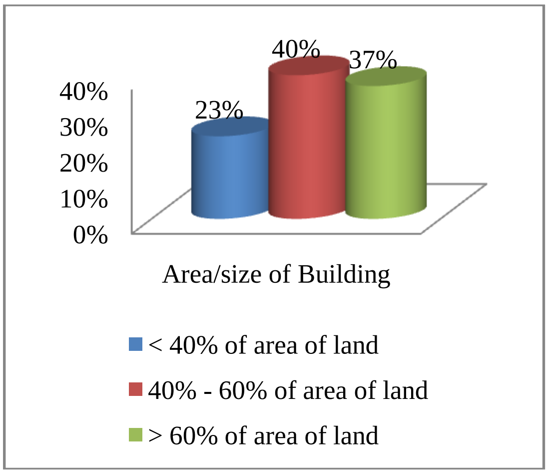

Figure 4: Area covered by the building in relation to the area of land

Fig. 4 indicated that about 40% (153) of buildings in the study area covered between 40% and 60% of the available land for the building, about 37%

(141) of the buildings covered more than 60% of the available land while about 23% of the buildings covered less than 40% (88) of the available land. This showed that most building owners in the study wanted to make maximum use of their land regardless of the existing building and urban development and planning laws in the state and has equally exposed the precariousness of the building and urban development and planning laws in the state. As a result, the rate of percolation get reduces and the volume of flooding increases.

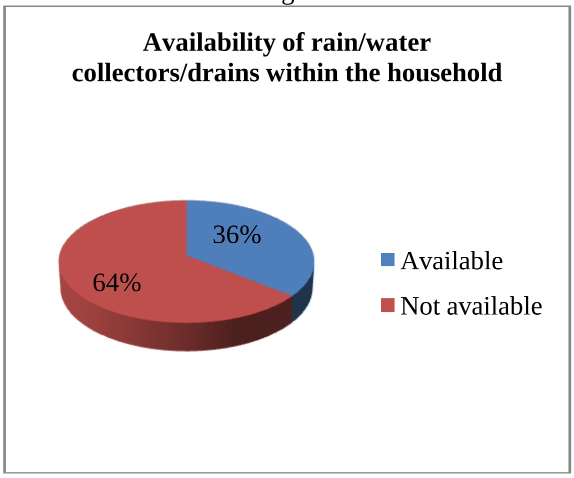

Figure 5: Availability of rain/water collectors/drains

From Fig. 5, it was indicated that about 64% of the households surveyed do not have rain drains/collector within their compounds. Majority of those that have rain drains, connected and/or emptied them to road rather than to gutter or drainage channels. Then since most of the surroundings in the area were covered with impervious materials in the name of landscaping, and greater number of buildings covered more than 40% of the available land space together with non availability of rain drains or collectors the whole environment became flooded soon after the rain has started (see plates 6 - 8).

Plate 6: Drain emptied to the Road

Plate 7: Inadequate Drain

Plate 8: Building on Flood Channel/Road without Drainage

Table 2: Building Development Practices that Contribute to Flooding

Factors	***SD***				***SA***	***Mean score***	***Rank***
	1	**2**	**3**	**4**	**5**		
			Number of Responses				
Siting/orientation of building	0	21	31	85	105	4.13	1
Height of roof	27	45	121	49	0	2.79	6
Size of the building/area occupied by the building	54	19	3	78	88	3.52	5
Landscaping of the compounds and the Use of Concrete and Asphalt in paving	0	62	60	62	58	3.48	4
Inadequate/Lack of drains in house/compound/built up area and Connecting drains from the house to road	23	22	55	66	76	3.62	2
Attitude of building users and Poor management of waste	67	54	103	17	1	2.30	8
Lack of planning restriction/developmental control	17	30	95	5	95	3.54	3
Lack of green area	95	0	95	28	24	2.53	7

TABLE 2 established the built environment issues that contribute to flood menace in the study area. From the result it was observed that siting/orientation of buildings with a mean score of 4.13 ranked first, closely followed by inadequate/lack of drains in house/compound/built up area and connecting drains from the house to road with mean sore of 3.62. Lack of planning restriction/developmental control with a score of 3.54 came third. Landscaping of the compounds and the use of concrete and asphalt in paving; size of the building/area occupied by the building and height of the roof ranked 4th, 5th and 6th respectively. This is an attestation of what was observed physically on the households that were surveyed (See plates 1- 8). This implies that a number of building practice contribute to the regular flooding of the area in the sense that, these practices such as concreting the entire surrounding does not allow adequate percolation which in turn causes rise in the volume of flood water.

Table 3: General Factors Responsible for Flooding

Factors	***SD***				***SA***	***Mean score***	***Rank***
	1	**2**	**3**	**4**	**5**		
			Number of Responses				
Building on flood channels/plain	0	0	27	95	120	4.38	2
Extraordinary Rainfall	0	4	16	114	108	4.35	3
Release of Water from Dams	60	139	15	23	5	2.07	8
Soil Moisture Saturation	58	77	20	75	12	2.61	6
Impervious surfaces/Decrease in permeability of open spaces	11	69	21	88	53	3.43	5
Land use change	54	142	18	25	3	2.10	7
Rapid urbanisation and urban expansion	17	29	33	97	66	3.69	4
Impact of urban microclimate	95	144	3	0	0	1.62	10
Lack or overload of drainage systems	0	0	0	85	157	4.65	1
Discharges from adjoining states	73	123	35	11	0	1.93	9

From TABLE 3, it was observed that lack/overload of drainage system, extra-ordinary rainfall, building on flood channels and rapid urbanisation were the major factors responsible for flooding in the study area. Therefore, the deduction made from this is that man-made activities (i.e. built environment issues) contribute significantly to the volume of flooding in the study area. It is therefore a reconfirmation of the physical observations made on the households studied which indicated that some building practices such as building on a flood channels or plains together with some natural phenomena such as extraordinary rainfall greatly contribute to menace of flooding in Ogbaru Local Government Area of Anambra State.

Deductively, it would be inferred that some building design and construction practices in the study area such as building on the flood plain, use of concrete materials for landscaping and lacks of drains in the compound and streets, height of the roof (i.e. "send down rain") and building up the entire area of land with little or no space remaining have the tendency of exacerbating the velocity and rate of flooding in the area which could turn into natural disaster.

In addition, the study revealed some other principal factors responsible for flooding in the area to include lack/overload of drainage system, extra-ordinary rainfall, building on flood channels and rapid urbanisation.

V. CONCLUSION

Flooding has been recognised worldwide as one of the greatest natural disasters. Its causes have equally been advanced with a number of solutions suggested. The current building practice in Ogbaru has been fingered to have associated with the regular flood occurrence in the area. Thus, as Ogbaru LGA of Anambra State is a suburb the commercial city of Onitsha, it is fast becoming urbanised, residents have continued to experience increased volume of flooding on yearly basis. The question however is whether the regular occurrence of flooding is a mere natural phenomenon or as a result of man-made activities (mainly the building construction practice and urban development being witnessed in the area).

Hence, this study has examined the building development practice in Ogbaru LGA of Anambra State and found that siting of buildings on waterways, flood channels/plains, overload and inadequate drainage system, rapid urbanisation and urban expansion, siting/orientation of building, inadequate/lack of drains around house/compound/built up area and connecting drains from the house to road, landscaping of the compounds and the use of concrete and asphalt in paving, size of the building/area covered by the building among others contribute greatly to the incessant flood menace in the study area.

It has further revealed that inadequate enforcement of planning restrictions and laws, and development control in the state added to the planlessness and indiscriminate siting of building on flood channels and plains which inadvertently increases the recurrence of flood in the area.

Since previous studies had focused on mere causes and impacts of flood disaster without considering the building development process and practice in the area in relation to the flood menace, this study has added a new dimension to the growing body of knowledge. Nevertheless, the result of this study would awaken the consciousness of the residents of the area, building owners and developers, professionals, practitioners, government agencies responsible for urban planning and development, building development and control through revealing the drawbacks of the current construction practice in the study area.

Notwithstanding, the terrain of the interior part of Ogbaru Council Area has no doubt limited the comprehensive coverage of the entire council area due to difficulty in accessing them at certain time of the year. Besides, the four selected towns are the hub of the council area and are very close to the commercial city of Onitsha.

From the foregoing therefore, it is recommended that building professionals, practitioners and developers should review the current construction practice in the area with a view to considering its susceptibility to flooding. Government organs responsible for enforcement of building planning and development laws and control should be strengthened to tackle the indiscriminate erecting of building structures on the waterways and flood channels and plains, in addition to ensuring adequate setbacks, green areas and open spaces so as to allow easy water percolation after rainfall. It is apparent therefore, that the tenet of the National Building Code should be implemented to curb the problem of building control in area and state in general.

While there are national laws and policies on urban and regional planning adopted for housing and urban issues, there is need for specific law on urban renewal in Anambra State. Additionally, there is need for review of Onitsha master plan to accommodate some parts of Ogbaru LGA which have now formed part of Onitsha metropolis. Implementation of structure plan for Onitsha and satellite towns prepared by the UN-HABITAT in collaboration with the Anambra State Government would be a step in the right direction.

The State Government should engage consultants in re-designing of all existing roads and designing of new ones to accommodate the volume of run-off water and flood being experience in the area and also engage the right contractors to execute the projects accordingly. More importantly, early warning signs and predictions of the Nigerian Metrological Agency (NiMet) pertaining to rainfall and flooding in the area should always be given serious thought as any negligence might be catastrophic.

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