Integrated Approach to Urban Flood Adaptation in the Niger Delta Coast of Nigeria

C. Okoko OGBA and Pius UTANG, Nigeria

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ABSTRACT

The paper highlights the physical, social, economic, technical and institutional dimensions of urban flooding as fundamental for planning to facilitate adaptation. Using one urban area, the paper compared the delineated flood prone areas based on traditional urban master plan with the observed spatial shifts in flood areas in temporal context. The two maps were superimposed to determine flood risk areas. Documented data were used and supported by field observations. The results were that while a spatial shift in the location of flooded areas were identified, the inadequacy of urbanization process, coupled with the phase of urbanization were responsible for the current flood problems urban master planning became imperative for flood prevention and remedial action. The unified urban flood management/planning concept was advocated to facilitate adaptation, while the integration of stakeholders, flood management system elements and floods aspects was illustrated and recommended.

INTRODUCTION

Although flood hazard is natural, human modification and alteration of nature's right of way can accentuate the problem, while the disastrous consequences are dependent on the degree of human activities and occupancy in vulnerable areas. In urban watersheds, physical developments of diverse ramification can create flood situations in areas hitherto not considered prone to flood. (Andjelkovic 2006; Odemerha, 1988, Akintola, 1978).

Urban flooding differs from regional and rural flooding in many perspectives. As noted used by Andjelkoric (2006), this can be viewed from the climatic, social, economic, institutional and technical aspects. The criticality of the perspectives for urban areas underscores the attention paid to developing on urban flood adaptation. In urban areas, which are characterized by increasing concentration of production and population, coupled with concentration of wastes and associated environmental and health problems, floods can be of monumental consequences. In these environments short and intensive showers can prove to be as effective as long lasting rains and as such the intensity and frequency of disruption of public life and traffic could be high. This means increasing financing from local revenues, which could have been used in the areas that are equally of priority.

Flood problems within cities of the Niger Delta appear to be increasing. This does not necessarily imply increasing rainfall but changing landscape be the underlying culprit. Urban flood as used for this paper is in line with Rashid (1982) in Odemerho (1988) and means any overland flow over urban surfaces (streets and settlements), sufficient to cause significant property damage, traffic obstruction, nuisance and health hazard.

Studies on flooding in the Nigerian cities have concentrated on the typologies, underlying determinants and consequences. Some have focused on the intensity of rainfall (Zabbey, 2007); while others focus on the intensity of the problem over time and space as closely related redacted to the rapid rate of urban expansion, especially where the simultaneous provision for adequate urban runoff disposal is lacking (Odemerho, 1988).

Urban floods in the Niger Delta have local and area-wide origin, with occurrences increasingly frequent and affecting human activities and livelihood in many ramifications. Although mainly the poor in high density areas are affected, the spate of disruptions knows no social boundary. Flood adaptations are needed and should involve a holistic and integrated approach to flood management. This is the main thrust of this paper.

THE NIGER DELTA AND FLOOD DIMENSIONS

The Niger Delta located at approximately $5^0$3' 49" N, $6^0$31' 38"E on the Northern fringe at Aboh; $5^0$44' 11 "N, $5^0$03'49"E on the western limit and $4^0$27'16" N, $7^0$35' 27"E on the Eastern limit (NDES, 1997), has a characteristic flat topography that is disserted by a plethora of river distributaries. The area generally comprises of river flood plans, tidal flood plains, beach and barrier ridge islands and higher fringing plains. Rainfall is generally high, but

spatially variable. Means annual rainfall varies from 4500mm in Bonny area to about 2500-3000mm in the Warri and Port Harcourt axis. These characteristics favour flooding which could be exacerbated by depletion of vegetation cover (Oku, 2003). In addition to the above, a considerable part of the river flood discharge takes peace overland in the Delta.

Flooding in the Niger Delta is thus a common and recurring phenomenon. There are different dimensions of flooding in the area. Zabbey (2007) for instance, identifies three type, namely: riverine, coastal and urban flooding. Apart from the local rainfall that is a risk factor in flooding, the Niger flood waters empty into the region, causing yearly flooding in many parts. In addition to this, is the almost lowland terrain with most parts lying below 6m above mean sea level (Ashton-James, 1998). Being within the coastal margins, it is periodically influenced by ocean surges. Currently, tidal influences are conspicuous, often extending inland to about 30-50km (NDES, 1997) or in some rivers up to 70km from the mouth (Onwudinjo, 1990 in NDES, 1997). The area is thus subject to coastal flooding and the susceptibility of many parts of the region to potential sea level rise induced flooding is high. This is expected to be compounded by land subsidence arising from increasing crude oil extraction. Settlements such as Bonny, Brass, Akassa, Forcados are significantly influenced by high tidal waters.

Although settlements in the region favour dry lands, some are under the influence of tides more than others, while others are more under the influence of occasional riverine floods. However, the high density and highly urbanized areas are peculiar in having a unique type of flood. This arises from urbanization that is accompanied by lack of respect for planning and development laws and regulations.

The growth of towns in the region increased since the 1970s and this is attributed to the creation of local government and states, where the headquarters became growth centres for regional development. However the pattern of increasing urbanization is in favour of cities where industrial activities arising from petroleum oil production are concentrated (NDES, 1997). Figure 2 is the map the region showing some of the major urbanized settlements. The figure suggests that a greater number of the urban areas are subject to both coastal and riverine flooding. However, the concomitance of inadequate urbanization, including surface concretion, drainage channel obstruction, lack of respect for planning in terms of drainage provision, obstructing nature's right-of-way, and solid waste management could compound the already vulnerable situation in the urban centres. Urban flooding in the Niger Delta is therefore a complex phenomenon in terms of both cause and effect implying complex and holistic approach to its management for adaptation.

URBAN FLOODING IN PORT HARCOURT AND ENVIRONS

Port Harcourt is the largest and most urbanizing city in the Niger Delta. Presently the city has so expanded such that much agglomeration and conurbation are experienced. To this extent, it is difficult to distinguish local boundaries. The city occupies a pivotal position in the concentration of production and population. Here the concentration of domestic, commercial and industrial activities generates waste, in addition paving way for the proliferation of

building and infrastructure provision. The wastes generated, are in most cases not managed properly and this could cause major environmental and health problems that can be spread by floods.

The contributive role of urban surface characteristics to flood has been established for some Nigerian cities (Odemerho 1988). Urban flooding in the context of pondages and overland runoff from nearby streams and creeks has been a recurrent phenomenon in Port Harcourt. In areas such as those along Amadi creek, between Ogbunabali and Rainbow town, Marine base and NPA, as well as built up areas north of Dockgard creek and many other settlements located close to the creeks such as Borokiri, river flooding is common (fig. 3a). This is compounded by the nature of development in those areas, which is characterized by inadequate urbanization. In the hinterland, where runoff from streams rarely exist flood episodes are still common. This is because of the flat nature of the terrain and high level of urban expansion that does not commensurate with the provision of drainage outlets to carry excess generated runoff. Pondages are common and found in many abandoned, unused plots and construction sites. There are increasing incidences of flood pondages and rapid runoff in vast areas experienced around Mgbouba, Mkpolu, Diobu, Alakahia, Army barracks and Rumukoro (fig. 3).

Zabbey (2006) reports of unprecedented flooding that submerged houses, paralyzed economic activities and rendered some residents of Mgbouba, Diobu and Mkpolu areas internally displaced. He attributed this to excessive rainfall associated with climate change. It should be noted that rainfall at that period could have been in excess of ground saturation and resulted in the saturation excess overland flow. However, increasing built-up areas without proper recourse to urban planning rules, and additional concretion, could have accelerated infiltration excess over-land flow. A combination of saturation and infiltration excess overland flow could have been responsible, with the proximate determinants being the rainfall and topography. Although rainfall may have been higher than previous years, this could skill have been lower than some other years prior to the present urbanizing phase of development that is being experienced.

As observed from the projections of rainfall for Port Harcourt in Nigeria's first national communication on climate under the United Nations Framework Convention on Climate Change, the period 2010-2039 are expected to experience a fall in rainy reason rain in Port Harcourt a against the 1961-1990 decades (FME 2003). The late 1990s and early 2005 are not included. These periods may have experienced greater or less rainfall. However the projections up to 2099 suggest increasing trend that rainfall of June, July and October will increase by 65mm, 20mm and 47mm respectively for the Port Harcourt region (FME, 2003). This suggests that flooding in Port Harcourt would increase in the future. This would particularly be more compelling given the increasing scope of urban expansion.

Many parts of Port Harcourt that are experiencing flooding outside those close to river floodplains, are at the initial stage of urbanization, characterized by inadequate urbanization According to Pouraghniaei (2001), the extent of urbanization on surface hydrology depends

on the level and magnitude of urbanization. The effects at the beginning of urbanization are usually different from those during the stage of large scale and continuing urbanization. Although in all the stages, more storm runoff is generated, the initial and beginning of large scale urbanization is experienced by erosion and sedimentation, which facilitate flooding. These are further compounded during the continuing stage, characterized by massive concretion and reduction of infiltration. Many parts of Port Harcourt are at different stages of urbanization. The apparent spatial shift in flooding tends to corroborate this. The trend is likely to continue, with areas hitherto not experiencing flooding becoming incorporated in the flood list. This is particularly for areas with relatively flat topography (fig. 3b) where urban expansion in associated with inadequate drainage pathways.

The foregoing suggests that, although flooding in Port Harcourt is primarily climatic, inadequate urbanization, relatively flat terrain, inflow from nearly creeks, surcharges due to blockage of drains and street inlets, in adequate waste management, which clogs drains, are other determinants. Although floods cannot be completely prevented, flood management through adequate information about rainfall regime and forecast, and urban flood management planning can reduce disastrous consequences and facilitate adaptation. How to deal with this forms the thrust of the next section.

INTEGRATED PLANNING FOR URBAN FLOOD ADAPTATION IN THE COASTAL CITY OF PORT HARCOURT

Integrated approach is mainly a policy driven action rather than project mode implementation program (Chattopadhay, 2002). It involves planning for environmental and social-economic sustainability. Because planning is future oriented, integrated planning is geared towards forestalling future problems associated with the inadequacy of human actions. In the area of urban flooding, integrated approach involves harmonizing and articulating all the components of urban flood management system. This holistic approach aims at integrating the stallholders, elements and aspects of flood management into a development plan.

According to Chattopadhay (2002), integrated planning is concerned with anthropocentric perspective area development plan, which enable urban dwellers to be adapted to flooding, since it provides planned adoption measures that are both structural and non-structural. The approach harmonizes environment and development, with specific thrust on the welfare of the urban poor.
As pointed out by Andjelkovic (2001), integrated urban flood planning is a unified approach which incorporates an array of urban flood management activities. Among others, it involves:

- Designing and implementation of land and water use activity zoning and sitting policy;
- Contingency plan for human induced and natural flood disasters, including the potential for climate change and sea level rise. This is to reduce vulnerability, which according to Chambers (2006), refers to exposure to the contingencies and stress, and difficulty in coping with them. It involves adopting both structural and non-structural measures in a unified framework.
- Improving human habitation covering housing, sanitation, solid waste management etc.;

- Conservation and restoration of critical habitats such as mangroves (wetlands) and riparian vegetation
- Human resource development and training in skills for emergency actions in case of disasters. This includes understanding of natural dimensions of flooding and developing early warning systems
- Public education awareness and information programme as aspects of flood preparedness and emergency action; and strengthening and developing institutions involved in flood management and planning.

All these involve the integration of relevant sectors of urban development with spatial planning and the relevant institutional and legislative framework. At the heart of all these is spatial planning, which is the allocation and reallocation of area for various uses. Within this is the concept of master planning.

Master planning is the key to flood management planning. This aspect of planning usually provides policy documents that help to direct flood controlled urbanization in an undeveloped or underdeveloped area or mitigates adverse consequences of flooding in areas that have already experienced flood.

The conceptual framework for urban flood management for local adaptation in represented in figure 4. The model shows that urban flood management in coastal areas has various elements-structural and non-structural. These system elements must all be articulated in any urban flood management planning. This is the unified model as provided by Andjelkovic (2001), in which non structural measures including: Emergency response measures, flood preparedness measures, local and state legislature, financing, and environmental impact assessment are incorporated with structural and flood recovery measures such as insurance, financial assistance, rehabilitation and tax adjustment designed to cushion the effect of urban – induced flooding.

The harmonization of the system elements does not work well when the technical, environmental, financial/economic, socio-cultural, institutional and policy/legal/political frameworks of the society are not adequately taken into consideration. The stakeholders, including various sectors in city council and state/national governmental levels, non-governmental and community based organizations, research institutions, Donor agencies and the private sector must also be part of urban flood management planning.

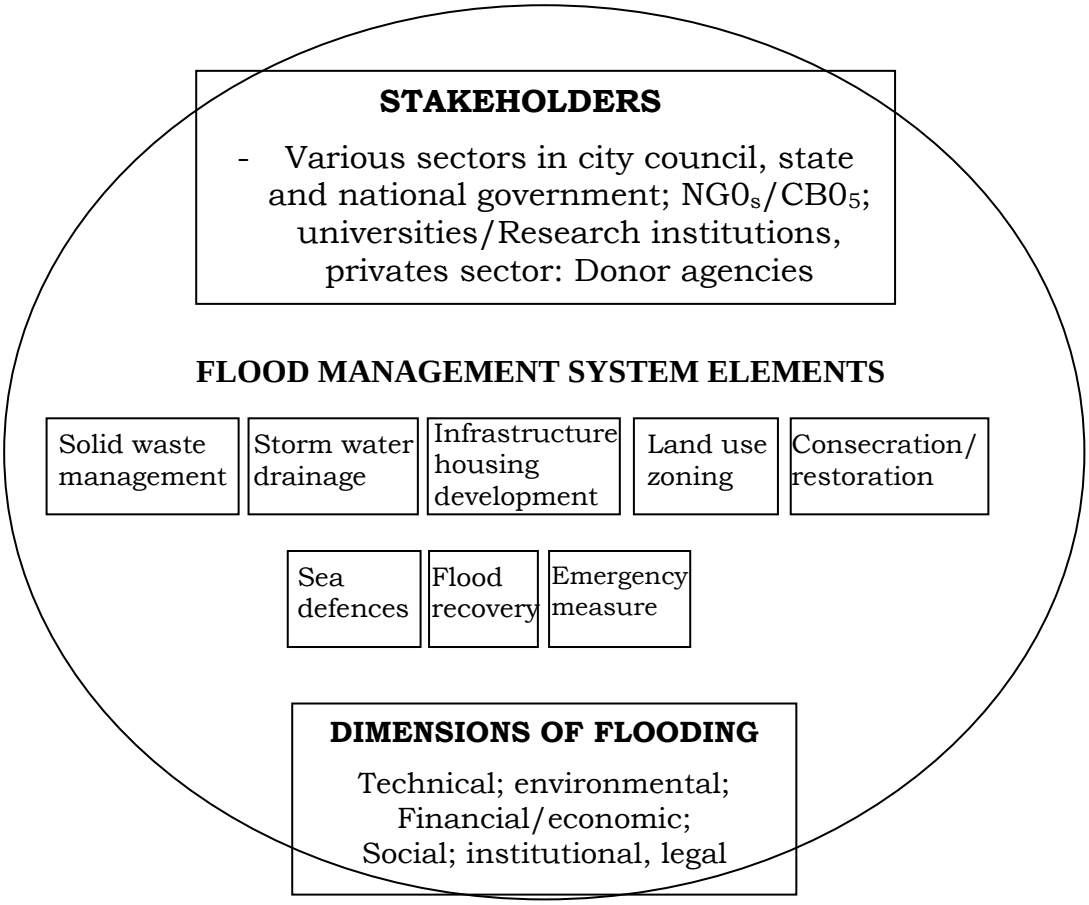

Fig. 4: Model of integrated flood management planning
Source: Modified from Klaudert and Anschiitz (2000)

CONCLUSION

Floods are naturally caused by rainfall, but in urban areas characterized by inadequate adherence to planning regulations, even a short duration shower can be a critical initiator of flooding. In the Port Harcourt urban region, flooding appears to be increasing in space- time dimensions. The fringes that are undergoing initial and continuing phases of urbanization are the worst affected at the present.

Floods cannot be prevented out rightly, but good planning and observance of the rules can reduce the level of vulnerability and facilitate coping. This calls for an integrated approach to urban flood management, since several element and dimension of urban planning can be identified. The unified urban flood management planning model is advocated and developed for policy implementation. This implies that in considering options for flood mitigation or adaptation, al stakeholders, elements in flood management and dimensions of the society involved in flood management and affected by urban flooding must be brought to the fore. The starting point is comprehensive spatial planning, while sectoral and institutional aspects are integrated for the purpose of providing efficient management plan (Klaudert and Anschiitz, 2000).

The traditional urban master planning determined concepts of how to reduce flood damages mainly using structural flood control measures. However, as adopted for this paper, the practicalities recognize that in order to ensure the realization of urban flood adaptation, a variety of additional pre-flood and post-flood measures need to be put in place too. These are the non-structural and recovery measures that are imbedded in the unified urban flood management planning concept.

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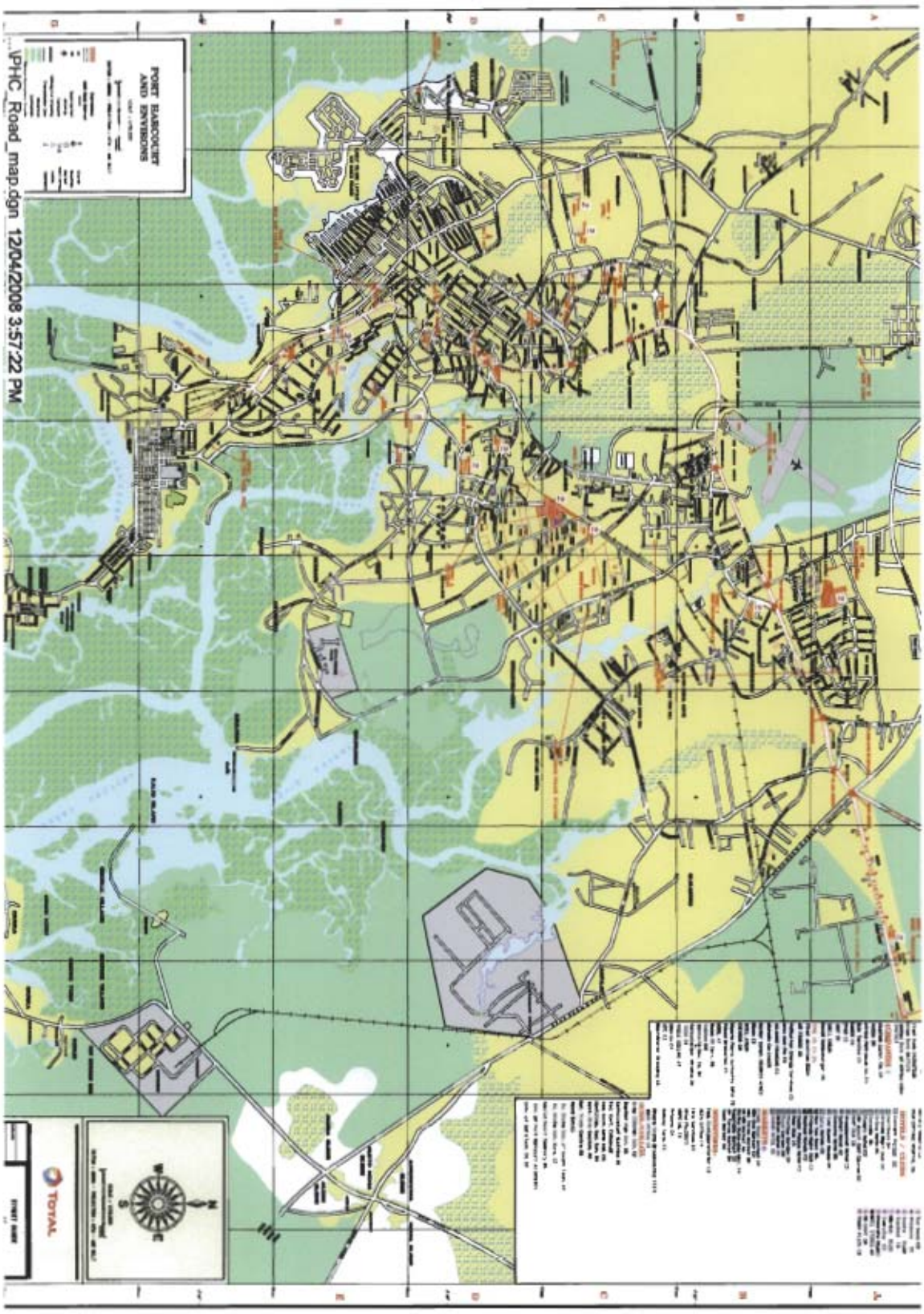
CONTACTS

Ogba C. Okoko

Contracts Department
Eff Petroleum,
Port Harcourt
NIGERIA
E-mail chimaogba@yahoo.com

Utang B. Plus

Department of Geography and
Environmental Management
University of Port Harcourt,
NIGERIA
betenutang@yahoo.com.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