

The Effect of Location on the Adoption of Flood Hazards Mitigation in the Forcados Basin of the Niger Delta

DR. TANO DUMOYEI AGUSOMU
dumoyei@yahoo.com
And
DR. HORSFALL DIGIENENI ELI
DEPARTMENT OF GEOGRAPHY AND
Environmental Management, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria

Abstract
Space perception and locational decisions affect the adoption of flood hazards mitigation in vulnerable areas. In the Forcados Basin of the Niger Delta region, the floodplain dwellers' choice of mitigation measures is a function of a complex process involving several variables. The spatial distributions of floodplain dwellers' residences were investigated in terms of their proximity and exposure to the hazard vis-à-vis information on the adjustments made. The results of the study suggest that the adoption of flood mitigation measures require little planning and are highly related to location in the Forcados Basin.
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INTRODUCTION

Floods are natural disasters that have been affecting human lives since time immemorial. Throughout history, nature has shown little respect for man's unwise occupancy of nature's right of way and has insured that the message has been clearly understood by sporadically flooding people's properties and taking lives (Perry, 2000).

Flood management analysis, prediction, control, crisis management, and rehabilitation are normally in the hands of national, regional or local administration and other authorities. One aspect of the problem is the fact that different aspects of management are often disseminated amongst a complex hierarchy of agencies. A second aspect, often ignored by scientists concerned with flooding, are the often numerous and varied reasons why people choose to live in flood hazard zones, and the ways in which they perceived the problem (Burton et al, 1979). To understand and manage successfully the flood problem requires an understanding of the physical problem; but it also requires an understanding of the threatened communities in hazardous areas.

Natural hazards researchers and policy-makers at all levels have embraced the need to increase public awareness of flood hazards in order to encourage the adoption of self-protecting measures of flood-hazard mitigation the world over. In the Forcados Basin of the Niger Delta, flood protection work has not always been successful. In some reaches of the basin, it has introduced unwanted side effects as experienced in Tuomo Community in the Bomadi Creek, or it has proved to be unable to withstand certain conditions. Recent geomorphological and stratigraphic mapping by the Niger Delta Regional Development Master Plan (NDRDMP, 2007) has provided an interesting record of dyke bursts. Dykes have been constructed in some communities in this area in the 1970s in an attempt to restrict flooding by the Forcados River. These engineering structures succeeded but dyke bursts have taken place and even now new work is ongoing to broaden and raise the height of some of these dykes which appears to be vulnerable to future bursts.

Many variables have been shown to be the factors in the development of awareness and in the adoption of mitigation measures in the face of environmental hazards (Cooke and Doornkamp, 1990), but few have general consistent influence (Montz, 1982). As the experience of a hazard is not universally effective in the management of same, information dissemination is being studied as a surrogate for experience in developing awareness, yet experience or public information will affect people most differently. Differences in types of experience, information sources, length of residence, personality, and spatial variations in response must be considered with information dissemination. Where there are differences in response between more and less hazardous areas, public information efforts must be employed to increase awareness and to influence the adoption of mitigation measures in hazard areas.

Aim and Objectives of the Study

The aim of this study is to document the residents awareness and adoption of flood mitigation measures in the Forcados Basin of the Niger Delta region. To achieve this aim therefore, the following objectives were considered.

- To identify the location of the resource users who adopt mitigation measures vis-à-vis the observed flood hazards in the Forcados River Basin.
- To assess the effects of location on the adoption of flood mitigation measures, and;

- To determine the impact of other variables in the flood mitigation process.

This study is, therefore, based on the assumption that floodplain dwellers in the most vulnerable areas and closer to the source of flood hazard areas are most likely to adopt appropriate mitigation measures as perceived.

The Concept of Mitigation

Mitigation is a long-term and ongoing process, prior to the occurrence of a disaster that is directed at reducing future flood damages of a community and a nation. Technically speaking, there is no flood risk that cannot be mitigated through engineering measures, but cost is the determining factor. This process teaches people how to live rationally with floods. Mitigation measures, active and passive, rely on the experience and capacity of the people where disaster occurs. Active measures encompass those activities, which require direct contact with people (Andjelkovic, 2001).

Mitigation measures are traditionally referred to as non-structural measures. Unified concept of urban flood management introduces *flood recovery measures* as a separate entity in order to emphasize the specifics of spreading the cost of compensation over time and among a large number of people exposed to similar risks.

Non-structural measures such as preparedness, response, legislature, financing, environmental impact assessment, reconstruction and rehabilitation planning, and their component techniques, contribute directly towards reducing losses of life and damage to property.

The order in which the mitigation measures are applied is of primary importance. An ideal sequence would be to first develop public awareness that leads to creating political will, followed by drafting and passing the laws and regulations, and secondly, to propose risk-reducing measures, and finally, to offer education and carry out training. Ultimately, market-oriented conditions for flood insurance industry should be created in order to spread potentially high flood damage cost over a long period of time and among a large number of people (Andjelkovic, 2001).

Other mitigating actions include reducing physical vulnerability, reducing vulnerability of the economy, and strengthening the social structure of the community. These actions can be undertaken at individual, community, and state levels. Non-governmental organizations, voluntary, and socio-cultural organizations may also play an important role in this respect.

Although not having a formal definition, flood mitigation can be accepted as a variety of measures that alter the exposure of life and property to flooding. It reflects the holistic nature of those flood management measures that do not have structural nature. Its non-structural nature led some countries to denote mitigation as *institutional* measures, while other countries preferred to use the name of *best management practice (BMP).* The latter is in use in urban conditions for many years. In Europe, the term SUD (Sustainable Urban Drainage) is obtaining increased popularity (Abbott, 2004).

Mitigating means planning, programming, setting policies, coordinating, facilitating, raising awareness, assisting and strengthening. It also undertakes educating, training, regulating, reporting, forecasting, warning and informing. However, it does not exclude insuring, assessing, financing, relieving and rehabilitating. If structural measures are the bones of a flood management program, then mitigation is its flesh (Criss and Shock, 2001).

The Study Area

The rivers Forcados and the Nun are the two main rivers that resulted in the bifurcation of the Niger River at the town of Aboh, south of Onitsha. While the Nun flows directly south-wards and empties into the Atlantic Ocean in the Bight of Bonny, via Akassa; the Forcados swings south-west wards diagonally across the Niger Delta region into the Atlantic Ocean in the Bight of Benin, via the coastal settlements of Burutu and Forcados respectively.

As a major distributary of the Niger River, the Forcados River system breaks the terrain of the Niger Delta into several creeks, swamps and wetlands, with the salt marshes of the mangrove swamps and the beaches lining the shoreline at the coastal margins. The numerous water channels in the Forcados Basin is bordered by natural levees which are of great topographical interest. These levees provide the site for most of the settlements in the basin as well as limited farmlands for cultivating yam, cassava, cocoyam, vegetables and plantain (Udo, 1978).

The river itself is approximately 200 kilometers in length and meanders through the freshwater swamps. The entire catchment of the river is liable to flooding with such important settlements as Patani, Sagbama, Bomadi, Ekeremor, Burutu and Forcados located at its banks. The Forcados Basin of the Niger Delta region is located between latitudes $4^{0}00$ and $6^{0}00$ North and longitudes $5^{0}15$ and $6^{0}30$ East. The basin occupies a surface area of about 5,013 square kilometers within the equatorial climatic zone.

According to the Niger Delta Regional Development Master Plan (NDRDMP, 2007), the Forcados Basin of the Niger Delta region has a population of about 817,792 people. The predominant people here are the Ijaws who are engaged in fishing and farming, lumbering and gin distillation and all other anthropogenic activities akin to their cultural heritage (Figure 1).

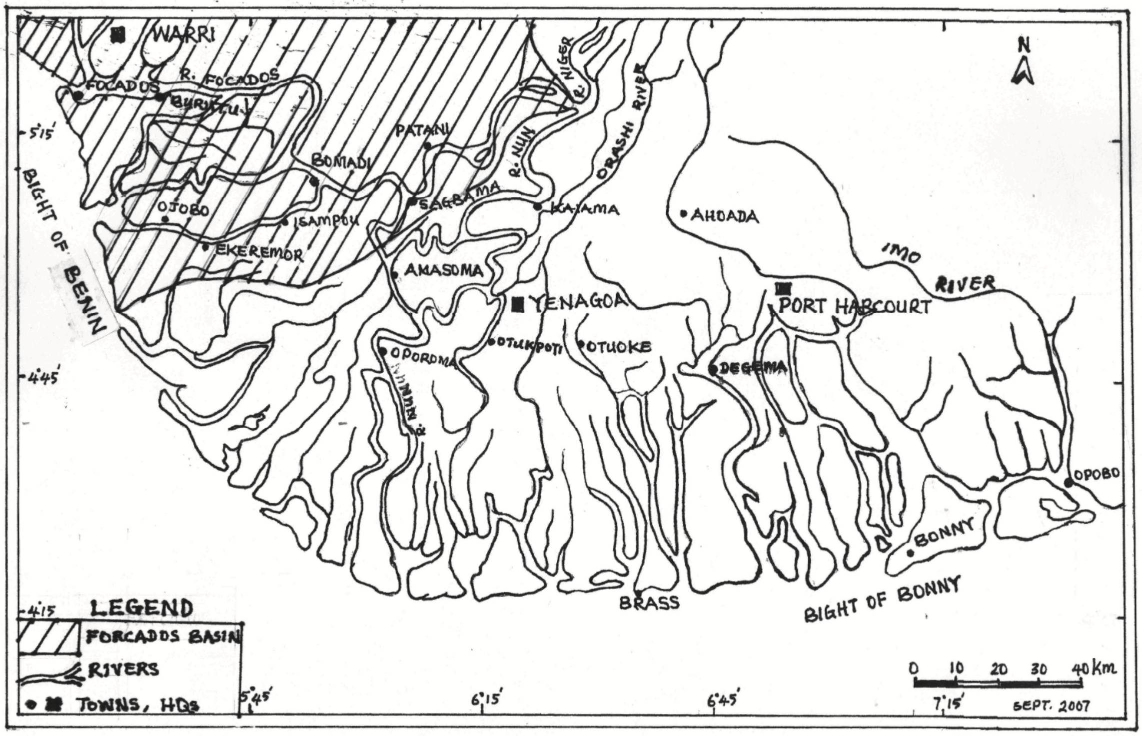

Figure 1: The Forcados Basin of the Niger Delta Region (NDRDMP, 2007).

Methodology

In order to determine the spatial distribution of the adoption of flooding mitigation measures in the Forcados basin so as to evaluate the effect that location has on the adoption process, direct field measurements, focus group discussions, observations and a basin wide survey of flood recovery, structural and non-structural measures, adequately related in time and space was embarked upon. The location of these measures were defined in terms of their proximity to the source of the observed flood hazards and the level of exposure to the hazards.

The nature of data required in this study included the locational addresses of residences adopting flood recovery measures (financial assistance, health and shelter programmes); structural measures (protecting against flood and modifying flooding) and non-structural measures (emergency response and flood preparedness). These data sets were collected from purposively selected communities prone to flooding such as Patani, Sagbama, Bomadi and Ekeremor. Analysis of data from these communities facilitated using location as a predictor of adoption - an approach similar to Baker's (1979) attempt to identifying variables useful to the prediction of evacuation.

Results

Four hundred respondents participated in the study and they could attempt a definition of the term "flood mitigation" in their own words as required in the interviews, indicating that residents of the Forcados Basin generally were knowledgeable about the mitigation of flood hazards. This knowledge has stemmed from experience and the progressive improvement in communication and reporting of flood hazards in the basin. About 95% of the respondents indicated a very high level of awareness of flooding and flooding mitigation in the area.

On the adoption of flood hazards mitigation measures, it was observed that besides engineering structures, little is known about non-structural measures in the Forcados Basin. The reliance upon structural flood controls have encouraged encroachment on the protected floodplain areas along the natural levees and this failed to contain floodplain development in the adjoining backswamps. The inquiry to knowing where those who adopt mitigation measures are located vis-à-vis the observed flood hazards led to an understanding of the effects of location on the adoption of flood mitigation measures as well as the impact of other variables. With respect to locational decisions in the Forcados Basin, several structural, non-structural and flood recovery measures were identified for the study (Table 1).

Table 1: Flood mitigation measures adopted in the Forcados Basin.

Type	Measures
Structural	Dyke Channel improvement Reservoirs Flood proofing
Non-structural	Flood Preparedness Emergency Evacuation Environmental Issues Government and Legislative financing
Flood recovery	Flood insurance Rehabilitation

Field survey, 2017.

In the Forcados Basin, flood flows are partially controlled or redirect away from specific areas and amenities at risk largely by engineering structures. This ranges from levee embankments, dykes or stopbanks, to drainage and culverts.These are often designed to restrict flood waters to well-defined, low value lands on the floodplain. They offer protection up to the heights or design limits of the particular flood magnitude expected. While these measures are adopted by government agencies and Community Development Committees (CDC), the four hundred residents used in the analysis of the adoption of flood-proofing drawn from the riverine urban community of Patani were segregated into four neighbourhoods. (i.e. Ekise, Osuoware, Watermans and Ogoinware). Within these neighbourhoods, the adoption of flood-proofing was carefully analyzed taking into consideration the horizontal distance of housings from the stream and the location of same in or out of the designated floodplain zones.

Analysis of the horizontal distance of residential locations from the stream exhibited a relationship with the adoption of other mitigation measures as well. Emergency evacuation, sand bagging and flood-proofing of residential structures were significantly associated with distance from the flood fringe of the stream. Table 2 illustrates this relationship.

Table 2: Distance and Sandbagging in the Forcados Basin

Distance	Sandbagged residences		Total
	No	Yes	
0 - 50m	30	70	100
50 - 100m	27	28	55
100 - 200m	70	15	85
200 - 300m	40	25	65
300 - 400m	65	30	95
Total	232	168	400

Field survey, 2017

The adoption of sandbagging in Patani as a measure of flood mitigation was inversely related to distance. The study revealed that 41.7 percent of the flood fringe dwellers (those closest to the stream) sandbagged and protected their residences while 48.8 percent of the residents in the same location flood-proofed their homes. In contrast, the middle distances contained fewer sandbagged and flood-proofed residences, and this is between 100 - 200meters from the stream. At the backswamps, over 300metres from the stream, 32.7percent and 13.0 percent of sandbagging and flood-proofing mitigation measures were adopted respectively. About 9 percent of the residents were complacent about the hazard and resolved to remain in the flooded zones to accept the loss (Table 3).

Table 3: Distance and Flood-proofing in the Forcados Basin

Distance	Flood - proofed residences		Total
	No	Yes	
0 - 50m	12	40	52
50 - 100m	22	25	47
100 - 200m	42	5	47
200 - 300m	34	10	44
300 - 400m	30	12	42
Total	140	92	232

Field Survey, 2017

Other adopted mitigation measures pointed at the establishment of local planning, zoning and disaster aids. Though there exists no relationship between the adoption of these measures with the distance factor, the resistance of flood victims to resettle away from floodplains is often abetted by disaster aids as well as local planning and zoning in the Forados Basin of the Niger Delta region. Residents who were flooded out typically repaired the damaged properties or built new homes and businesses on the same sites.

Since the response of society to flooding depends, in part, on how the hazard is perceived, their vulnerability instead was assessed by categorizing the location of the respondents' residences as either being at the flood-fringe (most vulnerable), the levees(less vulnerable), or in the backswamps. Within these areas, the actions of evacuation and making emergency preparations or accepting the loss were studied (after Baker, 1979).

There existed a significant relationship between vulnerability and evacuation in the study. About 55.8 percent of the flood-fringe dwellers evacuated while about 16.4 percent and 27.9 percent in the levees and backswamps respectively also evacuated. Thus it was concluded that the adoption of mitigation measures increased with increasing vulnerability among resource users in the face of hazardous situations in the Forcados Basin. It was therefore inferred that those in the levee areas had time to make emergency preparations in lieu of evacuation than those in the flood fringe zone (Table 4).

Table 4: Flood hazard vulnerability and Evacuation in the Forcados Basin

Area	Evacuated		Total
	No	Yes	
Flood fringes	12	58	70
Levees	13	17	30
Backswamps	11	29	40
Total	36	104	140

Field Survey, 2017

The rate of the adoption of flood mitigation measures were analyzed in different designated areas of the floodplains in Bomadi community in terms of the residents' vulnerability and evacuation and their plans of action in the face of flooding. The results showed two extreme situations. The vulnerability and eventual evacuation of residents and the establishment of a local planning and zoning exhibited gradual decreases as one moves away from the 100-year floodplain (the area submerged by the highest flood magnitude likely to occur over a 100-year period). The extent of flood-proofing increased outside the 100-year floodplains. Residents in and outside the 100 year floodplains are most likely to establish a plan of action. On the other hand, those outside the designated floodplains are more likely to have their homes flood-proofed. These divergent actions may be adduced to several factors, viz:

1. The differences in the interpretation of the term flood-proofing rather than in the propensity of residents to undertake such action (McNei,l 2000).
2. When the residents are not in designated flood hazard areas, they may develop different perception of what it takes to flood-proof since they are above the 100-year flood heights.
3. Local topography may be an important factor at distances greater than 400 meters from the stream (Moritz, 1982).

Discussion

Space perception and locational decisions affects the adoption of flood hazard mitigation measures in the Forcados Basin of the Niger Delta region. The investigations on the importance of location as a means to predict the adoption of flood hazards mitigation measures was based on the premise that the most vulnerable floodplain areas are necessarily those closer to the source of the hazard and that the residents of those areas would be the most likely to adopt needed measures (Montz, 1982). Studies in Panama City (Baker et al, 1979) however, revealed that the results may vary from this premise. Evacuation in Panama City and the adoption of flood insurance in Binghamton were both found to be statistically associated with vulnerability to the hazard. However, in the Forcados Basin, since little is known about flood insurance, other mitigation measures, structural and non-structural, were adopted.

In the Forcados basin, particularly in the riverine urban communities such as Patani, Sagbama, Bomadi and Ekeremor where little is known about non-Structural flood mitigation measures, the residents largely depended on engineering structures to control the effects of flooding. The reliance upon these controls have encouraged encroachment on the protected areas along the natural levees. This has increased the vulnerability of floodplain resource users to the impact of flooding. The real and perceived inter-annual variability of flood losses thus continue to rise in the communities and in the basin generally. Vlachos (1995), Promise (2005), Shaka (2005) and Atakpu (2001) in their studies and estimates of the impact of flooding in Nigeria have suggested that flood damages have been rising during this century at about 4 percent per year in real dollars. At the same time, the public cost of building flood mitigation works has also risen. Since 1936, the United States government, for instance, has spent more than $15 billion on structural flood control works. Data from other countries also show a similar picture. In New Zealand, Erickson (1986) estimated that the insured direct property losses grew from less than NZ $ 2 million in 1953 to about NZ $ 20 million in 1985.

In areas where flood insurance is adopted, one would expect an inverse relationship between distance from the stream and adoption if there were little topographic variations. Studies in Binghamton, New York (Montz, 1982); Bauman and Sims (1978) showed that this is not always the case. Several low-lying areas some distance from the source of flooding are affected by poor drainage and flood insurance is purchased for needed protection. In the Forcados Basin, when flood insurance is eventually adopted as a mitigation measure, the backswamps which are less than 1000 meters from the stream would influence development patterns in the communities. Topography will impose characteristic dense urbanization processes in well drained areas and otherwise in vulnerable areas.

Distance as a factor influencing the choice of flood mitigation measures adoption, was particularly important in predicting the relationship that existed in the adoption of flood-proofing and vulnerability in the study communities. The adoption of sandbagging, emergency evacuation and flood-proofing of residential structures was observed to be significantly associated with distance from the flood fringe of the Forcados River. Schein (1980), in his studies in Denver City asserted that distance cannot always be used as a surrogate for measuring vulnerability. The distances used in his study of Denver City were rather crude, straight-line measures and did not consider the effect of topography. Accordingly; there may be low-lying areas at great distance from the source of the hazard; and while the distance measure may be large, the areas may be very vulnerable to flooding. Thus, distance may be an important factor influencing the choice of mitigation measures adoption in areas in closer proximity to a stream. However, other variables may come into play at farther distances as observed in the Forcados Basin.

The study revealed that the adoption of measures requiring planning and forethought is not related to location. Vulnerability on the other hand impels floodplain dwellers in the Forcados Basin to respond spontaneously and thus resolves to evacuation in the face of flooding. Although not popularly adopted in the Forcados Basin, flood insurance and flood-proofing require planning. The adoption of these measures in closer, more vulnerable areas may result from the wider publicity and awareness created than the other measures. The proximity of resource users to the stream coupled with intensified publicity of the aforementioned measures may lead to the wider adoption of flood mitigation measures in the Forcados Basin of the Niger Delta region.

Conclusions

Space perception and locational decisions influence the adoption of flood hazards mitigation measures in the Forcados Basin of the Niger Delta region.

- In the riverine urban communities, little is known about non-structural flood mitigation measures and the residents depended on engineering structures to control the effects of flooding and this has greatly encouraged encroachment on the protected areas along the natural levees.
- Distance and location from the stream influenced the choice of flood mitigation measures adopted in the Forcados Basin, while the adoption of sandbagging, emergency evacuation and flood-proofing were significantly associated with the distance from the flood fringe, other variables may come into play at farther distances as observed in the Basin.
- The adoption of measures requiring planning and forethought is not related to location. The residents in very vulnerable areas in the basin responded spontaneously and resolved to immediate evacuation in the face of flooding.
- Flood insurance and flood-proofing require adequate planning and legislation. The adoption of these measures will depend on a basin wide publicity and awareness created in the study area.

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