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RESEARCH ARTICLE

FLOOD MANAGEMENT PRINCIPLES IN A WETLAND: A REVIEW OF SOME SCENARIOS IN NIGERIA

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ABSTRACT

Floods are naturally occurring phenomena that are part of the physical and biological process which have shaped our nation's landscape. It is a seasonal phenomenon in Nigerian environment and manifest when there is prolonged rainfall. In most cities in the Niger Delta, Nigeria and the rest of the world, the flood situation is worsening. Flood plains and wet lands are delicate ecosystem that should be effectively managed to control the menace of flooding. Flood plains are synonymous with wetlands. Wet lands are lands that have been saturated with water and capable of encouraging surface flow and flooding. The present paper reviews the management principles of flooding in a wetland. In Nigeria the issue of management of wetlands and flood plains has become very necessary and worrisome, because of the various havoc caused by flooding in different parts of the country over the past decades. During each flooding occurrence, lives are lost and properties worth lots of money destroyed. Flooding have affected property values, as flood prone properties remain in the market longer, when offered for lease or sale compared to flood free properties. Survey on household losses on flooding from 2009-2018 in Port Harcourt city, revealed a whopping loss of huge assets in millions of naira annually. The flood damages, very great, the losses very enormous and the destructions are complete impairment of the value of goods and services. Health challenges are on the increase especially as flood water from sewers flow into open drains and streets, thereby creating bad sanitary environment. Management options suggested include, land zoning, restriction on use of wetlands for development, conservation and re- afforestation policy to maintain stability of wet lands and, the construction of high drainages or channels, and an aggressive enlightenment campaign on hazards/ risks of developments on the wetlands.

INTRODUCTION

Flood water is substance flowing, rippling, swirling around obstacles in its path seeping, drilling, trickling, constantly moving from sea to land and back. The adequate presence of water has been acclaimed as being one of the pre-conditions in which all living processes occur. However, when this adequate water volume is exceeded, it may result into a kind of excess water. This excess water may pose a problem when it occurs in large volume, consequently flooding occurs. Flood incidents have been frequent at different scales across the country in recent times leading to loss of lives and property including farmlands. In his own views, (Efe, 2011)) noted that flooding occurs whenever runoff exceeds the discharge capacity of a river channel causing water to overflow its banks and spread over the flood plains. In essence, a flood is an abnormal overland flow arising from an inability of a stream or river to cope with its discharge or a surge in sea level in a coastal area that result in significant detrimental effects. The type of flood include ocean surge, riverine floods, urban flood, flash floods

that are short as a result of cloudburst (high intensity storm) and floods that results from dam bursts. Flood plains normally exist in flat or low lying areas when a lot of sediments are deposited and spread over low lying adjacent areas near a river. According to (Oriola, 2015), when these sediments are deposited with the passage of time, normally fertile plains are built up which are called flood plains. One thing that is clear is that flood plains are usually saturated with water and hence are potential areas for further flooding. Flood plains are synonymous with wetlands. Wetlands are lands that have been saturated with water and therefore capable of encouraging surface flow and flooding. Thus flood plains and wetland are delicate and sensitive surfaces that should be effectively managed to control the menace of flooding. This paper is therefore focused on the management principles of flooding in wet lands. In Nigeria the issue of management of wetland and flood plains has become very necessary because of the various havoc caused by flooding in different parts of Nigeria over the past decades. For instance, in a city like Port Harcourt, similar to other cities in the Niger Delta, flood events are annual in frequency and occur principally between the months of June and October. During each flooding incidents, lives are lost and properties worth lots of money are destroyed. According to (Gobo and Amakoromo 2008), flooding has affected real

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property values in Port Harcourt as flood prone properties remain in the market longer; when offered for lease or sale compared to flood free properties. More so, their survey of household losses on flooding from 2003 -2007 in Port Harcourt revealed a whopping loss of about 5 million naira annually on the average per households significantly affected by flood. Damages from flooding are quite significant; the losses recorded are very enormous, resulting in destructions that are either complete or partial impairment of the value of goods and services. Health challenges are recorded as a result of the action of the flood water and the debris they carry into and out of sanitary sewers into the streets creates bad sanitary environment. In 2012, Nigeria suffered the worst flooding in the past three decades, with over 300 local government areas submerged by flood waters. Properties worth billions of naira were destroyed. In Delta State alone, over 100 communities were submerged and 300,000 persons rendered homeless by flood in 10 local government areas (NHSA, Report, 2013). Furthermore, according to NHSA report (2013), the Federal government spent about 2.6 trillion naira in the management of the 2012 flood disaster in Nigeria. It is in the light of the huge human and material losses accompanying floods especially in wetlands environment like the Niger Delta, especially Port Harcourt Metropolis in Rivers State, which makes the management of flood in this very fragile environment very critical.

Flood water generation in Wetland and other Sources:

Flooding results from a number of basic causes of which the most frequent are climatological in nature. Ward (1978) reported that excessively heavy and prolonged rainfall is the most common universal cause of floods. Although in cold winter areas, where snowfall accumulates on the surface, substantial flooding frequently occurs during the period of melt in spring and early summer. In other types of flooding, climatological factors are only partly or indirectly responsible. Thus, in many estuarine situations, the immediate cause is the ponding back of stream flow by the rising tide, particularly during spring tide conditions or by various tidal surge effects. Furthermore, along low-lying coast flooding may result from excessively high tides associated with storm surge effects caused by a combination of very low barometric pressure and high wind speeds. Flooding can equally be generated easily on wetlands. Wetlands include bogs, swamps, wet meadows, marshes that serve the purpose of temporary or permanent natural water reservoirs with depth not more than 6 meters. In the past 200 years, more than one half of wetlands have been drained, filled or degraded owing mainly to agricultural drainages. Presently there are 1,179 Wetlands of international significance, otherwise known as Ramsar sites in 33 countries and covering a total of 102,126,170 hectare (NES, 2003). Wetlands due to their saturation nature may not require heavy rainfall before flooding results. Thus, a small amount of rainfall generates the required water since there would be an enhanced surface flow. Wetlands may either be located within a flood plain or in an area where underground water level is near the surface or in areas underlain by impervious rocks near the surface making the wetland to be easily saturated. In all these cases, flood water generation is enhanced. In essence, wetlands are potential generators of flood waters. Other important categories of flood water generators are human induced. According to Anih (1997) cited in Uchegbu (2003), urbanization is a great contributor to flooding. He states that as urbanization intensifies, buildings, paved roads, concreted surfaces, which do not allow water to percolate readily into the

ground, replaces natural surfaces. The consequences according to the author is that a large proportion of the rainfall which should normally infiltrate into the soil or be intercepted by the vegetation is immediately available for surface runoffs which end up in streams and rivers, thus generating excess water for flooding adjacent the wetlands. Furthermore, (Ahaman, 1997) noted that the contribution of urbanization to flood water generation is shown by the introduction of storm sewers that allow rainfall runoff from paved areas to be taken directly to channels. Due to poor planning or lack of proper hydrological survey of the area and poor topographic characteristics of some areas, runoffs are forced to flow along the roads, gutters etc; into depressions where seasonal lakes develop which ultimately flood with subsequent rainfall. In some cases these runoffs find their way into existing streams or rivers thereby enlarging their volume and probably resulting into flooding. It has also been noted that the failure of engineering control mechanisms generates water that flood wet lands, flood plains and other areas. Such engineering works include the construction of drains, levees, embankments, etc; initially constructed to control flood waters from rivers and streams and hence protect the wetlands or flood plains. The collapse of these structures due to over loading and pressure from increased precipitation, could lead to land subsidence etc., thereby freeing the contained flood waters and their subsequent flood of the wetland and other areas (Gobo, 1990). Typical wetland areas in Port Harcourt Metropolis Rivers State, which is one of the major cities of Niger Delta region in Nigeria that is annually inundated with the problem of flooding are shown in figure 1. From the map it could easily be seen that a significant land mass of the city is essentially wetland, which makes it a good case study cum reference point for studying empirical flood management principles, policies and practices in a wetland.

Effects of Flooding: According to Ahaman, (1997) cited in Uchegbu, (2003), floods are environmental hazards that occur regularly every year in different parts of Nigeria, with wide ranging effects. The immeasurable consequences of flooding as reported by Gobo (1990), is exacerbated by excessive rainfall and consequent reduction in the infiltration capacity of the soil due to its low permeability. Flooding is experienced in most homes during the rainy season in Nigeria. On a typical flooded day in any City in Nigeria, affected roads are rendered impassable to both human and vehicular traffics, properties are damaged and occasionally lives are made difficult for some time, as a result of the economic effect of the loss. Furthermore, other types of flooding, aside climatological factors are only partly or indirectly responsible. Thus, in many estuarine situations, the immediate cause is the ponding back of stream flow by the rising tide, particularly during spring tide conditions or by various tidal surge effects. More so, for communities and cities along low-lying coast, flooding may result from excessively high tides associated with storm surge effects caused by a combination of very low barometric pressure and high wind speeds (Ward, 1978). According to Mba (1996) cited in Uchegbu, (2003) Flooding hazards appear to be much more common in Nigeria in areas that a little above sea level such as the Niger Delta and may occur occasionally in the hinterlands. Some of the reported cases of flooding and their generated associated damages are shown in tables 1 and 2 below. From tables 1 and 2, it is evident that flooding incidents in Nigeria transcends both the coastal and swamp areas, across the hinterland and wide spread all over Nigeria.

Table 1. Some of the Reported Cases of Flooding in Nigeria

S/N	Cities	Nature of Flooding	Frequency
1	Lagos Metropolis	Flooding of the entire neighbourhood	Annually, but particularly in 1995, 1999, and 2011
2	Warri	Flooding of the entire neighbourhood	Annually
3	Maiduguri	Flooding of the entire neighbourhood	Occasionally, 1994 and 2011
4	Port Harcourt	Street flooding (flash flood) wet land areas especially the waterfront areas.	Annually
5	Onitsha	Flooding of the entire neighbourhood	Annually, but particularly in 1994 and 2011.
6	Enugu	Incidents of street flooding (flash flood)	Occasionally
7	Aba	Incidents of street Flooding (flash flood)	Occasionally
8	Bayelsa	Flooding of the entire neighbourhood	Annually
9	Sokoto	Flooding of the entire neighbourhood especially the UDUS areas	Annually, particularly in 2011
10	Niger State	Flooding of the entire neighbourhood especially around Suleja villages.	Annually, particularly in 2011.
11	Delta State	Flooding of over 100 communities and 300,000 persons rendered homeless in 10 local governments.	2012 flooding Report from (NHSA)
12	Rivers State	Flooding of over 300 communities in Port Harcourt Metropolis	2016-18 Flooding Report(NHSA)

Source: Federal Ministry of Water Resources (NHSA) 2017.

Table 2. Cases of Flooding Generated by Natural and Human Actions in Nigeria and Associated Damages

S/N	Causes	Location	Damages	Period
1	Human	Ilorin (Kwara State)	Submergence of 24 houses, evacuation of 456 persons, damaged farm land/roads	1979
2	Natural/Human	Ogunpa Stream Ibadan (Oyo State)	A total of 50 lives were lost and over 100 persons rendered homeless	1980
3	Natural/Human	Coastal areas/Beaches(Lagos State)	Coastal settlements swept away and valuable properties lost.	1988
4	Human	Warri (Delta State)	Millions of naira worth of property destroyed	1988
5	Natural	Kaduna Metropolis (Kaduna State)	300 Villages submerged.	1988
6	Natural	Bauchi City (Bauchi State)	Four persons died and 750 homes were destroyed	1988
7	Natural	Villages (Niger State)	Loss of crops and farm land especially around Suleja area	1988
8	Natural	Calabar (Cross River State)	130 hectares of land destroyed and 500persons rendered homeless	1988
9	Natural/Human	Uyo (Akwa-Ibom State)	Over 500 families displaced and properties lost.	1988
10	Natural/Human	Baganda dam Kano (kano State)	Crops, houses and thousands of naira lost.	1988
11	Natural/Human	Delta , Rivers and Bayelsa States	Properties , farm lands and lives lost	2012-2014

Source: Federal Ministry of water Resources (NHSA)(2014)

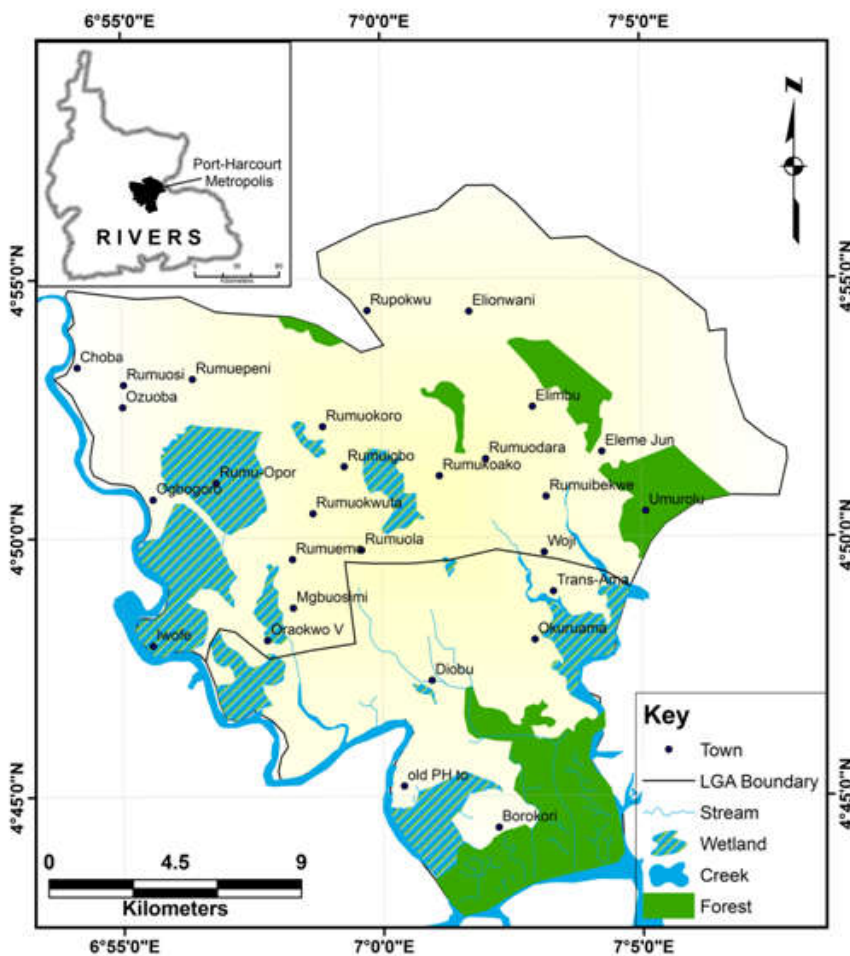


Figure 1. Showing Wetland Areas in Port Harcourt Metropolis in Rivers State, Nigeria

Considering the various factors that pre-dispose an area to flooding as earlier outlined, it is not surprising that a vast area of the Nigerian land areas, especially those accommodating anthropogenic activities are flooded.

Management Principles of Flooding in a Wet Land: Very often, after flood waters have subsided, the emphasis has been placed on rebuilding structures and trying to restore victims' lives back to normal as quickly as possible without addressing the causes. Unfortunately, in the rush, these flood victims have often rebuilt their structures to their previous "at risk" conditions. There is a growing societal impatience with continually "bailing out" those who choose to live at risk. However, the issue of flood management in wetland or the flood plain cannot be exhaustively discussed without mentioning some of the benefits of the wet land environment. In Nigeria, the Niger Delta is a wetland environment of about 70,000 square kilometers. It spreads over a number of ecological zones; sandy coastal ridge barriers and beaches, brackish or saline mangroves, fresh water, permanent and seasonal swamps forests and lowlands rainforests (SPDC, Annual Report 2001). The barrier lands and beaches are potential tourist attraction, the mangrove and fresh water swamps are rich with hydrocarbon deposits, the fertile plains are very useful for agricultural purposes, the rivers provide water supply and transportation facilities, the flat nature of the terrain allows for residential and commercial developments etc. Most importantly, this wetland serves as reservoir ground water recharge. It is in the light of these benefits and the highly sensitive nature of the wet land that there is an urgent need for its adequate and proper management.

The management of flood in a wetland shall focus on two important principles; Policy and Advocacy approach. The policy principle involves the need to have a comprehensive flood management programme, which should recognize the hazards and risks of wetland and flood plain occupancy. The advocacy principle encourages the participatory approach that involves all stakeholders including community members and relevant sectorial ministries, parastatals and agencies, as well as appropriate legal frame works. The policy principle involves the development of an integrated programme of flood forecasting and prevention, wetland protection including zoning and zoning restrictions and other environmental precautions on the management of sensitive areas as the wetland. Flood zoning; All over the world people have found flood plains, wetlands, river banks, river valleys as very serene environment for their, commercial industrial and residential developments without recourse to the potential cum real associated hazards and risks. In other words, when they do appreciate these challenges, they tend to ignore them as a result of the great economic potentials associated with properties developed within wetland areas. However, with the issue of haphazard and poor regulatory frame work/implementation capacity, flooding hazards in Nigeria, as a result of wrong citing of developmental infrastructures remains a highly challenging environmental challenge. According to (Hoyt and Langbein, 2005) flood zoning could be defined as a sensible adjustment of the land uses to flood peril. With the introduction and enforcement of the flood zoning policy, there will be prevention of unwarranted developments and any form of construction on the wetland. However, if wetlands must be developed, there should be a standard to which permissible structures should conform.

Other practical measures such as the following can be adopted to control water in a wet land;

- Construction of dykes, flood walls, levees or embankments to hold off the water and to confine the water in its channels of flow so that the wetland is protected.
- In cases of increase of flow of flood water, the channel of water passages may be enlarged, straightened, widened or deepened. This would help to contain more water and prevent the flood of the wetland.
- The construction of other auxiliary channels to divert the flood water from the original channel that was in excess of the carrying capacity.
- The construction of an impoundment reservoir which may be left empty in the dry season to receive excess water during rainy season or in the time of severe flooding to protect developments in the wetland.
- The policy on training of adequate high skill man power should be encouraged because the constructions mentioned must be done with highest level of engineering skill and expertise.
- There should be a policy on the re-forestation and conservation of the vegetation around the wetland areas, possibly such areas designated as conservation zones to help in stabilization of the land surface.
- The initiation of an action plan which should be proactive, emphasizing early detection and combat of flooding through improvements in planning, design, construction practice, maintenance, research and development.
- Development of an integrated early warning system that would help send out flood forecast information early enough to all possible stake holders, including potential victims and flood disaster response and management Agencies.

On the advocacy principle the following suggestion are proffered

- The need for continuous and thorough research on forecasting, monitoring and control of flood in wet land must be vigorously pursued by all stakeholders.
- Promotion of inter- and intra -agency linkages, sharing of information on the state of the art technology from outside or evolvement of local technologies to suit our environment in the management of wetland.
- Periodic compilation of a national inventory/survey of all wetland areas devastated by flooding and the development of a data bank.
- Formulation and review of land use laws and regulations, and ensuring that the amendments are passed into law by the legislative arm of government for enforcement.
- Raising public awareness and promoting understanding of the linkages between flooding and wetland and the enormity of the hazards and risks of carrying out developments of any kind in this fragile ecosystem.
- Also to encourage grassroots participation in the management of flood in the wetland, local techniques, methodologies for tackling site specific problems such as the menace of flooding.

Conclusion

This paper has discussed the management principles of flooding in a wetland focusing on some cases in Nigeria. Considering that wetland is a fragile environment, urgent steps should be taken to minimize the losses both lives and properties from flooding in affected cities in Nigeria. The suggestions raised in this paper in regards to the management of flood in a wet land should be addressed not just in Nigeria, but in other adjoining lands to the Nigerian land mass. This is because all action or inaction in adjoining wetlands upstream, either from a river or coast line can adversely affect positive efforts to prevent or combat flood within the country. It is a collective effort of all stakeholders that is required for a co-ordinated and lasting wetland flood management. In Nigeria there are various bottle necks that are faced; lack of use of information, shortage of skilled manpower, lack of implementation of policies, selfishness and corruption. Furthermore, the indifferent attitude of the citizens who build structures on wetlands without recourse to the hazards, risks, and regulations/laws on wetland development and management should be discouraged and stopped. There should be increased sensitization and awareness by all stakeholders and strict enforcement of the wetland regulation/laws by relevant agencies of government to avert the risks and hazards of flooding.

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