



## Strategies for Mitigation of Flood Risk in the Niger Delta, Nigeria

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**ABSTRACT:** The study has the major objective of evaluating flood risk mitigation strategies in the Niger Delta, a coastal region of Nigeria that suffers from perennial flooding. The Raper argues that the structural methods of flood control tends to give a false sense of security to flood plain dwellers and thereby encouraging investments in flood prone areas. The non-structural methods on the other hand are basically behavioural adjustments to flood control. The study observes that for flood risk mitigation strategies to be effective in the Niger Delta, there is need for establishment of coastal management zone authority, land-use zoning, legislation, building codes, flood forecasting and warning systems, flood insurance and engineering control of the major river systems. @ JASEM

The vulnerability of cities to hazards and disasters has been a subject of increasing academic interest, with recent special issues of *Geojournal* (Parker and Mitchell, 1995), *Applied Geography* (Mitchell, 1998), and *Ocean and Coastal Management* (Barbieri and Li, 2001), as well as influential publications by Timmerman and White (1997), Rakodi and Treloar (1997), Mitchell (1999), and Cross (2001). This academic interest has complemented the increasing policy interest, as reflected by initiatives of the International Decade for Natural Disaster Reduction (and now the International Strategy for Disaster Reduction – ISDR) and the Disaster Management Facility of the World Bank (Klein et al 2003). In response to this, the International Decade for Natural Disaster Reduction (IDNDR) was launched by the General Assembly of the United Nations in 1987 to run from 1990 to 2000. its aim is to reduce the loss of life, property damage and social and economic disruption caused by natural disasters. The resolution proclaiming the Decade makes specific reference to floods, tsunamis, drought and desertification among the principal disasters to be considered. The IDNDR calls for action by governments and international organizations to put greater emphasis than in the past on disaster prevention. Hydrologists, hydraulic engineers and those responsible for the management of land and water resources have a major role to play in this regard. It is in response to this that this paper has the major objective of evaluating flood risk mitigation strategies for the Niger Delta, a coastal zone of Nigeria that suffers from perennial flooding (Ologunorisa, 2001, 2004). The paper will first evaluate the various flood mitigation strategies before coming up with flood management strategies for the Niger Delta.

### **Evaluating of Flood Risk Management Strategies**

This involves large-scale constructional or structural measures designed to control the physical characteristics of the hazard. It attempts to modify

the frequency and magnitude of flood events. According to Smith and Tobins (1979), constructional measures can be categorized into three types of schemes.

**Engineering scheme:** This depends on specific control works and are basically of two types: (a) small-scale engineering schemes such as river training and works designed to prevent local bank erosion. (b) large scale engineering works. These include flood embankments, channels enlargement, channels enlargement, flood-relief channels, flood storage reservoirs and washland scheme. A number of these flood alleviation measures has some shortcomings (Nixon, 1966). Flood enlargements, and leaves for instance have the “right of way” problems and so there is need for the flood to be regularly maintained to preserve design standards. Channels enlargements may give rise to a false sense of security above the design capacities. There is also the problem silting of river channels, this therefore calls for proper maintenance. Flood relief channels have the problem of water management and solving this therefore requires a comprehensive knowledge of hydrological characteristics of the region. Flow storage reservoirs such as dams and reservoirs have their own problems. First, they are expensive to construct. Secondly, it requires a good management in terms of its operation vis-à-vis water management. Washland schemes are useful for small floods, and they require a large area of flat land for storage.

**Flood Abatement Schemes:** These schemes attempts to control flood by land-use management during the upland catchment phase of runoff. It aims at reducing flood peaks downstream, by a series of land-use changes upstream, so that runoff and the timing of the flood hydrograph are altered. This is done by reducing the land-to-channel runoff phase. This could be achieved through afforestation.

**Flood-Protection Scheme:** This consists of adjustments to building structure, and the contents of buildings, designed to reduce flood damage. It could be temporary or permanent. Temporary measures include the blocking-up of seldom-used entrances to buildings, the stocking of suitable shields to be placed in position at doors and windows prior to a flood and the use of heavy sliding doors to protect other entrances. Permanent flood-proofing measures include the raising of building above the flood level, the permanent use of lower storage for car parks, or the inclusion of pumping facilities in basement. Flood protection tends to be less effective in high, fast-flowing floods of long, duration than in small, slower-moving floods of short duration (Sheaffer, 1967). Consequently, Burton (1970) listed six criteria for ideal-proofing conditions. These are where:

- a. Flood stage is fairly low and velocities not very high
- b. Dams and dykes are really feasible
- c. Group action is not really possible and strong individual action can be encouraged
- d. Groups shun government action advice
- e. Activities requiring sites need protection
- f. Resource managers feel greater protection is required

Apart from these ideal requirements, there are additional drawbacks to such adjustment. For instance, such policies require the individual floodplain residents or managers to be aware of the flood risk and to make initiative of implementing flood-alleviation measures. Structural schemes, apart from flood proofing, all endeavour to change the magnitude and frequency of flood events by the control of excess water, and hence reduce flood losses. They are, for the most part, fairly expensive measure, although they are quite reliable up to the design standard of the project. Of the many disadvantages associated with these schemes, the most significant is the so-called "levee effect", which tends to result in increased investment in flooding-prone areas.

#### **Non-Structural Control of Flood Hazard**

Non-constructional or non-structural measures are basically behavioural adjustments. They depend on some form of pre-planned action by floodplain residents prior to a flood. Smith and Tobins (1979) recognized six types of behavioural adjustments.

##### **(a) Loss bearing or simply accepting the losses accruing from flooding:**

This is probably the most negative of all responses of flooding. No attempt is made by the people at risk to adjust to the hazard, except to replace lost or damaged goods following a flood event. This adjustment is found frequently in rural areas where other flood alleviation schemes would be difficult to justify.

##### **(b) Public Relief Funds:**

Here people in flood-prone areas may come to expect, as a right, both financial and other types of support following a flood. As a result, they may do very little to prevent future flood losses. Relief funds are particularly beneficial to those individuals who could not themselves afford to replace damaged property.

##### **(c) Flood Insurance:**

This response to the flood hazard does not reduce flood losses, nor does it have any effect on the flood characteristics. Instead, flood insurance allows the payment of flood losses to be made over a period of years rather than all at a time. Because of these apparent limitations. It has been observed (Krutilla, 1966) that flood insurance may eventually prove to be effective method of alleviating flood losses, provided some form of reliable association between insurance premiums and flood risk can be established.

##### **(d) Floodplain Zoning:**

Floodplain zoning aims at reducing flood by controlling floodplain development, rather than altering the hydrological characteristics in anyway. The ideal form of zoning would be to evaluate the floodplain completely and return the land to its natural state. For most areas this would be a highly impractical solution involving high costs and attendant social difficulties.

Alternatively, there have been numerous suggestions that floodplains should be divided into distinct zones, each restricted to well-defined uses. For examples, Murphy (1958) drew a basic distinction between the floodway and the floodway fringe. The former was defined as the river channel and such adjoining areas, which were required to be left clear for the safe passage of a flood of pre-determined magnitude, whilst the floodway fringe was seen as the remainder of the floodplain and subject to land use regulation. Kates and White (1961) put forward a three-zone division. The plan includes:

##### **i. A Prohibitive Zone:**

Where there should be no further development, except for essential waterfront facilities.

##### **ii. A Restrictive Zone:**

Where only certain essential development should be permitted, plus recreational facilities such as golf courses. All buildings should be flood-proofed.

##### **iii. A Warning Zone:**

Where the inhabitants should receive warning of impending floods and be regularly reminded of the flood hazard. There are several disadvantages of floodplain zoning policy. Firstly, there is the problem of accurately defining the different zones on the floodplain. The second is the effect on the behaviour of floodplain inhabitants. Like the levee system, zoning ordinances can create the impression of safety in areas outside the line

demarking the prohibitive zone and thereby encourage investment in these areas.

**(e) Flood Forecasting and Warning Schemes:**

Milet and Krane (1973), in a review of all hazard warning schemes, defined these three sequential stages as: evaluation, dissemination and response.

**(i) Evaluation:**

This is the first stage in any flood-warning system and involves the comprehension of hydrological and meteorological processes so that a suitable warning message may be formulated. Naturally, this requires a full understanding of the hydrological response of a catchment to a given input of precipitation so that accurate forecasts can be made of the time of arrival of the flood, the depth of the flood at its peak, as well as other characteristics such as duration of flooding or velocity of flows.

**(ii) Dissemination:**

This is the second stage in flood forecasting and warning systems. Flood warning dissemination is often confined to police touring the flood-prone area with loud hailers and, more recently, broadcasting warning on local radio stations.

**(iii) Response:**

The final step, response to the warning message, has been almost totally ignored by the authorities until recently, on the assumption that floodplain inhabitants would always react in a rational manner to reduce flood losses. However, evidence from various studies (Kates, 1962; White, 1964; James, 1974) now suggests that this assumption is unjustified. Indeed, it is argued that people will rather respond to various preconceived ideas about flooding.

**(f) Weather Modification:**

The most widespread form of weather modification at present relies on the seeding of clouds to encourage precipitation to fall in certain areas rather than others. As a result, this technique represents a new alleviation scheme with possible potential for the floodplain planner. However, Haas (1970) stressed the dangers of weather modification without a full consideration of all the consequences, although Farher (1974) carried out a study into the social implications of weather modification and found opinions generally favourable. It should also be mentioned that there are legal and political problems associated with modifications. This constitutes another major problem to its use as a flood control measure.

**(g) Legal and Institution Framework:**

It is essential for each country to have legislation, which firmly establishes responsibility for all necessary actions, whether of a long-term or short-term nature, which are related to flood disasters. It should be prepared as part of the overall legislation relating to natural disasters which constitute a hazard to land as flooding. Among the questions to consider are, apart from the adequacy of the

legislation, whether responsibilities are clearly defined, whether participating are properly coordinated.

**Flood Risk Mitigation Strategies for the Niger Delta**

One of the strategies for the mitigation of risk in the Niger Delta is the need for the establishment of Coastal Management Zone Authority in Nigeria. The battle for a coastal zone authority has been fought and won in several countries. A good and often-quoted example is the California coastal plan. This plan is a set of findings, policies, plans and recommendations designed to achieving a long-term protection of coastal resources. Countries such as Sri Lanka, Malaysia, Bangladesh, India and even Japan (using Osaka case study), have all established coastal management zone (Act) for effective way of evaluating coastal resources and the conservation. This awareness led Bell-Gam (1985) to propose a Coastal Management Zone Authority in Nigeria.

The contents of that proposal may now be restated:

“It is envisaged that this authority will operate through committee of the three tiers of government in Nigeria with funding from the Federal Government. It will undertake both development control and planning functions. Its research functions will be functionally organized to cover the gamut of problems threatening the national coastline such as flood, erosion, deforestation of the mangrove, weeds and pollution. It will have agency for land acquisition and development. It was also envisaged that this agency will control problems such as sewage disposal and would ultimately lead to the abandonment of the use of pit toilets in the settlements in the coastal zone and the ecological 1% fund of the Federal Government would then be channeled to such regional use rather than discrete uncoordinated projects” (Bell Gam, 1985).

It was then anticipated that the agency's links with state and Federal Governments should be able to resolve conflicts on land use, well as ensure free flow of information required for appropriate decisions. Secondly, this is need for establishing a flood control commanding system, at the Federal Level, and the Niger Delta, and the States having a flood controlling task, with the governors at each level as commanders and chief officials as executives from army units; departments of water, meteorology, planning, finance, police, commerce, transport and telecommunications, power, health, etc; and headquarters stationed in the Ministry of Water Resources to carry out daily work. In addition, under the commanding system, some institutions have been set up to do specialized work, such as forecasting and warning system to

acquire information on climate, rainfall, flood, structure, calamity, etc; and operation systems to prepare and dispatch men, equipment and materials, and to do relief work (See Table 1).

**Table 1:** Responsibilities of the Different Ministries

Ministry	Responsibilities
Water	Overall administration, including rainfall and flow information, flood, forecasting and warning. Operation of flood control works. Organisation of flood combats and restoration of broken works.
Power	Operation of hydro-power works to regulate water
Works	Supervision of operation of urban flood control works and drainage
Meteorology/Aviation	Climate forecasting
Defense	Flood control combats. Transfers of people and property
Police	Maintenance of order and stability. Retreat to transfer of people
Civil Affairs	Disaster relief
Health	Prevention of diseases and medial assistance
Commerce	Provision of materials and equipment
Transport	priority transportation of workers, people in urgent need, materials and equipment
Telecommunications	Priority transmission of flood control messages
Finance	Timely allotment and supervision of funds for flood control
Communication	News report and combat encouragement

Thirdly, confining the river water in the region by the building of floodwalls. Perhaps the Chinese more than everybody else (with the probable exception of the Egyptians), have had a longer experience with flood confinement. This was necessitated by the ferocity of the Hwang Ho floods, the floodable area (8, 192km<sup>2</sup>), and the unpredictability of the river. Fourthly, the channel capacity of the streams in the study area should be increased by enlarging the channels through dredging and excavation or by reducing flood resistance through the removal of snags and other obstacles, eliminating meanders and providing a more uniform cross section. Channel capacity can also be increased by providing alternative channels called flood ways that come into play only during great or severe floods. This has been successfully done at key points on the Mississippi river valley and in the Sacraments river valleys in California (Langbein, 1978). Also avoiding dumping of refuse in drainage paths and channels can also enhance channel capacity (Odermeho, 1988, P. 103). It may also be useful to incorporate – as in developed countries, storm sewers in urban design to convey surface runoff through the basin to the nearby channels. Fifthly, there is need for legislation for flood disaster prevention in Nigeria. The legislation should establish responsibility for all necessary actions, whether of long-term or short-term nature, which are related to flood disasters. It should be prepared as part of the overall legislation relating to natural disasters which constitute a hazard to land such as flooding, erosion and drought.

There are two basic types of legislation relating to flood disaster prevention and preparedness. They are legislation for long-term construction, for reconstruction and for prevention purposes and legislation for preparedness, emergency and short-term recovery purposes. The former establishes the legal framework and directive for orderly and safe development or redevelopment in a fairly lengthy time scale; the latter facilitates immediate access to rescue and relief. This legislation should also clearly define the role and functions of the

coordinating agency for long-term, pre-and post-disaster preparedness, planning and flood disaster relief and rehabilitation. Traditionally, this role is assumed by the civil defence or state emergency services organisations.

Furthermore, there is need for land-use zoning in the Niger Delta. Land-use control measures may be summarized under three main headings:

- (i) Legal measures for the enforcement of zoning and other regulations for controlling function (type of activity) and density and pace of development.
- (ii) Taxation measures to steer development away from hazard area; and
- (iii) Government action to acquire land by compulsory purchase and to alter existing land-use.

It is important to realize that land-use legislation and regulation control not only the type of development defined by hazard risk evaluation but also the rhythm or pace of development. A technical aspect of considerable importance should be supported by rigorous land-development policies and that land-use control for flood loss prevention constitutes one of the variables in the comprehensive framework of land development policies and plans.

In addition, the implementation of building codes cannot be overemphasized. Building codes should be regarded as an essential component of flood disaster prevention. Such codes, covering buildings and other structures, give specifications for design, constructions, operations and maintenance, all related to the lifetime for which the building is required. Well-conceived buildings can have the effect of lessening property losses during floods and even if damage is incurred, the buildings may not be seriously damaged and thus the toll of human suffering is less than it might be. In addition, buildings which are not severely damaged or destroyed can normally continue to perform the functions for which they were constructed and contributing to a more rapid return to normal

economic and social conditions following the abatement of flooding.

It may be necessary to undertake a regional study of floods and the hydrological characteristics of rivers in the Niger Delta region in order to determine the magnitude and frequency of floods, which may be expected to occur within specified intervals. Such a data would also be useful in demarcating hydrologically homogenous areas as well as serve as a basis for regionalization and in the design of structures encroaching on floodplains. The need for forecasting and warning systems in the Niger Delta is very imperative. A fundamental preventive step would be to install devices to foretell a possible flood and to provide evacuation plans. It should be emphasized that the more accurate the forecast and the longer the warning time, the better the Community is able to react. The flood forecasting and warning system, to be effective for the Niger Delta region, should operate under three functional headings:

- (i) Environmental monitoring;
- (ii) The preparation of forecasts and warnings; and
- (iii) The dissemination of forecasts and warnings.

Closely linked to the flood forecasting and warning system is the need for proper evacuation and sheltering of flood victims. The most obvious way to prevent a flood disaster from occurring is to remove people and property. Planning to formulate detailed plans on evacuation so that people may be moved in good time, smoothly and efficiently. At the time when the warning service indicates the possible onset of flood conditions, one of the most important questions that will have to be considered by the authorities is: which areas might have to be evacuated? The resulting decisions would be largely based on the forecasts of the areas likely to be flooded and anticipated depth of water and/or the likelihood of storm surge and the coastal area to be affected. When all the questions have been considered and conclusions reached, the organisation for evacuation, already at full readiness, would be called into action.

The need for flood fighting teams as a way of preparing for flood disaster is also very important. Flood fighting should aim at preventing damage or to minimize its extent, to protect life, limb and property and, in general, to ensure the safety of the population. Successful to flood fighting and the attainment of the above goals depend upon good organisation, thorough advance planning, well-trained personnel and effective coordination at national, state and local level. Finally, there is need for flood insurance schemes for residents of floodplain in the Niger Delta as a way of reducing the loss arising from flooding in the region.

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