



EVALUATION OF NEWMAP MODEL IN FLOOD RISK REDUCTION IN FLOOD PRONE SITES IN SOUTH EAST NIGERIA

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Abstract: Floods are among the most catastrophic geological hazards and have attracted global attention. In Nigeria, the prevalence of flooding is on the increase due mainly to a growing population, rapid urbanization and extreme weather events. Effective flood risk management requires a broad, practical and proactive approach. This study evaluated the success of integrated approaches (NEWMAP model) to the reduction of flood risks in flood prone sites in south east Nigeria using Anambra state as a case study, with a view to formulating strategies and policy options for the reduction of flood risks in the area. The population of the study was 1,403,860 drawn from 11 flood prone sites from the study area, multi-stage cluster sampling technique was adopted to select three sites from the study area giving a sample size of 400 (please see details in the methodology) based on the magnitude of the floods, the resultant devastation on the landscape, the impact on critical infrastructure and on the residents of the area. Four research questions guided the study. A survey research design was used for the study. The instruments for data collection were physical observations, in-depth interviews, questionnaires and Arc-GIS and Remote sensing measurements and observations. Research questions were answered using mean, standard deviation, frequency and percentage. The findings of the study showed that the NEWMAP model in flood risk reduction in South East Nigeria can be categorized into physical intervention, stakeholder involvement, catchment scale intervention, forecasting for preparedness, flood risk reduction effort involving flood prevention, preparedness, response and recovery and provision of alternative means of livelihood to inhabitants of the flood-prone areas to prevent over dependence on natural resources. The findings also showed that NEWMAP has succeeded in reducing the flood risks since it has been observed that the yearly flood submersion and washing away of sections of roads and other critical infrastructure in the study area have abated and that the approaches conform to global best practices in the subject. Based on the findings, the researchers recommend among others that there is the need for government to provide early warning systems and equipment in the study area to aid in warning the populace on time in the case of any flood occurrence and adequate safeguard measures to strengthen disaster risk reduction.

Keywords: Evaluation, NEWMAP, Model, Flood, Risk, Reduction

Introduction

Floods are probably the most widely experienced catastrophic geological hazards (Amadi and Azubuike (2017). They are very serious environmental problem that have attracted global attention and research from academia, the media and other international discourse (Echendu (2020). According to Amadi and Azubuike

(2017), floods do not discriminate between the developed and the developing or under developed countries. Amadi and Azubuike (2017) further stated that floods are usually caused by river or lakes overflowing their banks or by surges of ocean water during periods of heavy rainfall. Floods, among the most terrifying forces on Earth, have led to countless disasters throughout history

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(Echendu (2021). According to Echendu (2021), the story of a catastrophic flood has become a metaphor for a cleansing of humanity's sins and appears in many cultures, from ancient Mesopotamia to China, to Maya peoples and aboriginal tribes in Australia.

Globally according to Abdulahi and Bakari (2020), climate change and urban development have radically increased the frequency and the severity of flooding events. This has generated a lot of interest within the scientific community in conducting more accurate studies regarding flooding in urban areas. Flooding causes severe environmental and ecological damages through ecosystem and biodiversity losses (Abdulahi and Bakari (2020).

In the United States, much of the severe flooding has occurred around the Mississippi River and in Texas, as well as along the Gulf Coast and Florida, because those areas are vulnerable to hurricanes (Komolafe;, Adegboyega;, & Akinluyi;, (2015). Komolafe *et al* also stated that flooding killed 116 people in the country in 2017, the most lethal type of weather event in the nation and that floods also are responsible for about \$6 billion in damage annually in this country. Floods have shaped the history of the United States of America, wiping out some communities forever, and forcing others to start a new life in another part of the country (Komolafe;, Adegboyega;, & Akinluyi;, (2015).

In recent times, heavy rain and flooding in the districts of Al Mahabishah, Ash Shahil, Qafil Shamer, Khayran Al Muharraaq and Aslem in Yemen caused damage and fatalities (Davies (2022). Homes and farms were damaged and several roads were cut, leaving villages inaccessible. According to Davies (2022), UN Agency, the International Organization for Migration (IOM) in Yemen said flash floods in Ma'rib have caused extensive damage to the shelters of thousands of internally displaced people.

In Japan, according to Davies (2022), authorities issued evacuation orders to over 300,000 people in northern and central Japan after heavy rain caused flooding and mudslides. Evacuation orders were also in place for residents in Aomori, Iwate, Yamagata, Fukushima, Niigata, Ishikawa and Fukui. Davies (2022) further stated that Japan's Chief Cabinet Secretary Matsuno Hirokazu had said in a statement that houses were damaged in Yamagata and Niigata prefectures. A bridge in Iide, Yamagata was destroyed and witnesses said a car that was on the bridge at the time was swept away.

In most developing countries, flooding has been linked to causes such as urbanization and poor management practices and has resulted to loss of lives, income, property damage and spread of diseases (Egbinola, Olaniran and Amanambu (2017).

In Africa according to Crilly (2016), floods have become critical national issues in many countries and lack of the financial resources and technical knowhow to mitigate its impacts has rendered most African countries vulnerable to disasters. Apart from climate change which is expected to exacerbate periodic devastating floods in Africa, some other factors and features such as flat topography, geological conditions, urbanization and poor draining networks have rendered African countries vulnerable to flood hazards (Komi, Amisigo, Diekrüger, Kokou, Bossa, Lawin and Adounkpè (2019)

According to United Nations International Strategy for Disaster Reduction (UNISDR) (2017), Africa shows a continuously increasing level of risk materializing through natural hazard extremes. UNISDR (2017) also observed that these natural risks are hurdles to the development of many African countries that see their gross domestic product and investments impaired by the impact of such natural hazards. This is particularly true for Malawi, which is periodically hit by severe floods like the one that occurred in 2015 when the Shire River south of Lake



Malawi and tributaries flooded large parts of the country in several flood waves (UNISDR (2017). UNISDR (2017) further stated that more than 170 people lost their lives, thousands were displaced, and crops were lost.

Many countries in Africa have witnessed devastating floods in the last few decades. In 2007 according to Egbinola *et al.*, (2015) various parts of Africa experienced one of the worst and severe flooding events. More than one million people were affected in over 20 countries. Approximately 500 lives were lost and more than 1.2 million people were displaced with several infrastructural facilities, such as roads, bridges, water pipes and dams destroyed (Egbinola *et al.*, (2015).

In South Africa, catastrophic flooding wreaked havoc in the month of April 2022 killing at least 448 people, displacing more than 40,000 more and destroying thousands of homes (Cohen (2022). According to Cohen (2022), the torrential rainfall caused landslides and massive floods in the Eastern Cape and KwaZulu-Natal provinces that the nation's president called "a catastrophe of enormous proportions." Many lost their loved ones in the middle of the night while they slept.

In Nigeria one of the most prevalent natural disasters is perennial flooding (Echendu (2021). According to Abdulahi and Bakari (2020), flooding has worsened recently due to a number of possible factors including rapid population growth, poor and unplanned urbanisation, and climate change conditions. Flooding is the most frequent and most widespread natural hazard accounting for about one-third of all disasters arising from geophysical hazards and adversely affecting more people than any other natural hazard in the country (Obeta (2014). According to Obeta (2014), flood disasters accounted for about 38% of all the federally declared natural disasters between 1995 and 2005 in the country.

For the past two decades, according to Umar & Gray (2022), annual floods in Nigeria have resulted in the loss

of 1,763 lives and damage to properties worth close to \$1 billion. Most of these disasters were caused by fluvial, flash, and pluvial floods, the deadliest being the fluvial flood.

A fluvial (river) flood occurs when the water level of a lake, river, or stream rises and overflows onto the surrounding banks, shores, and neighbouring land. The rise in water level may be caused by extreme precipitation. Umar & Gray (2022) further stated that between the years 2011–2020, Nigeria recorded about 1,187 deaths connected to flooding, 15% of Africa's deaths by flooding within the same period. The cost of damage to properties was \$904.5 million, which comprised 21% of property damage in Africa from flooding.

Nigeria experienced its worst flooding in over 40 years in 2012 because of heavy rainfall across the country for many days coupled with the fact that the Lagdo Dam in northern Cameroon east of Nigeria, used for electricity generation and irrigation, released its excess water (Umar & Gray (2022). According to Umar & Gray (2022), the floods which affected 32 states of the country occurred from July to October that year, affecting more than 7 million people. More than 2 million others were counted as internally displaced persons (IDPs) while more than 5,000 people were physically injured and over 5,900 houses were destroyed (Umar & Gray (2022). Flooding has become a major hazard in Nigeria in recent years. The 2012 flood disaster in Nigeria adversely affected more people in one year than the combined number of all the people affected by other natural hazards, including soil erosion between 2005 and 2010 (Obeta (2014). It was estimated that Nigeria suffered combined losses of more than \$16.9b in damaged properties, oil production, agricultural and other losses due to flood events in 2012 alone (Oladokun & Proverbs (2016). In South East Nigeria, flooding has been prevalent with wide ranging impacts (Nwagbo (2021). The flooding is majorly



due to rainfall which is prevalent in the southern parts of the country. South East Nigeria is drain

Many cities in south east Nigeria have suffered from the ravaging effects of flooding leading to lose of lives, internal displacements, destruction of properties, disruption of socioeconomic , cultural and religious activities; and splintering of family ties. The cities of Awka and Onitsha in Anambra state, Nigeria featured among the vulnerable cities which are susceptible to flooding.

Over the years according to Nkwunonwo and Malcolm (2015) various levels of government, the community and other stake holders have been active with measures to tackle flooding in Nigeria. These measures include the provision of hydraulic structures like drains, canals and culverts to convey flood waters to safe areas, the provision of early warnings, and Seasonal climate Predictions (SCP) for the year from Nigerian Meteorological Agency (NiMet) and the Annual Flood Outlook released by Nigeria Hydrological Services Agency (NIHSA) Andrea;, Lucas & Kibler (2015):. There is also Flood Alleviation by the National Emergency Management Agency which provides relief and emergency services to flood affected communities (Akoni;,Adelaja;, Onyegbula; & Onodjae,(2022).

Unfortunately, most of these drainage infrastructures in South East Nigeria are poorly constructed and decaying, often silted up or filled with solid wastes, resulting in inundation of such areas with the long-term effects of erosion and ponding due to high energy storm patterns (Enviplan-Grid Design-RMSI-Parkman (2018). Generally, flood management in south East Nigeria and Nigeria as a whole according to Cirella and Iyalomhe (2018) is a reactionary after effect with relief provided to unfortunate victims. Management is limited to waiting for an event to occur with limited seasonal rainfall predictions, mass communication, hazard prevention or associated risk reduction efforts (Cirella and Iyalomhe (2018). Therefore

a strategy that will rescue the populace is urgently needed. Hence, this study evaluated the effectiveness of the NEWMAP model in flood risk reduction in flood prone sites in south east Nigeria using Anambra state as a case study

Research Questions

The following research questions were formulated:

1. What is the state of flood risk reduction efforts in South East Nigeria prior to NEWMAP intervention?
2. How can the components of the NEWMAP model in flood risk reduction in flood prone sites in the study be categorized?
3. To what extent do the NEWMAP Model in flood risk management in the study area conformed to global best practices on the subject?
4. How effective is the NEWMAP model in flood risk reduction in flood prone sites in the study area.

Method

The study was a combined qualitative and quantitative study which adopted a descriptive survey research design. According to Engwa and Ozofo (2015), descriptive survey research design involves samples of different sub-groups of a population to look at similarities or differences between them at any particular time. A qualitative research design is concerned with establishing answers to the whys and hows of the phenomenon in question. Due to this, qualitative research is often defined as being subjective and findings are gathered in a written format as opposed to numerical. Multi-stage cluster sampling technique was adopted to select one state out of the five states in the South East. Anambra state was then selected. This choice was informed by the fact that the highest population densities and rate of urbanization in southeast Nigeria were recorded in Anambra state. Anambra state is mostly involved in commercial activities with huge volumes of poorly managed solid wastes generated,



The population of the study was 1,403,860 drawn from New Niger Heritage Gully Erosion Site, Omagba-Onitsha (45,000), Amachalla Gully Erosion Site, (25,000), Nero Plaza-Thomas Aquinas Gully Erosion Intervention Site, Awka (15,000), Ire Obosi Gully Erosion Site Idemili North LGA (176,725) Nkpor Flyover, Nkpor Gully Erosion Site Idemili North LGA (86,410) Ojoto Gully Erosion site, Idemili South LGA, (34,000) Ugamuma, Obosi Gully erosion Site Idemili North LGA (176,725) Abidi Village Umuoji Gully Erosion Site (80,000), Federal high court– Ekwueme Square Gully Erosion Site (67,000) Nnewichi gully erosion site, Nnewichi (250,000), Enugwu-ukwu gully erosion site, Enugu- ukwu (448,000). Multi-stage cluster sampling technique was adopted to select samples for the study. The sample size was allocated proportionately to the population of the selected sites and the samples were finally selected purposively for the study. Three study sites were selected from the study area based on the magnitude of the floods and the resultant devastation on the landscape, the impact on critical infrastructure and on the residents of the area. In these regards, the following study sites were selected along-side the sample size allocation as follows: New Niger Heritage Gully Erosion Site, Omagba-Onitsha (24), Nnewichi gully erosion site, Nnewichi (135), Enugwu-ukwu gully erosion site, Enugu- ukwu (241). This gave a sample size of 400. It is note-worthy that while some of the study sites were flood control sites, others were gully erosion sites. The justification is that both gully erosion and ponding/inundation are the long term effects of floods. If reduction of flood risks is achieved, these effects will similarly be reduced.

The instruments for data collection were physical observation, in-depth interviews, well-structured questionnaire and Arc-GIS and Remote sensing measurements and observations. In physical Observations the researchers made direct observations on the physical

environment so as to identify physically how effective NEWMAP interventions on the flood prone site were.

Face to face in-depth interviews were employed with professionals and residents of the study area in order to gather specific data meant for the study especially on the state of flood risk management on the various study sites.

The in-depth interviews involved visits to the National Geo-hazards Centre in Awka and other establishments to source for data like updated maps and their latest flood management strategies to enhance the data base for the research work. Some companies working on the flood control sites were visited too.

A well-structured questionnaire was developed and used to gather information on the effectiveness of integrated catchment approaches in the reduction of flood risks on some flood prone sites after the intervention of NEWMAP. The questionnaire was of 5 sections: Section A contained questions on personal data of the respondent like: age, sex, and academic qualification, how long the respondent has been in the study area, frequency of occurrence and heights/density of flood as well whether there was any warning prior to flood occurrence and whether life and property are insured. Section B contained questions on the application of integrated catchment approaches to flood risk reduction under NEWMAP in Southeast Nigeria; Section C contained questions on the degree of success attained by the integrated catchment approaches to flood risk reduction adopted by NEWMAP in the study area in reducing flood risks in the area. Finally, section D contains questions on the extent to which NEWMAP intervention measures conform to global best practices in flood risk reduction and management.

Validity of Research Instrument

The validation of the instrument (questionnaire) was done by experts in measurement and evaluation and the supervisor. Their comments, recommendations and



suggestions were followed in restructuring the questionnaire.

Reliability of Research Instrument

A pilot study was conducted, and 20 questionnaires were administered to the resident of flood prone sites in Abia state. Their responses were used to test for internal consistency using Cronbach's alpha specifically split-half test to avoid bias. A Cronbach's alpha coefficient greater than 0.5 was obtained indicating that the instrument was reliable for the study, Remote sensing and Geographical Information Systems were used to provide spatial information for the purposes of flood monitoring, forecasting and analysis in all NEWMAP intervention sites in the study area. The historical images in Google earth before intervention were compared with the recent images of intervention sites. This approach was used to determine the physical impact of the flood risk reduction effort by NEWMAP and presented as satellite imageries of the site before and after the intervention. High resolution satellite imageries obtained from remote sensing and Geographical Information systems before and after intervention were

used to assess the degree of success of NEWMAP intervention measures in the three study sites.

Method of Data Analysis

The results of the study were compiled in a data base using the Statistical Package for Social Sciences (SPSS). The analyses were carried out using SPSS version 23. Two types of statistical tools were employed in this study, inferential and descriptive statistics. A criterion mean of 3 was used as cutoff for the 5-likert scales. P values less than 0.05 level of significance were regarded as significant. Results were presented in tables and charts.

Results

The data collected were summarized, analyzed and then presented in tables, charts and graphs as follows.

Research Question 1

What is the state of flood risk reduction efforts in South East Nigeria prior to NEWMAP intervention?

Frequency of Floods

Data was obtained from the respondents on the frequency of floods in the study area

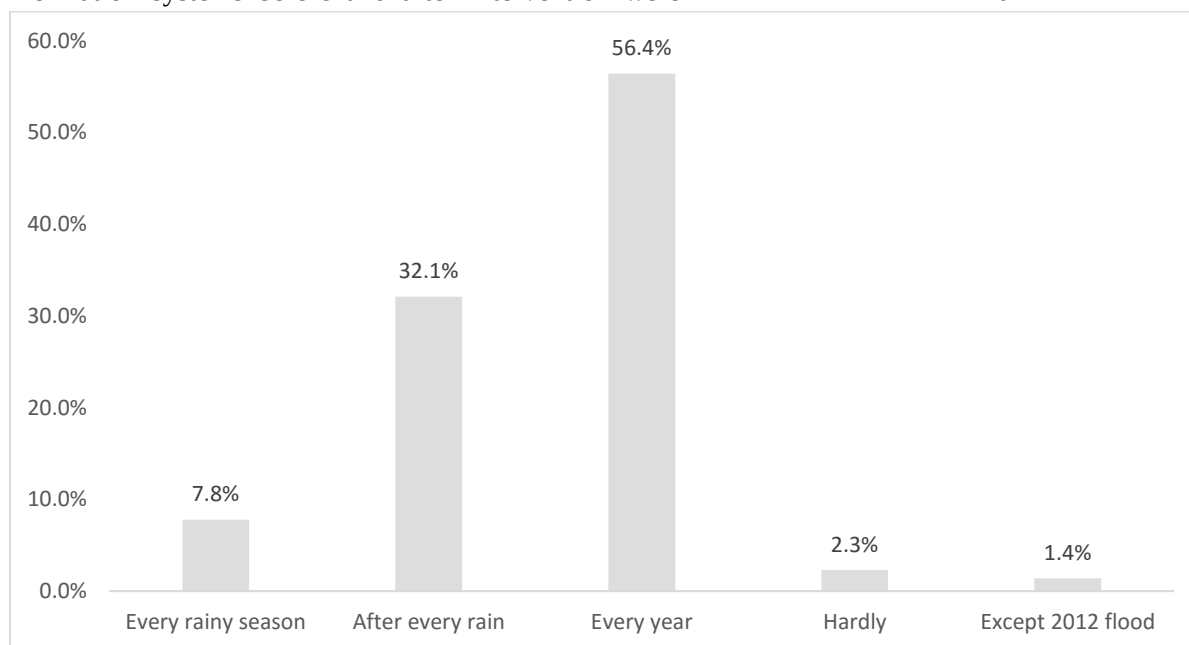




Fig 1: Frequency of flood

Source: Researcher's Field Analysis, 2021

Figure 1 shows that flood commonly occur in the study area every year (56.4%) and after every rain (32.1%)

Fig 2: Time Lag of Floods

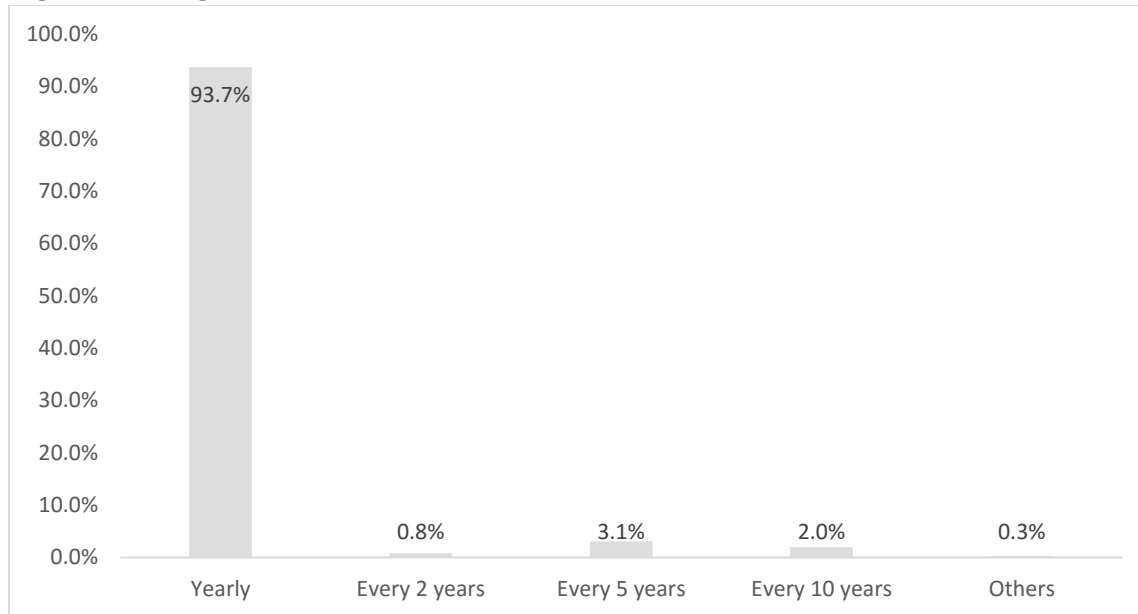


Fig 2: Time lag of the flood

Source: Researcher's Field Analysis, 2021

From Figure 2 it is seen that the time lag of the flood is yearly as was indicated by 93.7%.

Figure 3: Density/height of the flood

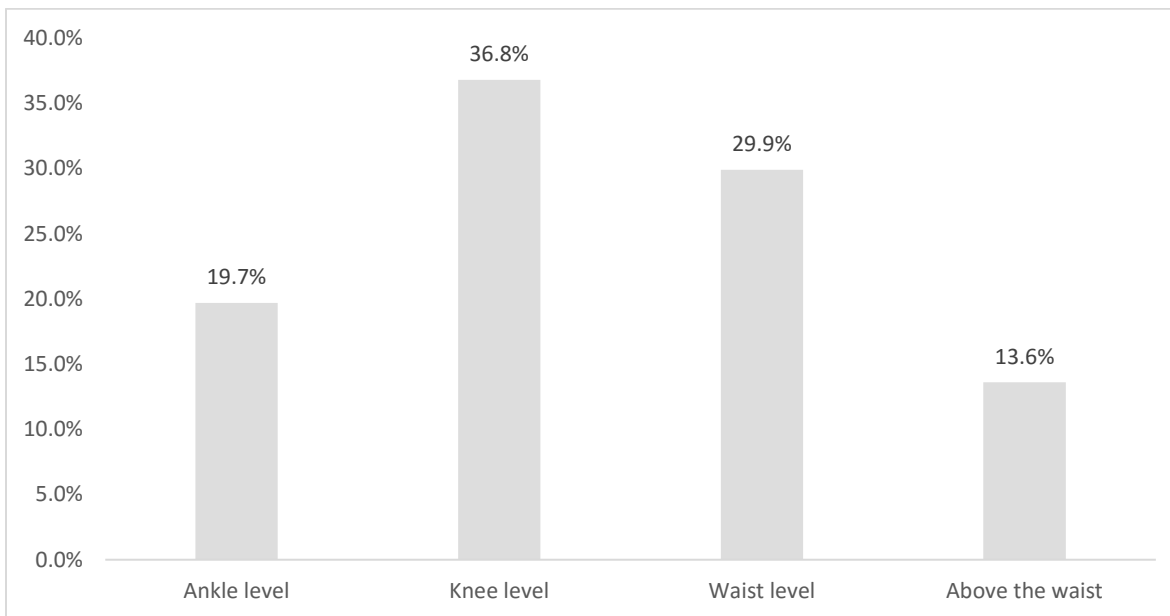


Fig 3: Density/height of the flood

Source: Researcher's Field Analysis, 2021

Figure 3 shows the response of respondents to the density/height of the flood water. 36.8% of the respondents reported that the density/height of the flood is at knee level, 29.9% were of the opinion that it reaches the waist level and 19.7% said it is at the ankle level while 13.6% believes that flood exceeds the waist level. From the analysis of data collected, it can be observed that flood posed enormous environmental problem in the study area and thus justified a study on the approaches for flood risk reduction.

Figure 4: Any Education on Flood Risks

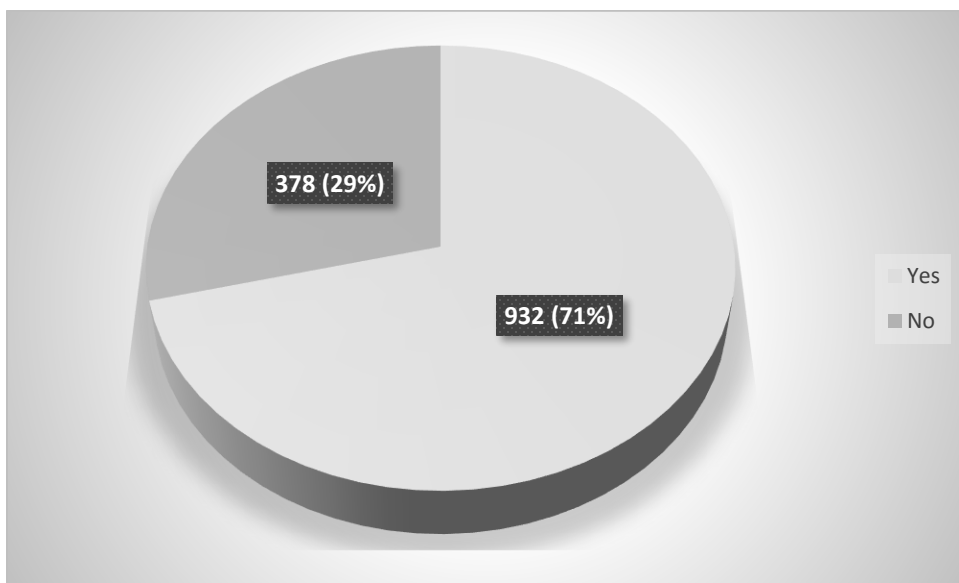


Fig 4: Are you educated on flood risk?

Source: Researcher's Field Analysis, 2021

Figure 4 shows that 71% of respondents are educated on flood risks.

Figure 5: Property Insurance

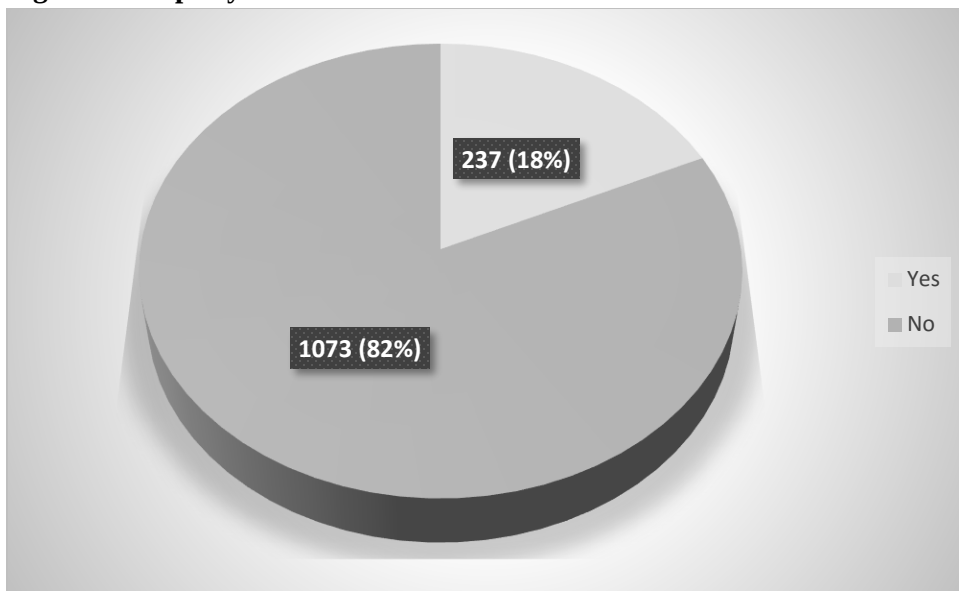


Figure 5: Are your properties insured?

Source: Researcher's Field Analysis, 2021

From figure 5, it was observed that only 18% of the respondents have property insurance. This is so in as much as 80.5% of the respondents have knowledge of property and life insurance. The results of data analysis indicated that there is a level

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of awareness and education on the issue of flooding and its mitigation strategies in the study area. Data collected showed that this was achieved through public enlightenment campaigns carried out by NEWMAP.

Table 1.3: Comparative analysis of the State of Flood Risk Reduction Systems in Anambra State before and after NEWMAP intervention

S/No.	Performance Indicator	Flood Risk Reduction System in South East Nigeria	Application of the NEWMAP MODEL
1	Flood risk reduction measure	Structural only	Integrated
2	Scale of operation	Fragmented	Entire Catchment
3	Philosophy	Reactive	Proactive and anticipatory
4	Community participation	Community is not involved	Community sensitization and participation was implemented
5	Compliance to flood event prediction and early warnings	Little or no compliance	Full Compliance
6	Flood emergency	No plan for flood emergency	Plans for emergency response in the event of flood
7	Flood alleviation	NEMA provides relief items like blankets and food items to flood victims	
8	Financial instrument		NEWMAP provided financial tool in the form of compensation to these at risk to enable them relocate and to victims to offset their losses from flooding and allow recovery without placing undue financial burdens on those impacted by flood disasters
9	Prevention of pollution		
10	State of drainage facilities	Poor drainage facilities and decaying infrastructures,	
11	Bio- remediation		
12	Use of flood plains	Floodplain invasion and deforestation	
13	State of institutional framework for flood disaster management	Weak	Strong



Research question 2:

S/n		Strongly disagree	Disagree	neutral	Agree	Strongly agree	Mean $\pm$ SD
1	Structural measures in the form of rigid structures such as reinforced concrete canals, chutes and stilling basins provided by NEWMAP in the intervention areas as part of flood hazard management was effective in keeping floods away from people and critical infrastructure.	151 (11.5)	58 (4.4)	155 (11.8)	876 (66.9)	70 (5.3)	3.50 $\pm$ 1.07
2	Flexible material installations like gabion walls, gabion check dams and Reno mattresses provided by NEWMAP succeeded in not only reducing flood risks but also facilitated ground water recharge and avoided pitfalls inherent in rigid structures.	26 (2.0)	175 (13.4)	204 (15.6)	707 (54.0)	198 (15.1)	3.67 $\pm$ 0.95
3	NEWMAP approach to flood risk reduction to your area involved a shift in paradigm from defensive action against flood hazards to management of the risk and living with floods	109 (8.3)	98 (7.5)	189 (14.4)	778 (59.4)	136 (10.4)	3.56 $\pm$ 1.05
4	Human uses of floodplains for the purposes of solid waste dumping and erection of structures were discouraged and outlawed at all NEWMAP intervention areas	36 (2.7)	82 (6.3)	177 (13.5)	884 (67.5)	131 (10.0)	3.76 $\pm$ 0.82
5	NEWMAP intervention provided for timely and reliable flood warning, flood forecasting information	213 (16.3)	109 (8.3)	184 (14.0)	619 (47.3)	185 (14.1)	3.35 $\pm$ 1.29
6	NEWMAP flood risk reduction strategy covered the entire catchment area and promoted the coordinated development and management of actions regarding water, land and related resources	57 (4.4)	73 (5.6)	90 (6.9)	825 (63.0)	265 (20.2)	3.89 $\pm$ 0.94
7	NEWMAP provided for and maintained regular basic information and continuous on-going training actions to ensure preparedness to alert, rescue and safety measures and thus seriously limited potential flood damages	10 (0.8)	115 (8.8)	73 (5.6)	748 (57.1)	364 (27.8)	4.02 $\pm$ 0.87
8	NEWMAP provided financial tool in the form of compensation to those at risk to offset their financial	4 (0.3)	14 (1.1)	121 (9.2)	603 (46.0)	568 (43.4)	4.31 $\pm$ 0.71



	risk from flooding and allow recovery without placing undue financial burdens on those impacted by flood disasters						
9	NEWMAP carried out aggressive flood risk awareness campaign to discourage occupation of the floodplains out of ignorance and	8 (0.6)	41 (3.1)	136 (10.4)	833 (63.6)	292 (22.3)	4.04 ± 0.71

How can the Components of the NEWMAP Model in Flood Risk Reduction in Flood Prone Sites in the Study be categorized.

Table 2.1a-c: below shows the analyses of questionnaires from respondents on the application of integrated catchment approaches (**NEWMAP model**) to flood risk reduction by NEWMAP in the study area

Application of integrated catchment approaches to flood risk reduction by NEWMAP

Table 2.1b Application of integrated catchment approaches (NEWMAP model) to flood risk reduction by NEWMAP

S/n		Strongly disagree	Disagree	neutral	Agree	Strongly agree	Mean ± SD
10	NEWMAP integrated flood risk management into land use planning in order to minimize encroachment of floodplains and other flood-prone areas	23 (1.8)	27 (2.1)	104 (7.9)	624 (47.6)	532 (40.6)	4.23 ± 0.82
11	NEWMAP ensured stakeholder and community preparedness by engaging in active campaign and the consultation of stakeholders about flood risks and making the public aware of emergency procedures	19 (1.5)	6 (0.5)	12 (0.9)	905 (69.1)	368 (28.1)	4.22 ± 0.63
12	NEWMAP carried out enlightenment campaigns on the importance of collective environmental security and avoidance of unwholesome environmental practices such as sand mining and deforestation	5 (0.4)	15 (1.1)	95 (7.3)	878 (67.0)	317 (24.2)	4.14 ± 0.61
13	NEWMAP encouraged community members to participate in proactive preparation to cope with flooding which included response, recovery as measures that are best suited to the locality or community	2 (0.2)	5 (0.4)	152 (11.6)	768 (58.6)	383 (29.2)	4.16 ± 0.64
14	NEWMAP put in place adequate and well-maintained modern drainage infrastructure like reinforced concrete canals and detention ponds to keep flood away from dwellings, farms and business areas.	5 (0.4)	9 (0.7)	157 (12.0)	741 (56.6)	398 (30.4)	4.16 ± 0.68



15	NEWMAP ensured proper urban planning by ensuring that structures are not built on natural waterways thus obstructing the free-flow of floods	73 (5.6)	65 (5.0)	125 (9.5)	487 (37.2)	560 (42.7)	4.06 ± 1.10
16	NEWMAP encouraged relevant authorities to enact and fine tune existing urban planning laws to enforce compliance	95 (7.3)	17 (1.3)	182 (13.9)	803 (61.3)	213 (16.3)	3.78 ± 0.98
17	NEWMAP encouraged water retention in vegetation, soil, ground and wetlands through tree planting and discouraging of ground sealing	8 (0.6)	6 (0.5)	51 (3.9)	854 (65.2)	391 (29.8)	4.23 ± 0.59
18	NEWMAP developed plans for identifying major hazards, areas and infrastructure at risk as well as appropriate risk reduction measures	23 (1.8)	70 (5.3)	90 (6.9)	760 (58.0)	367 (28.0)	4.05 ± 0.85

Table 2.1c Application of integrated catchment approaches (NEWMAP model) to flood risk reduction by NEWMAP

S/n		Strongly disagree	Disagree	neutral	Agree	Strongly agree	Mean ± SD
19	There existed a multi-sectorial approach to flood risk reduction efforts which involved Federal, State and Local Council Ministries, Departments and agencies along with stakeholders in host communities in all NEWMAP intervention areas	12 (0.9)	26 (2.0)	141 (10.8)	603 (46.0)	528 (40.3)	4.23 ± 0.79
20	NEWMAP provided alternative means of livelihood to low-income earners resident in the intervention areas to prevent over dependence on natural resources	5 (0.4)	8 (0.6)	72 (5.5)	684 (52.2)	541 (41.3)	4.33 ± 0.64
21	NEWMAP has put in place arrangements for supporting recovery-based activities such as those that deal with physical damage, humanitarian issues (e.g. dealing with displaced communities and welfare needs of those affected), environmental issues (e.g. pollution control and decontamination), economic issues, and infrastructure issues (e.g. reinstating critical infrastructure).	105 (8.0)	82 (6.3)	354 (27.0)	552 (42.1)	217 (16.6)	3.53 ± 1.09
22	NEWMAP assessed the impact of each of the major interventions on social and environmental aspects in consultation with community association including	98 (7.5)	82 (6.3)	232 (17.7)	685 (52.3)	213 (16.3)	3.64 ± 1.0



	the possible need to relocate homes, businesses, roads, e.t.c						
23	NEWMAP planned and executed risk mitigation measures such as resettlement action plan and eliminated activities that are of high risk of flood in intervention areas	25 (1.9)	49 (3.7)	135 (10.3)	743 (56.7)	358 (27.3)	4.04 ± 0.83
	Grand mean						3.95 ± 0.29

Tables 2.1a-c shows that majority of the respondents in the study area are in agreement that NEWMAP provided structural measures in the form of rigid structures such as reinforced concrete canals, chutes and stilling basins in the intervention areas as part of flood hazard management to keep floods away from people and critical infrastructure. This was indicated by mean response value of 3.50 which is greater than the criterion mean of 3 with low standard deviation of 1.07 which indicates low variability of response.

They were also in agreement that NEWMAP provided flexible material installation like gabion walls, gabion check dams and Reno mattresses not only to reduce probability of flood events, but also to facilitate ground water recharge and to avoid pitfalls inherent in rigid structures (3.67 ± 0.95).

NEWMAP approach to flood risk reduction to the area involved a shift in paradigm from defensive action against flood hazards to management of the risk and living with floods (3.56 ± 1.05).

Human uses of floodplains for the purposes of solid waste dumping and erection of structures were discouraged and outlawed at all NEWMAP intervention areas (3.76 ± 0.82), NEWMAP intervention provided for timely and reliable flood warning, flood forecasting information (3.35 ± 1.29), NEWMAP flood risk reduction strategy covered the entire catchment area and promoted the coordinated development and management of actions regarding water, land and related resources (3.89 ± 0.94),

NEWMAP provided for and maintained regular basic information and continuous ongoing training actions to ensure preparedness to alert, rescue and safety measures and thus seriously limited potential flood damages (4.02 ± 0.87),

NEWMAP provided financial tool in the form of compensation to those at risk to offset their financial risk from flooding and allow recovery without placing undue financial burdens on those impacted by flood disasters (4.31 ± 0.71) and NEWMAP carried out aggressive flood risk awareness campaign to discourage occupation of the floodplains out of ignorance and to introduce buffer zones between their dwellings and flood prone areas (4.04 ± 0.71).

Other NEWMAP approaches applied are found in tables 3b & 3c. In summary, the grand mean response of 3.95 ± 0.29 greater than the criterion mean of 3 indicates that majority of the respondents are in agreement with the application of integrated catchment approaches to flood risk reduction by NEWMAP.

Conclusively, it can be deduced that NEWMAP application of integrated catchment approaches to flood risk reduction in south east Nigeria, Anambra state as a case study can be categorized into provision of structural measures in the form of rigid structures such as reinforced concrete canals, chutes and stilling basins, provided flexible material installation like gabion walls, gabion check dams and Reno mattresses, a shift in paradigm from defensive action against flood hazards to management of



the risk and living with floods in the realization that absolute freedom from flood is a mirage as one can only aspire to mitigate the effect, flood plains are free from development and solid waste dumping, flood risk reduction measure cover the entire catchment area, regular basic information and continuous ongoing training actions

to ensure preparedness and compensation in the event of flood event are maintained.

Research question 3:

To what extent do the NEWMAP Model in Flood Risk management in the Study Area Confirmed to Global Best Practices on the Subject.

Table 3.1a-c: Extent to which NEWMAP approaches in flood risk management in the study area conform to global best practices on the subject

S/n		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean $\pm$ SD
1	Intervention measures for flood prevention and protection by NEWMAP are carried out at catchment scale and not fragmented thus ensuring that flood risks are not merely transferred downstream	0 (0.0)	0 (0.0)	8 (6.2)	92 (70.8)	30 (23.1)	4.17 $\pm$ 0.52
2	NEWMAP's adopted social mobilization activities such as sensitization on community land-use plans, adoption of water harvesting, and soil and water conservation practices, communal labour to maintain drainage structures, restoration and the maintenance of vegetation	0 (0.0)	8 (6.2)	2 (1.5)	66 (50.8)	54 (41.5)	4.28 $\pm$ 0.78
3	NEWMAP engages in flood risk awareness campaign to discourage occupation of flood plains and is also involved in advocacy to ensure that on-going development and encroachment of floodplains and other flood prone areas are outlawed	0 (0.0)	6 (4.6)	4 (3.1)	62 (47.7)	58 (44.6)	4.32 $\pm$ 0.75
4	NEWMAP ensured that human uses of flood plains are adapted to the existing flood hazards and appropriate instruments and measures developed for all flooding related problems	0 (0.0)	6 (4.6)	4 (3.1)	80 (61.5)	40 (30.8)	4.18 $\pm$ 0.70
5	NEWMAP provides financial mechanism like compensation or some financial to those at risk to offset their financial risk from flooding so as to allow recovery without placing undue financial burdens on those impacted by flood disaster	6 (4.6)	2 (1.5)	8 (6.2)	70 (53.8)	44 (33.8)	4.11 $\pm$ 0.93



6	It is a known fact that existing waste disposal practices may cause or exacerbate flooding, by impeding the flow in drains and watercourses, or by filling low-lying areas which may otherwise act as temporary storage lagoons during floods. NEWMAP is involved not only in advocacy but directly in waste management.	0 (0.0)	2 (1.5)	10 (7.7)	62 (47.7)	56 (43.1)	4.32 ± 0.68
7	Flood forecasting and warning is a prerequisite for successful mitigation of flood damage and its effectiveness depends on the level of preparedness and correct response. To achieve this, NEWMAP provides timely and reliable flood warning, flood forecasting and information	0 (0.0)	6 (4.6)	2 (1.5)	114 (87.7)	8 (6.2)	3.95 ± 0.51

Table 3.1b: extent to which NEWMAP approaches in flood risk management in the study area conform to global best practices on the subject

S/n		Strongly disagree	Disagree	neutral	Agree	Strongly agree	Mean ± SD
8	NEWMAP intensifies cross border efforts to restore rivers' natural flood zones in order to reactivate the ability of natural wetlands and floodplains to retain water and alleviate flood impacts	0 (0.0)	2 (1.5)	4 (3.1)	98 (75.4)	26 (20.0)	4.14 ± 0.52
9	There are institutional arrangements for flood forecasting and warning in the study area	0 (0.0)	6 (4.6)	0 (0.0)	84 (64.6)	40 (30.8)	4.22 ± 0.67
10	There are flood forecasting tools such as flood hazard maps in place	0 (0.0)	8 (6.2)	2 (1.5)	76 (58.5)	44 (33.8)	4.20 ± 0.75
11	NEWMAP assists relevant government agencies through enlightenment and advocacy to ensure proper urban planning so that structures are not built on natural waterways thus obstructing the free-flow of floods and existing urban planning laws to enforce compliance	0 (0.0)	4 (3.1)	4 (3.1)	72 (55.4)	50 (38.5)	4.29 ± 0.68
12	NEWMAP advocates for building codes and legislation to keep structures away from flood prone areas, appropriate land use, adequately designed floodplains and flood control structures	0 (0.0)	4 (3.1)	2 (1.5)	114 (87.7)	10 (7.7)	4.00 ± 0.47



	planning, mitigation, early warning systems, correct risk communication and preparedness of the populations how to act during floods						
13	NEWMAP efforts have been fundamental to the “living with floods and not fighting them” idea, which dominates key environmental risk research themes	0 (0.0)	4 (3.1)	6 (4.6)	80 (61.5)	40 (30.8)	4.20 ± 0.66
14	NEWMAP encourages relevant government agencies to put in place effective municipal solid waste management	0 (0.0)	2 (1.5)	2 (1.5)	76 (58.5)	50 (38.5)	4.34 ± 0.59
15	NEWMAP has provided structures and systems for the implementations of procedures and mechanisms for proactive culture of institutional learning aimed at increasing the skilfulness, responsiveness and proficiency of emergency actors and organizations in a flood event and to continuously improve the emergency management system as a whole	0 (0.0)	4 (3.1)	8 (6.2)	86 (66.2)	32 (24.6)	4.12 ± 0.65

Table 3.1c: extent to which NEWMAP approaches in flood risk management in the study area conform to global best practices on the subject

S/n		Strongly disagreed	Disagree	neutral	Agree	Strongly agree	Mean ± SD
16	In NEWMAP intervention, there existed a multi-sectorial approach to flood risk reduction efforts which involved federal, state and local council ministries, departments and agencies along with stakeholders in host communities	0 (0.0)	2 (1.5)	2 (1.5)	80 (61.5)	46 (35.4)	4.31 ± 0.58
17	NEWMAP provided early warning systems to give advance notice of an impending flood, thus allowing emergency plans to save lives and reduce other adverse impacts	2 (1.5)	4 (3.1)	4 (3.1)	56 (43.1)	64 (49.2)	4.35 ± 0.82
18	International and trans-boundary co-operation are needed especially in terms of shared approaches to river basin management, preparation of risk analyses and flood forecasts at transnational level, improving the co-	0 (0.0)	2 (1.5)	2 (1.5)	60 (46.2)	66 (50.8)	4.46 ± 0.61



	ordination of the existing forms of assistance, sustainable use of biodiversity, are one of the components of an anticipatory approach which NEWMAP implements						
19	The reduction of flood risks has to be based on the principles of solidarity and precaution by not passing on water management problems, and not passing on administrative responsibilities. NEWMAP ensure this	0 (0.0)	2 (1.5)	24 (18.5)	86 (66.2)	18 (13.8)	3.92 ± 0.62
20	NEWMAP advocates that there is a need for interdisciplinary co-operation at all government and local levels for a co-ordination of sectoral policies regarding environmental protection, physical planning, land use planning, agriculture, transport and urban development and a co-ordination regarding all phases of risk management: risk assessment, mitigation planning and implement measures	0 (0.0)	6 (4.6)	4 (3.1)	96 (73.8)	24 (18.5)	4.06 ± 0.63
21	NEWMAP advocates for an effective co-operation between state authorities, the communities, water regulation enterprises and other interested parties, e.g by creating a local water commission, which is more than needed for a regional co-ordination and the implementation of a holistic approach	0 (0.0)	2 (1.5)	6 (4.6)	96 (73.8)	26 (20.0)	4.12 ± 0.54
	Grand mean	4.19 ± 0.14					

Table 3.1a-c shows that majority of the respondents agree that NEWMAP approaches in flood risk management in the study area conform to global best practices. They include:

Intervention measures for flood prevention and protection by NEWMAP are carried out at catchment scale and not fragmented thus ensuring that flood risks are not merely transferred downstream (4.17 ± 0.52),

NEWMAP's adopted social mobilization activities such as sensitization on community land-use plans, adoption of water harvesting, and soil and water conservation

practices, communal labour to maintain drainage structures, restoration and the maintenance of vegetation (4.28 ± 0.78),

NEWMAP engages in flood risk awareness campaign to discourage occupation of flood plains and is also involved in advocacy to ensure that on-going development and encroachment of floodplains and other flood prone areas are outlawed (4.32 ± 0.75),

NEWMAP ensured that human uses of flood plains are adapted to the existing flood hazards and appropriate



instruments and measures developed for all flooding related problems (4.18 ± 0.70),

NEWMAP provides financial mechanism like compensation or some financial to those at risk to offset their financial risk from flooding so as to allow recovery without placing undue financial burdens on those impacted by flood disaster (4.11 ± 0.93),

It is a known fact that existing waste disposal practices may cause or exacerbate flooding, by impeding the flow in drains and watercourses, or by filling low-lying areas which may otherwise act as temporary storage lagoons during floods.

NEWMAP is involved not only in advocacy but directly in waste management (4.32 ± 0.68) and Flood forecasting and warning is a prerequisite for successful mitigation of flood damage and its effectiveness depends on the level of preparedness and correct response.

To achieve this, NEWMAP provides timely and reliable flood warning, flood forecasting and information (3.95 ± 0.51). Other NEWMAP approaches in flood risk management that conforms to global best practices can be found in table 5b & 5c.

In summary, the grand mean response of 4.19 ± 0.14 greater than the criterion mean of 3 indicates that NEWMAP approaches in flood risk management in the study area conform to global best practices.

Discussion of Results of analyses

From the results of the analysis, it can be deduced that the flood risk reduction approaches adopted by NEWMAP in the study area conform to global best practices in the subject.



Research Question 4: How effective is the NEWMAP model in flood risk reduction in flood prone sites in the study area.

This research question was answered by taking pictures before and after NEWMAP intervention in the various sites studied to ascertain if the measures succeeded in reducing flood risks as can be seen below.

3.1 Effectiveness of the NEWMAP Model in Flood Risk Reduction in Flood Prone Sites in the Study Area

Nnewichi Gully Erosion Site, Nnewichi



Plate 3.1a: Nnewichi Gully Erosion Site, Nnewichi before intervention



Plate 3.1b: Nnewichi Gully Erosion Site, Nnewichi after intervention.

Flood risk reduction measures carried out on the Nnewichi Gully Erosion Site, Nnewichi was closely studied before (see Plate 3.1a), and after (see Plate 3.1b) the intervention. The result of the study shows that the measures succeeded in reducing flood risks in the area.

Study Site No. 1: New Heritage Gully Erosion Site, Omagba, Onitsha



Plate 3.2a: Satellite Imagery of New Heritage Gully Erosion Site, Omagba Onitsha before intervention





Plate 3.2b: Satellite Imagery of New Heritage Gully Erosion Site, Omagba Onitsha after intervention

The possible cause of the gully erosion at the New Niger Heritage, Omagba, Onitsha, was concentrated flow coming from a broken down culvert, due to road failure. The cause of this failure was as a result of an increase in storm water runoff due to road repairs.

The New Heritage erosion site is located within the Onitsha-bound side of the Federal dual carriage way about one-kilometer north of the popular Zik's roundabout. The flood/erosion control works at the New Heritage Omagba, Onitsha involved the reinforced concrete drainage channel

dimensions; 425m long X 5.3m wide X 4m deep X 0.4m thick from the junction with the Enugu/Onitsha dual carriageway down to the Nkisi River. The first phase of this intervention project has been completed.

Plate 3.2a is the satellite Imagery of the area before intervention and it shows gullies created by flood while Plate 3.2b is the satellite imagery of NEWMAP intervention works. The flood risk has thus been reduced and the gullies remediated.

Study Site No. 2: Nnewichi Gully Erosion Site, Nnewichi

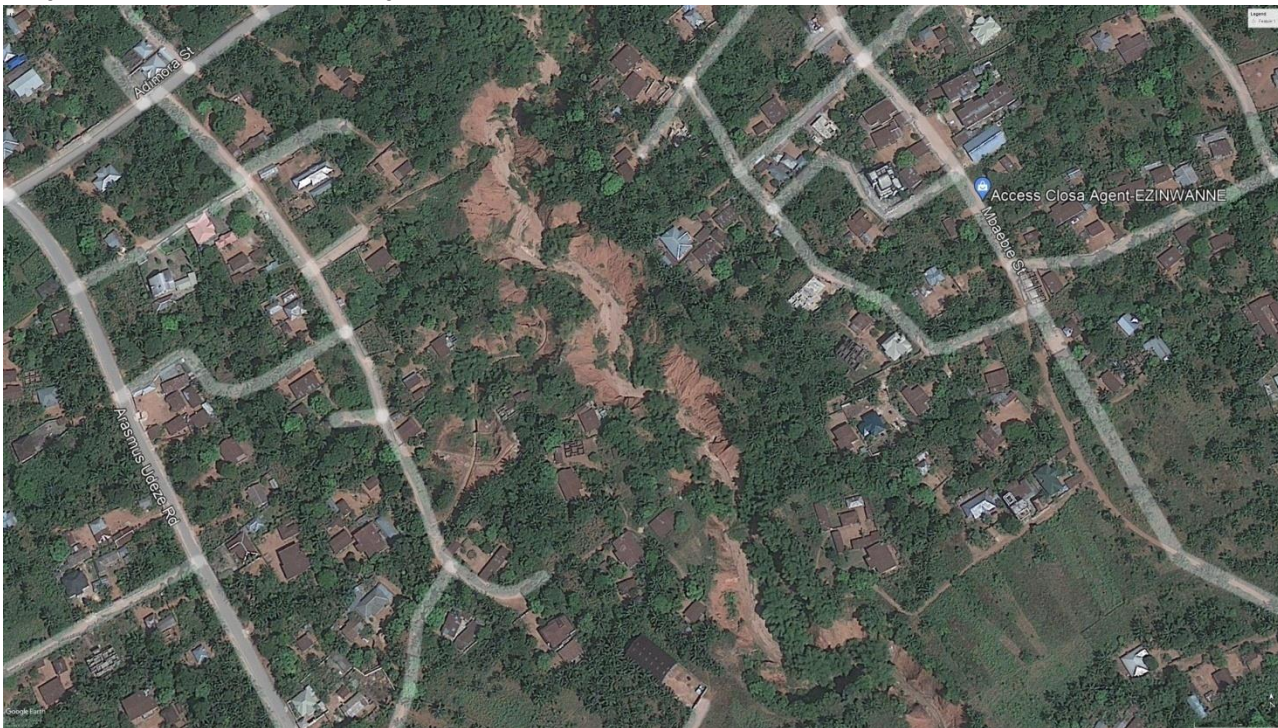


Plate 4.1a: Satellite Imagery of Nnewichi Gully Erosion Site, Nnewichi before intervention



Plate 4.2b: Satellite Imagery of Nnewichi Gully Erosion Site, Nnewichi after intervention

The Nnewichi Erosion Site is located in Nnewichi Township, within the Nnewi North Local Government Area (LGA). Nnewichi is bounded on the east by Otolo, on the west by Uruagu, on the north by Ojoto and Nnobi, both of Idemili South Local Government Area, and on the South by Uruagu and Umudim.

The areas around the gully head at Nnobi road were usually flooded during the rainy season because the culvert across the road to a drainage channel was not of enough capacity to carry the runoff. The channel was abruptly terminated thus causing the gully erosion.

Study Site No. 3: Enugwu Ukwu Gully Erosion Site, Enugwu Ukwu

Flood risk reduction measures undertaken were construction of reinforced concrete drainage channel on main and finger gullies, installation of gabion retaining wall, check dams and reno mattresses, bank stabilization on head, gully walls using stone pitching and vetiver grass; Provision of toe protection through the installation of collector or trunk drains at the toe and bed of the main and finger gullies; construction of chutes, terminal structures, energy dissipaters, drop structures and stilling basins.



Plate 5.1a: Satellite Imagery of Enugwu Ukwu Gully Erosion Site, Enugwu Ukwu before intervention





Plate 5.2b: Satellite Imagery of Enugwu Ukwu Gully Erosion Site, Enugwu Ukwu after intervention

The project area cut across two (2) major communities in Enugwu-ukwu. The larger section in Urunnebo community had separated Umujana and Umunwankwo Villages while the other section falls in Umuorji village in Avomimi Community of Enugwu-Ukwu

The intervention carried out was aimed at ameliorating the erosion problem through proper management of prevailing flood flow path to the gully and subsequently control the gully using adequate drainage systems such as culverts, drains, chute channels and stilling basins, rip-rap resting on geotextile, then gabion check dams placed along the gully bed to slow down the flow velocity, etc.

Discussion of Findings

Prior to the intervention of the Nigeria Erosion and Watershed Management Project (NEWMAP) in flood risk reduction in south east Nigeria (Anambra state) the approach to flood risk reduction and management was fragmented and involved measures to keep flood away from the people merely the construction of physical structures such as the provision of hydraulic structure such as drains, culverts and canals to convey flood waters from the area of interest to another area further downstream, flood channelization and river containments. Response to flood event was reactive and agencies saddled with flood management could hardly anticipate flood event. Even when the Nigeria Meteorological Agency (*NiMet*) predicts a flood incident, hardly any action is taken in anticipation. This study observed that NEWMAP approaches are different as NEWMAP in addition to the provision of physical barriers against flood also laid emphasis on timely and reliable flood warning, flood forecasting information. The study also found out that unlike what was the case before NEWMAP intervention when measures to flood risk reduction was fragmented, NEWMAP intervention was carried at the scale of the entire catchment area and the avoidance of developments on flood plains.

Hitherto, intervention by government agencies to flood victims in the study area involved relocating them to internally displaced persons 'camps and the provision of relief materials, but this study indicated that NEWMAP approach provided for financial tool in the form of compensation to those at risk to offset their financial risk from flooding and allow recovery without placing undue financial burdens on those impacted by flood disasters. Finally, this study also indicated that the NEWMAP intervention approached to flood risk reduction in south east Nigeria conform to global best practices in the subject and have succeeded in flood risk reduction in the study area.

Conclusions

Based on the results of the various analyses carried out in this study, the following conclusions were arrived at; that: Absolute freedom from flood is a mirage, we must move from fighting flood to living with flood while attempting to reduce flood risks to an acceptable level.

Integrated catchment approaches involving a combination of physical construction and the four phases of disaster risk reduction namely: prevention, preparation, response and recovery taken in a proactive and anticipatory manner is the best practice to reduce flood risk to an acceptable level. Community participation and mobilization, public education and information on these techniques are essential in order to create necessary awareness

Recommendations

Based on the findings and observations of this study and to ensure a sustainable and better environment, the researchers make the following recommendations:

- i. There is the need for government to provide early warning systems and equipment in the study area to aid in warning the populace on time in the case of any flood occurrence as this will enable inhabitants of the need to be evacuated to safe place and mitigate the effect of the flood.



The inhabitants of the area should be educated on the workings of the early warning system.

ii. Government at all levels should provide the enabling policy and legal framework to stop developments at flood prone areas.

iii. Government should provide policy guidelines and allow the private sector to get involved in municipal solid waste management for greater effectiveness.

iv. Adequate safeguard measures to strengthen disaster risk reduction should be provided.

v. Developing and disseminating relevant and appropriate key messages on improper waste disposal, rain water harvesting, deforestation and illegal sand mining is highly recommended

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