A review of decision-making for pre floods resilience in housing

Anthony, Peter[1,2*], Roshida Binti Abdul Majid[1], & Nor Izura Binti Tukiman[1]

[1] Department of Architecture Universiti Teknologi Malaysia.
[2]Department of Architectural Technology. The Federal Polytechnic Ado-Ekiti, Nige

DOI: https://doi.org/10.56293/IJASR.2022.5489

IJASR 2023
VOLUME 6
ISSUE 1 JANUARY - FEBRUARY **ISSN: 2581-7876**

Abstract: Most people inhabiting or owning houses in flood-prone areas do not have a prior idea of the situation of the site. The type of flood determines the causes and effects of flooding. It is, therefore, necessary to understand the causes and consequences of flooding in our sites. Both the developer and homeowners after having an in-depth idea of the situation and especially the impact of a particular flood will from the onset decide on whether to go on with the intended idea of development or seek an alternative area. The decision of choices would be taken based on the flood's known effects, causes and professional evaluation. The purpose of this study was to look into the five types of floods alongside their features, and decisions to be taken after evaluation. The scope of the study was to assess the condition of sites regarding floods and a subsequent decision arrived before starting any construction. Data was gathered using the review approach: Books and articles. The knowledge acquired would be relevant in the decision of the end-users or developer to either start construction or abandon the site. In situations where the choice is to start development, further education would be needed on resilience to the specific flood type found in the location. The impact of the study reveals that an estimated cost, time, emotional worries, and resilience techniques would be disclosed before the start of any construction for early decision. However, if the disadvantage of starting the project outweighs the advantages, the best decision is to avoid the site and not start the work.

Keywords: Flood-prone areas, types of floods, Decision- making, pre floods, resilience, housing

1.0 Introduction

Flooding is amongst the most damaging and prevalent catastrophic events, causing destruction of property, interim homelessness, business loss as well as fatalities. Flooding claimed 223,482 lives and caused over $1 trillion in damage worldwide between 1980 and 2018 (Munich RE, 2021). Furthermore, it is the most frequently occurring natural hazard globally, causing widespread life and property losses every year(Willner S.N., Otto, C., Levermann, 2018).

Between July 2012 and January 2019, Malaysia had the greatest percentage of its population (67%) exposed to floods among ASEAN (Association of Southeast Asian Nations) member states. Flooding has been a major source of danger and loss in Malaysia for the past five years, with a remarkable three-fold rise in population vulnerability in the last 20 years. Several researchers have criticised the Malaysian government's implementation of a holistic approach to flood risk reduction from preparedness to post-event relief, even though the Malaysian government has officially adopted a holistic approach to flood risk reduction from preparedness to post-event relief (Shafiai, S., and Khalid, 2016).

Flooding is not a recent phenomenon in Nigeria (Adeloye, 2011). Recent flooding events in Nigeria, such as the floods in Sokoto in 2010, Ibadan in 2011, Lagos in 2011, and much of the country in 2012, have demonstrated that flooding is one of the country's major environmental issues. Coastal flooding, river flooding, and urban flooding are the three basic types of flooding in Nigeria(Orok, 2011).

The fact of widespread flooding in Nigeria, combined with the belief that floods are an unavoidable occurrence that can never be contained within the natural environment, appears to be obstructing efforts to find a remedy(UC, 2015). It is possible to build structural defences in some circumstances, but not in others, and non-structural defences should be devised instead (Qari et al., 2014).

A natural hazard like a flood requires sound leadership and decision-making before, during, and after it occurs. For people's needs to be satisfied in emergency pre-flood resilience in housing, they must have access to and participation in decision-making. This is especially true for vulnerable population groups and marginalised groups. People's vulnerability may increase if they are not included in decision-making processes if their demands are not taken into consideration (Hewawasam & Matsui, 2020)(Mason et al., 2021). In flood evaluation consideration has to be given to relevant flood-resilient factors, which include, Non-reinforced masonry construction, Amphibious design, Limiting Water Entry, Floodwalls and levees, Building above flood level, Elevation, Relocation and Demolition, space planning, materials, and construction. The relevant professionals are consulted in the pre floods era to determine the appropriate resilient factor to be used.

However, non may be used if the evaluation is not efficient from the professional's viewpoint. The decision-making process for pre-flood preparedness is aided by sensitive and applicable factors among all other factors (Sen et al., 2021). Regardless of the type of flood, those who lack resilience because they are not involved in decision-making are likely to be more vulnerable **(Mason et al., 2021)**. Poor participation in decision-making may also be a result of a lack of community leadership. How to incorporate the required understanding among the stakeholders is complicated by the fact that decision-making amongst homeowners is oftentimes dependent, with homeowners hesitant to pursue resilience unless they see others in the community doing the same (Kunreuther, 2006). Flood resilience in housing will be efficient when decision-making is considered from the design stage (Miguez & Veról, 2017).

The purpose of the study are:

i. To Identify the types of floods
ii. To determine the causes and impacts of floods
iii. To evaluate the site for decision-making from the onset; continue or abandon the site.

2.0 Methodology

Examining earlier publications in the field served as the study's secondary source of data collecting. The books and articles were electronically retrieved from the Scopus, Web of Science, and Google Scholar databases. A search was conducted to discover the body of material that was relevant to decisions on flood resilience in housing. When searching, terms like "decision-making for pre-flood resilience in housing," "decision-making for flood resilience in housing," "types of floods," "causes of floods," and "Impacts of floods" were relevant.

In all, 245 publications were identified, of which 62 were from Scopus, 71 were from Web of Science, and 112 were from Google Scholar. There were 91 documents left after duplicates were filtered out. After a second screening to verify that only materials related to the study's scope were taken into consideration, 13 documents are centred on decision-making for pre-flood resilience in housing. 27 on types of floods. 19 on flood causes. 16 concentrates on the effects of floods. At this stage, 75 documents, spanning the years 1998 to 2021, are still up for review (25 years). Table 2 provides decision-making for 14 Authors for pre-flood resilience in housing. The analysis includes documents with only English-language content as well as conference proceedings and journal articles. Table 1 illustrates the research study's methodology.

Table 1. The specific settings for search and findings

S/N	Settings for Search	Findings
1	Where collected	Scopus, web of science, and Google scholar
2	Words imputed	"Decision-making for pre floods resilience in housing", "Decision-making for floods resilience in housing", "types of floods", "causes of floods" and "Impacts of floods"
3	Types of Documents	All relevant documents
4	Duration	1998-2022 (25 years)
5	Analysed documents	75
6	Pre floods decision-making	Flood evaluation; efficient, or not efficient
7	Types of floods	5; Flash floods, river floods, Coastal floods, Urban floods, and Pluvial floods

8	Causes of floods	Prevalent downpours rainfall, steep terrain, high surface runoff and mainstream length, extreme restoration, lack of sustainable flood-control measures, global warming, strong tides, low and flat terrain, a funnel-shaped coast, and drainage system failure to absorb water from torrential rain
9	Impacts of floods	With rising population density and economic growth in flood-prone communities, Green Infrastructure that is not intimately linked to a drainage system was found to contribute more to total runoff depth and peak runoff depth.

Table 2. Decision-making for 14 Author/Authors

	Author/Authors	**Year**
1	Zevenbergen chris, Escarameia Manuela, Nicholas Walliman & Rutger de Graaf	2014
2	Doyle, S. E.	2012
3	Adebimpe,O., Oladokun, Y., Oladokun, V., & Odedairo, B.	2018
4	M.M. Cernea	2004
5	Nilubon, P., Veerbeek, W., & Zevenbergen, C.	2016
6	USACE	1998
7	FEMA	2007
8	FEMA	2012
9	Bowker, P., Escarameia, M., & Tagg, A.	2007
10	Balasbaneh, A.T.; Bin Marsono, A.K.; Gohari, A.	2019
11	Balasbaneh, A. T., Abidin, A. R. Z., Ramli,M. Z., Khaleghi, S. J., & Marsono, A. K.	2020
12	Potter, K., Ludwig, C., & Beattie, C.	2016
13	Hayes Josh L., Thomas M. Wilson, Charlotte Brown, Natalia I. Deligne, Graham S. Leonard, and Jim Cole	2021
14	Insang Yu and Huicheul Jung	2022

3.0 Decision-making trends

A review of the literature on resilience for well-informed decision-making is presented in table 2. In all these scenarios in the table, the sites were evaluated, and ultimate decisions were reached. Where Flood evaluation is based on professionals' views skewed towards being efficient, the project was Continued with flood resilience consideration. While in circumstances where flood evaluation skewness is not efficient, the site was abandoned, and better sites were sought.

For a deeper knowledge of the procedure required for a good project's execution, this study examines the coordination mechanisms, decision-making criteria, and complex interactions among the various stakeholders involved in the housing area. By analysing the approach and procedures used to create the ideal circumstance, the research aims to evaluate the types, causes, and effects as well as decision-making based on worth and quality. This will improve the decision-making process for housing in terms of motivation, sustainability, and renewal.

The effectiveness of treatment following Zevenbergen, (2014) is influenced by several factors, such as the structural quality of the buildings and the contextual variables of flood depths, frequency, and length. Whereas wet-proofing (which allows water to enter the building) is probably more effective in areas with high water depths, dry-proofing (which keeps water from entering the building) is most successful in sites with low water depths (up to 0.3 metres) (between 0.3 and 0.6 metres). When designing a unit dwelling, flood is a crucial concern that must be taken into consideration. The architect must give priority to flood impacts throughout the erection and construction of structures throughout the design stage to manage the severe flood consequences. In areas with high flood depths (>0.6 metres) and a relatively high risk of flooding (>1:25 years), a complete rebuilding of the existing houses and structures into raised or amphibious constructions may be taken into consideration (Nilubon et al., 2016). The link between flood depth and vulnerability states that damage to the wood occurs around the time of initial contact with water. It sustains 20% more damage when floodwater reaches a height of about 50 cm. This type of building's wall and material are destroyed by over 30% when floodwater reaches 150 cm or more (Balasbaneh et al., 2019). A confirmation that to make housing more resilient to flooding, wood materials must be replaced with those that are more flood-prone. Wood is not a suitable material for construction near or in flood zones, and the best solution, in this case, is an alternative hand blockwork system. Wood walls were damaged 15% more than block walls in flood depths of 50 cm, and 22% more in flood depths of 150 cm. By selecting the right material for a building wall, pre-flood decision-making can have less of a detrimental impact than it otherwise would (Balasbaneh et al., 2020). This ultimately resulted in Bowker et al., (2007) study conducted in the United Kingdom to argue that flood depth, flow speed, occurrence, and duration can all be used to evaluate floods (although not all of this information is always available). The risk of a flood to people and property in a particular location can then be determined using this data.

Accordingly, flood resilience must strike a delicate balance in a study by Doyle, (2012) between maintaining the benefits of the flood and minimising the expenses and destruction to people and property. The Republic of Korea's central government establishes flood risk zones and areas in different administrative districts, while local governments assess flood risks and choose priority sites for construction taking into account flood resilience (Yu & Jung, 2022). Enhancing building resilience can reduce flood risk, but doing so requires a realistic attitude from everyone involved, including the government, residents, and building professionals (Adebimpe et al., 2018). In reaction to more frequent disasters, the severity of the risk to people, and the amount of property loss, resettlement programmes must be used to protect vulnerable communities in cases where decision-making was not used from the start. Contrarily, these have unanticipated financial, budgetary, control, and coordination effects (M.M. Cernea, 2004). With the assistance of the relevant professional as well as a structural or foundation engineer, these decisions should be made (USACE, 1998). However, relocating a structure is one of the most effective ways to flood-proof it (FEMA, 2007, 2012; USACE, 1998).

To negotiate sensible, strategic, and more resilient housing solutions, more accountability and transparency in decision-making are needed, together with increased public sector capacity and the availability of experienced planners (Potter et al., 2016). The decision-making procedures will be intricate and multifaceted, and it may be necessary to consider abandoning human settlements permanently or temporarily. These choices are probably going to require more context-specific analysis than can be provided by a single professional(Hayes et al., 2021). For instance, a decision about climate change must consider not just the availability and accuracy of scientific and technical data, but also the availability of tools, procedures, and practises that encourage the creation and sharing of knowledge and streamline decision-making. Therefore, community organisations are essential in fostering participation in decision-making. See table 2 for detailed information on 14 notable author/ authors in the current field of study.

4.0 Types of Floods

If proper flood management techniques are to be established, it is necessary to first understand the type and source of flooding(Bloch, 2012). The five types of large-scale floods are addressed here: flash floods, coastal floods, river floods, urban floods, and pluvial floods.

4.1 Flash floods

Flash Floods are swiftly moving water bodies that engulf anything in their direction. They are caused by heavy rain or a fast thaw of Water. Floodwaters typically cover a small area but mostly happen with no or little warning, sustained just under six hours. Massive objects such as automobiles, gravel, and vegetation can be relocated by the increased water streams.

Flash floods, which are primarily produced by severe and persistent extreme precipitation and originate in the hilly catchment area of a few hundred square kilometres or less, have long been regarded as one of the world's most dangerous and expensive natural dangers. (Saharia et al., 2015;Trigo et al., 2016). From 1975 to 2002, an average of 181 people were killed in every flash flood event, with a 3.62 per cent death rate (the number of people killed divided by the number of people exposed to the event) (Jonkman, 2005).

China is repeatedly hit by large, devastating flash floods that cover a huge region and happen regularly(Zhai et al., 2021). It is a hilly country that experiences flash floods frequently during the rainy season, affecting an area of 4.87 million km2 (51 per cent of the total land area) and a population of 0.55 billion people. From 2010 to 2016, more than 10,000 flash floods were observed(Guo et al., 2017). In China, flash floods are the bloodiest type of flood, accounting for more than 70% of flood-related deaths(CFDDB, 2017). Examples of flash floods are in figures 1.1 & 1.2.

4.1.1 Causes of flash flood

Prevalent downpours rainfall, steep terrain, high surface runoff and mainstream length, extreme restoration, lack of sustainable flood-control measures, and global warming, among other factors, promote and exacerbate the risks, susceptibility, and negative consequences of nationwide flash floods (Elnazer et al.,2017; Miao et al.,2016; Perry, 2000; Youssef et al., 2011). However, multiple causal processes such as regional meteorological regimes, physical hydrological cycles, and anthropogenic cause flash floods to behave differently throughout time and location (Adnan et al.,2019; Merz, R., Blöschl, 2009).

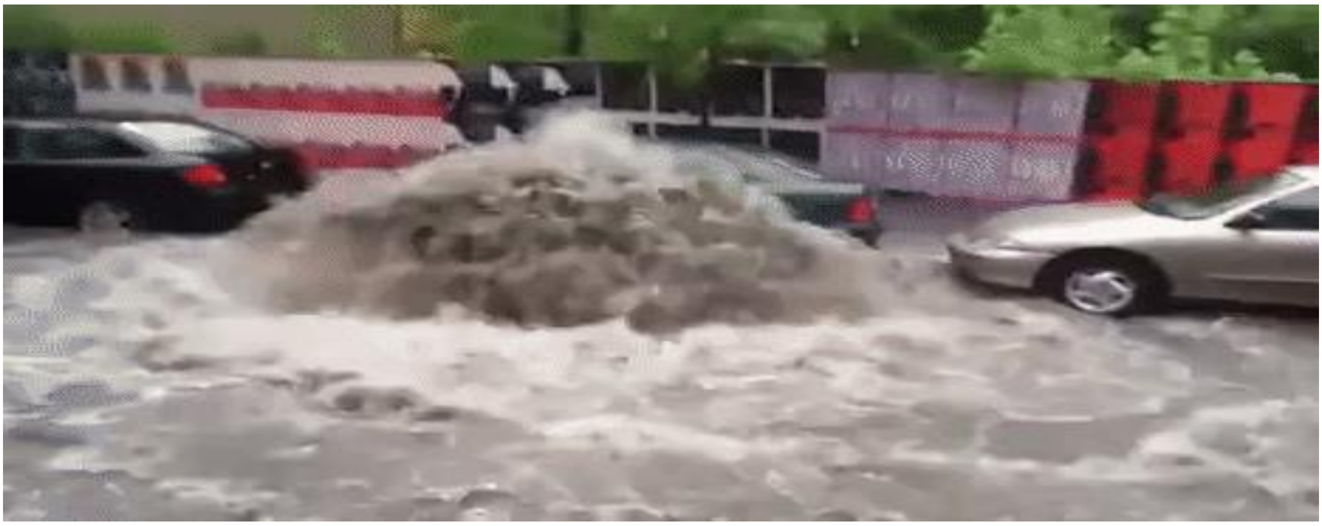

Figure 1.1: Flash flood (Ellicott City Floods of 2018)

Source:(Geyser rue Wolfe, 2018)

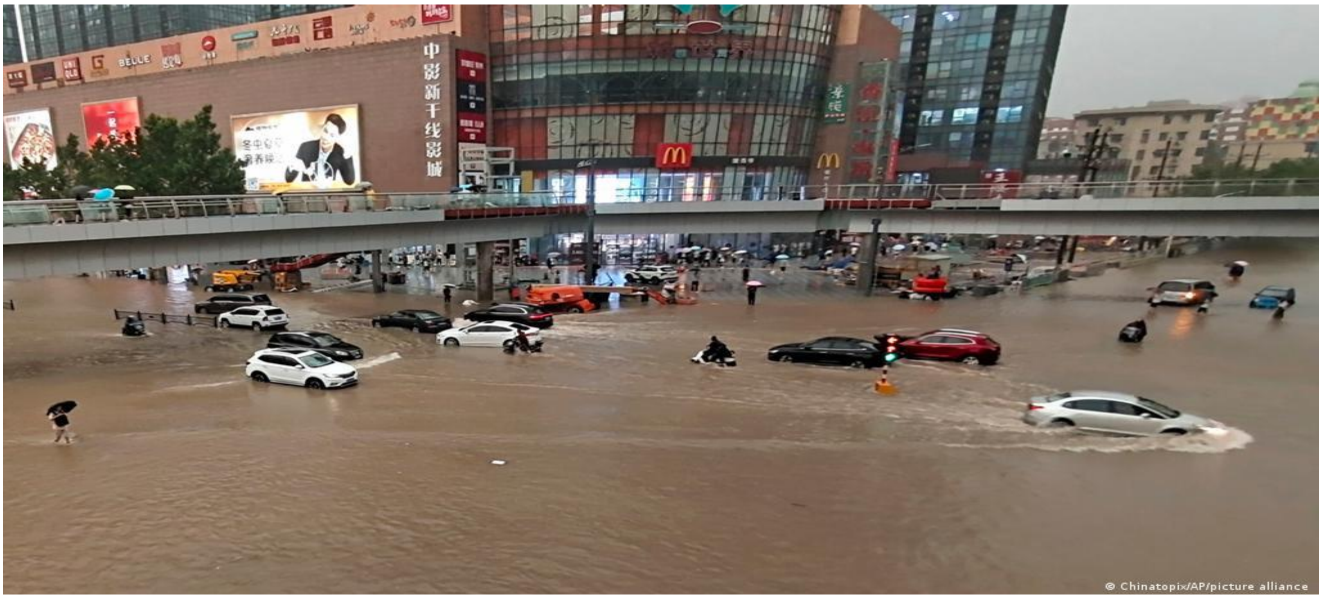

Figure 1.2: Flash flood, Henan province in China,2021

Source:(Environment in focus: Climate catastrophes, 2021)

4.2 River floods (Fluvial Floods)

River floods are defined as the slow overflowing of riverbanks induced by heavy rain over a lengthy amount of time. River floods affect different places based on the size of the river and the quantity of rainfall. Although river floods rarely result in fatalities, they can cause significant economic devastation. The timing and amount of rainfall, i.e., the amount (quantity) of heavy rains in a location, determine the severity of a river flood. An example is in figure 1.3.

Figure 1.3: River/Fluvial flood (Davenport, Iowa2019)

Source:(Jiang, 2019)

4.2.1 Causes of river floods (Fluvial Floods)

With elevated amounts of temperature rise, the fraction of people exposed to river flooding increases significantly(Arnell NW, 2013): In a 4°C future, roughly twice as many people are expected to be flood-prone in 2100 as in a 2°C world, and by the 2050s, increases in the risk of flooding are expected to be particularly high for South Asia(Vinke et al., 2018).

The clogged drainage systems exacerbate river flooding by increasing the amount with which floodwaters reach watercourses, beyond their given number of cycles. Though poor drainage infrastructure can be found in all Territories, individuals who live near a large water body, such as in the Municipality, Amatagwolo, Rumuepirikom, and Mgbuosimiri Zones, are affected by river floods. Impermeable surfaces worsen river flooding by speeding up the rate at which stormwater reaches natural drains and allowing floodwaters to enter rivers at almost the same time (Thecla I, 2014).

River flooding is caused by impermeable surfaces, as well as excessive rainfall, in all Regions where it occurs. The specified capacity of available drainage facilities that were created decades previously cannot manage the increasing volume of surface run-off generated especially considering impermeable surfaces, culminating in flash floods and flood bondage in the Port Harcourt metropolitan area. Despite drainage facilities that exist in some regions of the Port Harcourt metropolis, these are both insufficient in number and capacity or are not effectively coupled (weak integration) to transport the accumulated surface run-off. This is one of the biggest causes of river flooding downstream in the Port Harcourt metropolis, as an inadequate drainage network causes all the floodwaters from various regions to join natural outlets (such as lakes and streams) at almost the same time. When downpour rains reach these rivers and streams at the same time, the volume of run-off outweighs their local flow limitations, resulting in river flooding. This is most noticeable in the Town and Amatagwolo Regions, particularly in the Diobu, Lagos, and Borokiri sections of the ancient Port Harcourt City(Thecla I, 2014).

Unplanned construction in the flood plains and urban population encroachment on marginal low-lying riverine lands or swamps have resulted from uncontrolled urbanisation in the Port Harcourt metropolis. As the population of Port Harcourt has grown over the years, residents have begun to develop haphazard and unauthorized structures along floodwater routes, blocking the free passage of run-off and worsening river floods in certain regions. Additionally, as the inhabitants of Port Harcourt have grown over the years, residents have begun to develop indiscriminate and unauthorized structures in stormwater routes, blocking the free passage of run-off and worsening river floods in the metropolitan area (Thecla I, 2014).

Infringements towards river flooding plains usually result in homeowners wanting to preserve those buildings utilising structural measures and channelization procedures. As the floodplain is cleared for cultivation, a greater proportion of significant water discharge can be borne by the floodplain. While the river's channel capacity is steadily diminished, certain portions of the flood plain are destroyed and others are built up by deposition of the trample. The use of satellite remote sensing aids in the monitoring and assessment of flood zone expansion(Ejenma et al., 2014). Since early 1924, when the Ogunpa River burst its boundaries due to excessive rains, destroying the Ogunpa village, river flooding has been a recurring calamity in Ibadan (Olayide et al., 2019).

Floods can happen in Nigeria in three ways: coastal flooding, river flooding, and urban flooding, according to research. Coastal flooding occurs in the coast's low-lying mangrove and freshwater swamp belts. River flooding occurs in the flood plains of bigger rivers, whereas flash floods are linked with rivers in inland places, where heavy rainfall can turn them into devastating floods in a matter of seconds. Urban flooding, on the other hand, happens in townships, on flat or low-lying topography, particularly when little or no surface drainage has been built, or where existing drainage has been blocked by municipal garbage, rubbish, and degraded earth materials(Folorunsho, 2001; Ologunorisa, 2004).

4.2.2 Impacts of river floods (Fluvial Floods)

River flooding is predicted to have a greater global impact as a result of climate change, rising population density, and economic growth in flood-prone communities (Jongman et al., 2012; Vinke et al., 2018). We don't know whether urban expansion or intensification occurs out of harm's way or increases exposed asset value, therefore the influence of both development paths on river flood risk is uncertain.

Annual river flooding damage in Southeast Asia is expected to rise by 8% in Thailand and 211 per cent in Laos because of urbanisation until 2040. This significant growth is in line with the findings of (Jongman et al., 2012) and (Winsemius, H. C., Aerts, J. C. J. H., van Beek, L. P. H., Bierkens, M. F. P., Bouwman, A., Jongman, 2016). climate Given the expected increase in both river flood prevalence and magnitude as a result of climate change, the influence of river flooding on urban growth warrants further investigation (Hirabayashi et al., 2013).

Southeast Asian countries have rapidly transitioned from primarily rural to mainly city dwellers, resulting in significant growth in urban lands. This rise in urban acreage has primarily happened in coastal regions and floodplains, putting people and their property at risk of flooding(Tierolf et al., 2021).

Filani M. O., Akintola, F. O., and Ikporukpo, (1994) examine how Ibadan's city development practices contributed to the severity of river flooding. He explores the causes and impacts of the Ibadan flood of August 31, 1980, and cites climatic factors (such as rainfall seasonality), land-use considerations, infiltration capabilities of urban surfaces, and deforestation as having a substantial impact on flooding in the metropolis. The whole produce of a country can be forfeited in excessive flood situations. Some tree species may not be able to withstand extended root flooding (Folorunsho, 2001).

4.3 Coastal floods (Storm Surge)

Coastal flooding is the temporary inundation of coastal regions by the sea (E. Chaumillon et al., 2017). Spatial imbalances, housing types, the amount of urbanisation, and the growth rates and economic vigour of various regions all contribute to coastal communities' susceptibility (S.L.Cutter, B.J. and Boruff, 2003).

Strong winds or storms moving towards a coast during high tide generate coastal flooding. The area is regularly inundated when high waves breach the dune or dike along the shoreline. The coastal areas with the fewest fortifications and the lowest elevation are the hardest hit. Low tide is the ideal time to strengthen the breach. See Storm surge crossing over barriers during Hurricane Michael,2016 in figure 1.4.

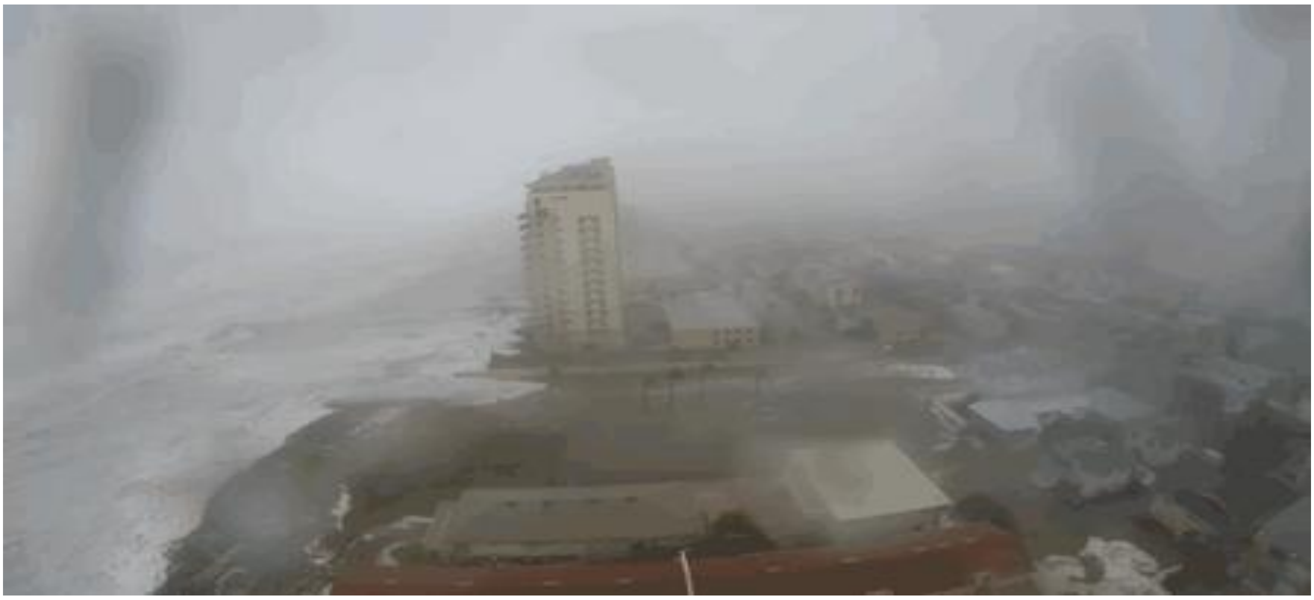

Figure 1.4: Coastal /Storm surge 2016

Source:(ArcGIS Story Maps, 2016)

Research suggests that persons who have a strong sense of place attachment have a feeling of mastery over occurrences in their surroundings, making them invulnerable to coastal flooding hazards(E. Michel-Guillou, N. Krien, C. Meur-Ferec, 2016). The employment of emotion-focused or avoidant coping mechanisms to handle the stress caused by coastal flooding is negatively influenced by risk perception. Furthermore, while risk perception does not describe real concern and effective coping strategies directly, it may do so secondarily through personal involvement and location connections(Navarro et al., 2020).

4.3.1 Causes of Coastal floods.

In the northern Bay of Bengal, strong tides, low and flat terrain, and a funnel-shaped coast result in greater water levels close to the coast, causing coastal flooding (Sahana, M., Sajjad, H., 2019). Sea level rise, coastal flooding, coastal inundation, degradation, and sedimentation are all affected by coastal elevation differences (Diez et al., 2007). Flood control devices, such as embankment dams, are another major feature that can have a big impact on coastal floods and inundation (Tong et al., 2012). Storm surge flood vulnerability assessment using good modelling could aid in determining the spatial distribution of storm surge-induced coastal flooding and assist with future research (Sahana et al., 2020).

As a result of sea-level rise and climate-change-induced extreme events, deltaic regions are increasingly susceptible to serious flooding, the loss of wetlands, and the loss of infrastructure and jobs (Bank, 2010; Douglas I, 2009; Syvitski et al., 2009). Flooding and sea-level rise are becoming increasingly vulnerable due to a variety of factors, including climate change.

Coastal population centres on the South Asian coasts, such as Kolkata and Mumbai, are extremely exposed to possibly cascade threats caused by a mix of climatic changes such as sea-level rise, rising temperatures, and increasingly intense tropical cyclones, and coastal floods(Vinke et al., 2018).

4.3.2 Impacts of Coastal floods.

Flooding threats have increased since 1980, owing to population growth and economic development in coastal and low-lying regions. In 2010, floods affected almost 45 million people in South Asia, accounting for around 65 per cent of the global population affected by floods that year (UNISDR, 2011).

Glacial lake outbursts are one of the flooding episodes impacted or caused by climate change (Bates et al., 2008; Mirza MMQ, 2010). Combining the impact of sea-level rise and storm-surge-induced coastal flooding, flash floods, inland river floods, high precipitation-causing landslides, and coastal river flooding. Flooding is mostly caused by precipitation(Mirza MMQ, 2010) and, as an example, the Pakistani torrential downpour of 2010(Webster PJ, Toma VE, 2011).

Bangladesh is one of the world's most densely populated countries, with a major portion of the people living only a few metres above sea level. The Ganges-Brahmaputra-Meghna Delta floods regularly, and it is a natural aspect of the province's agriculture and production process. However, flooding affects up to two-thirds of Bangladesh's land area every three to five years, causing significant damage to buildings, livelihoods, and agriculture—particularly in poorer families (Bank, 2010). The country faces significant and expanding threats, according to forecasts. Mirza MM, (2010) For a 2.5°C increase in warming above pre-industrial levels, the flooded area might expand by as much as 29 per cent, according to calculations. The rate of increase in the amount of mean-flooded area per degree of warming is expected to be slower at higher levels of warming (Mirza MMQ, 2010).

Human operations inland (such as upstream damming, irrigation barrages, and diversions) and on the delta (such as irrigation water) can have a substantial impact on the pace of aggradation and localized subsidence. Another factor is subsurface mining (Syvitski et al., 2009). Flooding provides a special risk to deltaic agricultural productivity. Food shortages continue to be a problem in Bangladesh nowadays (Douglas I, 2009; Wassmann et al., 2009).

4.4 Urban floods

Whenever a city's or town's drainage system fails to absorb water from torrential rain, flooding occurs. Flooding can also be caused by a lack of natural drainage in a city. Water spills into the street, making driving extremely hazardous. Urban floods can inflict considerable structural damage even if the water levels are only a few inches deep. See figure 1.5.

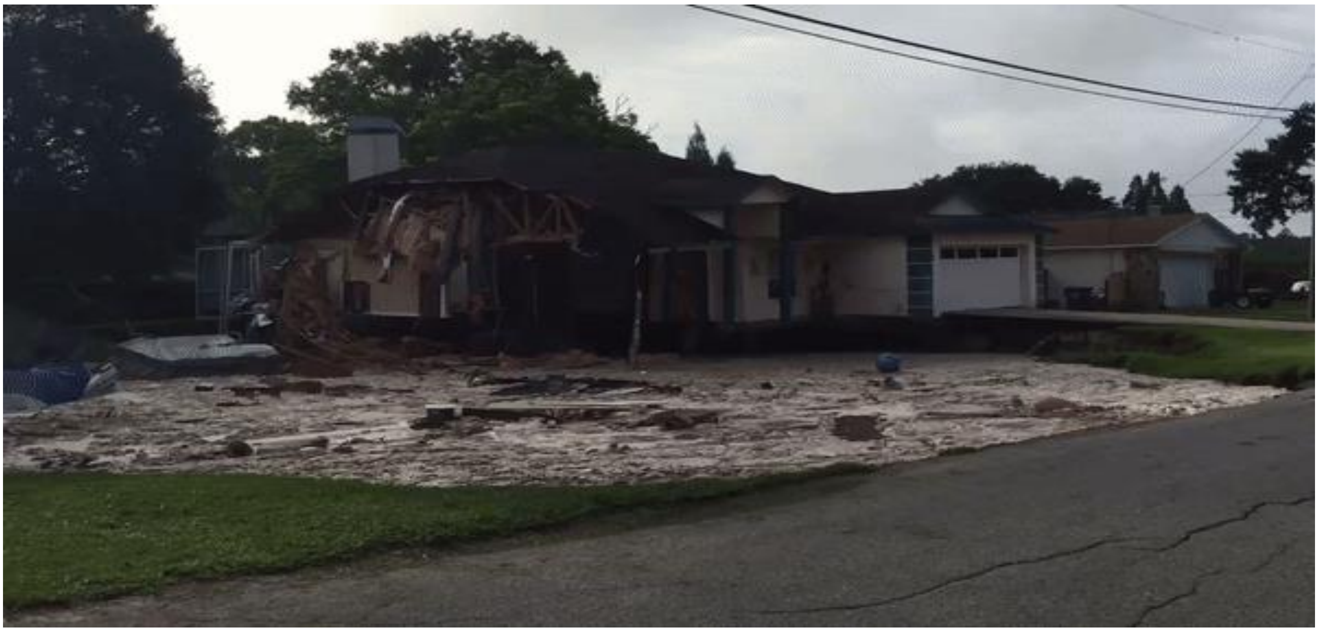

Figure 1.5: Urban/Ground waterflood (Florida 2017)

Source:(Pam Wright, 2017)

Nonetheless, numerous cities' drainage systems and flood-mitigation equipment are not intended to adapt to the expected urban flooding dangers caused by climate change, providing a serious technological risk to metropolitan areas(Gimenez- et al., 2020; Mohtar et al., 2020)

Urban flooding is becoming a bigger concern in cities around the world, and it's only going to get even worse as urbanisation and climate change intensify(Choi et al., 2021). Urban development has resulted in an increase in impermeable surfaces and a decline in infrastructure development, altering the regional hydrological cycle's procedure, which, in combination with climate change, is expected to increase the frequency and severity of urban floods caused by extreme events in the city(Li et al., 2021).

4.4.1 Causes of Urban floods

Globally, rapid urbanisation occurs as a consequence of vegetated soil with impermeable surfaces, which can have a significant effect on hydrological models(Zhang et al., 2015). Increased impermeable surfaces and global climate change are contributing to the rise in urban flooding (Olang et al ., 2011; Zhang et al.,2018). Urban development and excessive precipitation pose substantial difficulties to urban drainage infrastructure, with far-reaching consequences for cities, people, the ecosystem, and also businesses (Li et al.,2020).

Changes in the urban micro hydrological process and insufficient capacity of urban drainage systems result in the formation of surplus direct runoff and increased urban flooding (Liu et al., 2019). 62 per cent of the 351 cities surveyed in China experienced urban floods, with 137 towns experiencing severe floods more than three times annually (Zhan et al.,2018). Urban floods are worsened not just by a deficiency of drainage capacity, but also by the massive development of impermeable surfaces, that alter the hydrological mechanism while reducing the natural environment (Kaspersen et al., 2017).

4.4.2 Impacts of Urban floods

In general, Green Infrastructure upstream of the catchment has a lower impact on flood control. Green Infrastructure, on the other hand, may exacerbate flood risk in downstream areas closer to the outlet(Fiori and Volpi, 2020). Green Infrastructure that is not intimately linked to a drainage system was found to contribute more to total runoff depth and peak runoff depth than Green Infrastructure that is directly connected to a drainage network, although the latter had a larger influence on peak runoff lag time(Yao et al., 2016).

Due to the paucity of urban property, much greenbelt has been converted into a higher-value home and business land, leading to a loss in area and segmentation of vegetated areas (Daniels et al., 2018; Kim et al., 2017). Rainwater storage capacity limitations and growing overflow storage requirements have resulted from rapid urbanisation (Du et al., 2015). The supply and demand for runoff storage are being squeezed by expanding urbanisation. The irregularity in the allocation of runoff storage supplies and demands will exacerbate urban floods (Maragno et al., 2018). The supply and demand for runoff storage have been studied at various levels and areas. (Chen et al., 2020; Nedkov et al., 2012; Shen et al., 2019). There is, however, little research on the supply and demand for runoff storage at the municipal level.

The key difficulty in urban flood regulation is determining how much rainfall can be controlled in the urban catchment, taking into account the quantity of rain that can be soaked, penetrated, retained, and conveyed via the drainage network (Pappalardo et al., 2017).

4.5 Pluvial floods

Puddles and ponds form in flat locations where the soil is unable to absorb rainwater. Pluvial flooding is equivalent to urban flooding, although it happens more frequently in rural settings. Agricultural activity and property in locations affected by pluvial flooding might be severely harmed.

5.0 Conclusion

From the reviewed literature relevant to floods it is evidenced that floods, their causes, and their effects play a great role in identifying the decisions of the stakeholders. The major players in this context are the residents, professionals, and developers. Evaluation of the site is the initial step before any decision is taken. In a scenario where the decision was to embark on housing the projects in a flood-prone area the pre-knowledge of the situation would assist in no small measures involving resilience measures as appropriately advised by the professionals. In circumstances where decisions did not favour being involved due to inefficient evaluation; a new site would be sought to avoid the inherent adverse consequences. However, in situations where judgments are slanted toward having a structure developed in flood-prone zones because of efficient evaluation, more knowledge is advised on the resilience techniques to be incorporated for the housing. Considering this knowledge, the study is valuable as a decision-making tool for the stakeholders as well as humanity.

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