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FLOOD RISK MANAGEMENT BY PUBLIC AND PRIVATE AGENTS IN THE COASTAL CITY OF LAGOS

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ABSTRACT: Lagos, West Africa's foremost port city is projected to rank the third largest global megacity with an estimated population of 23.2 million in 2015 according to a report of the UN World Urbanization Prospects. An increasingly important environmental threat to the city's high population and large concentration of residential, industrial, commercial and urban infrastructure systems is coastal and urban flooding due to climate change and sea level rise. The rapid rate of urban development with the attendant environmental problems is a further driver of flooding in the city. Over the past decade, flood risks has increased significantly affecting key sectors of the urban system as well as impacting on all social aspects of society. The paper presents findings of an on-going research project which employs a mix of quantitative and qualitative methods to examine the multiple approaches to flood risk management by public and private agents in the city. Community-based flood protection measures adopted by different socio-economic groups as well as the factors that influence flood management decisions are also discussed.

Key Words: Flood Risk, Flood Management, Public and Private Agents, Lagos

1. INTRODUCTION

There is a broad consensus that flood risk is already changing at a significant rate as a result of climate change (IPCC, 2012; Meijerink and Dicke, 2008; Milly et al, 2002). This explains the attention towards flood risks and the management particularly in large urban areas where populations and critical infrastructures concentrate (Jha *et al*, 2012; Wilby and Keenan, 2012; Merz et al, 2010; Pelling, 2003). Flood risk management is particularly important for urban areas in developing countries which are experiencing relatively rapid changes in urban patterns, population growth, infrastructure and the natural environment. As these changes progress, relationships between people and the environment (built and natural) become even more complex and more difficult to manage, and so are the disasters that occur in these settings. In low-lying coastal urban areas, high populations and assets are highly vulnerable to flood risks which underscore the need for flood risk management in these locations (Pelling and Blackburn, 2014; Hallegatte et al, 2013; UN-HABITAT, 2011; Nicholls et al, 2007; McGranahan et al., 2007).

Flood risk management, defined by Gouldby and Samuels (2005) is "the continuous and holistic societal analysis, assessment and mitigation of flood risk". The objective is to employ structural and non-structural methods to achieve acceptable residual risk for sustainable development (Klijn et al., 2008). The modern approach to the management of flood risk embraces the full spectrum of management processes from technical analysis to institutional arrangements (Merz et al, 2010) and the involvement of all actors within the system of concern. Flood risk management has assumed the dominant paradigm in public policy and engineering practice dealing with floods (Hall et al, 2003) as evident in many developed societies experiencing the impacts of floods (e.g. Klijn et al, 2008). In the face of increasing flooding events developing societies are under pressure to manage flood risks. Developing countries are generally considered to have low adaptive capacity to manage climate change impacts. The paper discusses the current approaches for managing flood risk by public and private actors in the coastal city of Lagos. Specifically, the responsibilities of government agencies at various levels and the role played by private

agents (individuals and households, communities and property developers) in managing floods is examined.

2. FLOOD RISK IN LAGOS

The coastal city of Lagos, West Africa's foremost port city and Nigeria's economic capital, is the second largest megacity in Africa after Cairo. The population is projected to be 15.8 million in 2025 (UNHABITAT, 2010). Lagos has witnessed years of rapid urbanization. Its population density of 20,000 persons per square kilometer (LASG, 2012), far exceeds the global average population density of 112 persons per square kilometer for coastal zones (IHDP, 2012). The city's high population density and growth rate have also meant severe pressure on the environment and infrastructure. Lagos accommodates a poor majority, most of whom inhabit slums and marginal areas of the city. From 42 slum communities in 1981, the city has spawned about 100 slum communities, comprising almost 70 per cent of the city's population (Adelekan, 2010).

Lagos is expected to rank the fifth most exposed city to climate change threats by 2070 (Nicholls et al., 2007). A computation of Climate Change Vulnerability Index (CCVI) identified Lagos as one of the ten cities with "high risk" from climate change globally (Maplecroft, 2012). An important effect of climate change in Lagos is the increasing severity and impact of both inland and coastal floods (Young et al, 2014; Adelekan, 2010). Flooding is one of the most important concerns for the city of Lagos due to the varied adverse social and economic impacts and public health impacts (Adelekan, 2010; Ajibade et al, 2013). The large population and social vulnerability of the majority of the population as well as the level of economic activity within the city mean that Lagos is exposed to significant flood risks. The earliest historical record of flooding in Lagos dates back to 1947 when Lagos was only a small coastal settlement (*Daily Times*, 1947). The pattern of flood occurrence has however changed significantly over the decades. Flooding of the city has been recorded with increasing frequency over the years (Adeoye *et al*, 2009; Odunuga, 2008; Ayoade and Akintola, 1980). The spatial extent of flooding has also increased with many parts of the city experiencing flooding during the rainy season. Changes in the intensity and pattern of rain storms, land use changes, and subsequent changes in the hydrological fluxes of the urban watershed associated with urban growth, compounded by inadequate or lack of drainage infrastructure, poor waste management, poor urban planning, and poor development control have strongly exacerbated flooding in Lagos over the decades (Jha *et al*, 2012; Adeloye and Rustum, 2011; Adelekan, 2010; Odunuga, 2008; Folorunso and Awosika, 2001).

While many flood events in Lagos have been reported by the local media, only major flood disasters have been documented by global flood/ disaster observatories. Recent flood events with severe impacts are those of 2010 in Ikorodu and the widespread floods of July 2011 and July 2012. In July 2011, heavy rainfall which lasted about 17 hours precipitated a total of 233.3 mm of rainfall – the equivalent of the amount expected for the entire month. About 25 people were reported killed as a consequence of the floods while 5,393 persons were displaced from their homes (IFRC, 2011). The total cost of the 2011 flood, in terms of goods and properties, was estimated at NGN30 billion (USD200 million) by the Nigerian insurance industry. Substantial properties lost to flood are, nonetheless, not insured and are owned by middle-class and poor residents, some of whom live in informal settlements. Also in June 2012, 216.3mm of rainfall was recorded in a single rainstorm event. The resulting flood wreaked widespread and severe damage to infrastructure, roads, bridges, rail track, houses and other properties, and claimed seven lives. The livelihoods and economic activities of residents were also affected. The floods of 2010 which had severe impacts in Ikorodu was as a result of the release of water from the Oyan dam upstream on the course of Ogun River. As a consequence the problem of flooding in Lagos is increasingly raising serious concerns among the general public and government. The need for effective flood management in the city of Lagos has therefore assumed some level of significance not just at the local level, but also at the national and international levels (Douglas *et al*, 2008; Breitmeier *et al*., 2009).

3. DATA AND METHODS

The study employed a mix of qualitative and quantitative methods to elicit information on flood risk management by public and private agents in the city. Focus group discussions with community members in selected flood affected areas of the city and interviews with key informants among the general public and city officials in different government departments provided insights into flood management strategies at individual, household, community and city levels. The administration of purposively designed questionnaires to 1000 members of the public in selected flood-affected areas in all the local government areas of the city provided further information on strategies adopted for flood management at household level. The review of Government documents and other published materials also provided additional information.

4. FLOOD RISK MANAGEMENT

Flood risk management and governance in Lagos did not emerge quickly and significantly enough to match the increasing threats and impacts of flooding in the city. This is evident in the inability of the city to effectively mitigate the impacts of, and learn from successive flooding incidents that have ravaged the city over the years. Until more recently government took primary responsibility for flood risk management in Lagos. This characteristic is not however unique as a similar trend was observed in the early history of flood management England (Johnson and Priest, 2008). The emergence of private agents as actors in flood risk management in the city is therefore a relatively recent development. This section examines flood management approaches by government at different levels (public agents) and private agents (communities, households, individuals and the insurance sector).

4.1 Flood Risk Management by Public Agents

4.1.1 Structural measures

To a large extent, the traditional approach to the management of urban flooding in Lagos by the city government has been based primarily on structural measures in form of the construction of drainage channels. The first drainage master plan in the city, the Lagos Mainland drainage master plan, was designed and concluded in 1974. Subsequently, two other drainage master plans were designed in 1992 (Apapa and Lagos storm water drainage master plans) and in 1998 (Greater Lagos Drainage Masterplan). During the period 2007 and 2011, about 100,000 hectares of land was drained and 84km of concrete secondary storm water collector drainage was constructed. In 2011, the sum of N36.79billion, 8.6% of the state's total appropriation for the year, was invested in infrastructural development and drainage and flood control. Five channelization projects were executed and state-wide de-flooding and drainage de-silting programme were undertaken. Furthermore, in preparation for the rainy season each year, the Ministry of The Environment through the Office of Drainage Services undertakes a city wide maintenance program of existing network of drains which comprise tertiary drains, secondary collectors, channels. Rivers receiving runoff from primary channels are also continuously maintained and dredged.

At the coastline, measures have been undertaken over the years to protect the city's Atlantic coastline from storm surges and coastal flooding. A breakwater was constructed at the Bar Beach on the Atlantic coast in 2006 to protect the Bar Beach and the concentration of business infrastructures in Victoria Island. Presently the construction of a 7 km of revetment referred to as "Great Wall of Lagos" to protect the city from storm surges and coastal flooding is on-going. The wall at completion will comprise 100,000 concrete blocks (accropodes) weighing 5 tons each which interlock loosely to form an effective barrier that dispels the force of the waves and provides the primary sea defence. By the first quarter of 2013, 3.5km of the Great Wall of Lagos had been constructed.

4.1.2 Non-structural measures

Non-structural measures to reduce the exposure of urban population to flood risks have also been embarked upon by the Lagos state government. This includes the existing framework for urban

development in the city which is guided by land use plans and zoning regulations in terms of permissible developments, height, density and building setback provisions. Property developers in Lagos are expected to build according to zoning regulations. To this effect the regulatory frameworks contain provisions that provide safeguards to flood risks e.g. regulations on the minimum setback to the ocean, lagoon, river and creeks, and gorges/canal/drainages respectively (Adelekan, 2013). These regulations are however not effectively enforced as seen in the large numbers of buildings and other structures on drainage paths, flood plains and close to the coastline. To address this situation the state government has embarked on the demolition of buildings located on drainage paths. The demolition exercises in flood prone communities of Ijora-Badia (2010, 2012 and 2013) and Agege and Ijeshatedo in 2011 are examples.

Other soft measures employed by the state government to factor disaster risk reduction into investment in building and construction is the provision of land to private estate developers at less than premium cost to discourage development arbitrarily on marginal lands. The government has also mandated the discontinuation of physical development in areas liable to flooding and wetlands which were originally approved for building development e. g. Isheri North which is vulnerable to flooding from Ogun river (Adelekan, 2013).

More recently, at the national level, a directive for nation-wide campaign on flood awareness was issued by the National Emergency Management Agency as a result of increasing flood occurrences. However, this is not new to Lagos residents as city authorities had always done this in preparation for annual flooding of the city. Also, the Nigerian Meteorological Agency has in the last few years begun to provide seasonal rainfall predictions for the country. The reach of the predictions to the wider public is however an issue to be considered. In early 2011 NIMET forecasted "a near normal annual rainfall in the south of the country (1200 to 2700mm)" (NIMET, 2011 P.3). Specifically, it was predicted that Lagos along with Sagamu would have the highest seasonal rainfall amount of 2695mm for the year. The June 2011 edition of NIMET's *Drought and Flood Monitor Bulletin* also warned that flood prone states including Lagos should expect flood episodes. The warnings, however, are not specific in terms of how heavy or unusual the floods would be, when it would be, and what should be expected. In a city like Lagos accustomed to perennial floods such generic warnings were probably regarded as just another reminder of the perennial problem. A survey of 1000 residents across the city indicated that only 29% had any knowledge of the possibility of the July 2011 flood occurring. A closer and a more specific prediction would probably have helped both the government and the residents of Lagos to prepare and manage the flooding more effectively to minimize destruction of lives and properties.

Although relevant government agencies advice residents of flood prone communities through the print and electronic media at the beginning of the rainy season to relocate, evacuation or relocation plans that could facilitate such exercise are nevertheless not available to the target population. Residents are therefore left to make decisions on their best considered approaches. For want of alternative accommodation and limited financial resources, majority living in flood plains largely ignore such advice and stay back to defend their homes and property.

Other non-structural measures undertaken towards the effective management of floods by city officials include the following:

- Establishment of an Emergency Command Control Centre
- Strengthening of the staff strength of the drainage department of the Ministry of Environment by increasing the number of engineers and staff from five before 2007 to 75 in the period 2007 to 2011
- Posting of structural engineers to all local governments
- Building Control Agency is divisional and local government based
- Decentralization to enforce and ensure free flow of information
- Division of the state into areas that are flood prone and not flood prone areas
- Building of relief camps, one in each of the three senatorial districts, to shelter displaced persons. Only one is presently completed and in use
- Improving primary health care delivery in communities

4.1.3 Future Directions

In furtherance of efforts to manage flood risks in Lagos by the state government strategies identified to be implemented in future are documented in a draft Climate Change Policy 2012-2014 and the Model City Master Plans produced within the last two years.

The provisions of the climate policy with respect to flood risk management are that the State shall:
 Inform the public of the risk of residing in low-lying areas that are threatened by sea level rise and storm surges and offer incentives for them to relocate to alternative, safer locations;
 Develop a flood and storm warning system including a GIS-based storm and flood simulation system as part of disaster risk management;
 Support research to identify low-cost but effective shoreline protection technologies;
 Support generation of data on coastal geomorphology and topography, land use and ownership, and infrastructural, economic and cultural assets to inform Integrated Coastal Zone Management (ICZM);
 Promote ICZM, bringing together all stakeholders in the coastal area to address coastal zone problems;
 Create buffer zones or setbacks from the shorelines within which no development project should be implemented to accommodate anticipated sea level rise;
 Climate-proof existing and new infrastructure against anticipated climate change impacts such as floods and sea level rise;
 Replant mangroves in degraded zones to protect biodiversity, and reduce erosion and storm surges;
 Mobilise funds to construct sea walls at vulnerable points to minimize the impact of sea level rise and storm surges; and
 Build the capacity of the local communities to protect themselves against storm surges and sea level rise through training in making sand bags and other low-cost sea defense technologies.

Three of the four city Master Plans that have been developed by the Lagos state government to guide the future development of delineated areas of the city have factored strategies for the management of flood risks into the proposed plans. These are those of Lagos Mainland Central, Lekki and Alimosho City. The proposed flood management strategies for the Mainland Central Waterfront comprise the following key methods:

1. Low Intervention: Natural soft measures - a vegetated bank to replace the concrete wall capable of absorbing flood water

2. Medium Intervention: Hard and soft terracing - Combination of soft and hard structural measures, such as flood defence concrete walls and vegetated terraces.

3. Slum Shoreline Flood mitigation in Makoko- This includes a flood defence concrete wall running parallel to the slum's boundary and a drainage channel running parallel to the to the defence wall to provide a long term solution for the collection and dispersal of surface water.

4. In addition a ‘Vision’ for Mainland Central is to use wherever possible, porous material such as self-binding gravel, to pave areas, allowing for rain or potential flood water to drain away directly, and not run into the existing sewer system.

5. The widespread adoption of green roof technology in Mainland Central to reduce the burden on the storm water and sewerage system during rainstorms and assist in facilitating flood prevention.

In the case of Alimosho, a primary objective of the Model City Plan is to prevent encroachment into flood plains and facilitate a mechanism for relocating development off the flood plains. A key objective of the Lekki Comprehensive Master Plan is to manage potential changes to the physical form of the Lekki Peninsula such as coastal flooding and erosion. To this effect the plan proposes that a buffer of between

50m-250m be maintained along the coast with no construction. The Lekki Comprehensive Master Plan also makes provision for storm water management.

4.2 Private Agents

4.2.1 Household Level

The strategies for management of flood risks by households in Lagos are as varied and diverse as the exposures and socio-economic class of affected households. While majority of residents of flood-affected communities have developed strategies for coping with floods, some community members have abandoned their dwellings and relocated to safer areas of the city. However, most residents of slum communities choose to remain in the severely flooded communities rather than relocating. Table 1 shows the suite of strategies employed by residents in managing floods:

Table 1: Flood risk management strategies employed by households

Strategy	Percentage
Construction of wooden walkways	12.1
Prayer	8.5
Replacement of damaged items	1.4
Relocate	27.5
Provision of drainage	11.4
Help ourselves/affected people	6.1
Waste management	37.4
Stay indoors/Do nothing	38.6
Seek government assistance	5.7
Evacuating the flood water out of building	10.2
Raise the wall/foundation of building	17.7
Community effort	7.7
Raise funds	3.6
Protect unaffected property and survivors	47.8
Planting trees	1.1
Insure properties	0.8
Regular sanitation/cleaning	57.3

As shown in Table 1, the primary strategy for managing floods by households is clearing of their immediate environments (57.3%). This is closely associated with solid waste management (37.4%). The impact of this has however not been evident in many parts of the city as the blockage of drainage channels by solid waste is a significant factor contributing to flooding. A large proportion of residents (47.8%) attempt to protect their property from being damaged by floods while 38.6% do nothing and stay indoors during flood episodes. In some locations, residents have employed the use of water pumping machines to remove water from their dwellings. This is usually at considerable costs to the household. Many property owners in flood-affected areas have embarked on flood-proofing their buildings by building walls to keep flood water out.

4.2.2 Community Level

At the community level, the common strategies adopted include organized sand filling of roads, use of sand bags, building wooden bridges as walkways within the community and clearing drainages of solid waste and silt to allow free flow of storm water. Sometimes these measures may necessitate the levying of households within neighborhoods. In selected communities the use of canoes for movement is adopted as a result of the severity of flooding experienced. In communities where the severity of flooding exceeds the capacity of residents to help themselves, Community Development Associations requests the assistance of the local or state government. In a high income residential estate along the coast, residents levied themselves at a high cost to procure boulders to protect their properties from storm surges.

Source of Support

Majority (70%) of surveyed households in flood affected communities noted that they did not benefit from any form of external assistance in managing flood risks. Family and friends (9%) were the main support for those that received support (Table 2). Majority of surveyed residents in flood-affected areas of the city are of the opinion, however, that the State government (73%) and local governments (64%) have the primary responsibility of managing flood risks.

Table 2: Source of support/assistance in times of major flood events

Source	Percentage
Federal Government	1.3
State Government	2.8
Local Government Authority	5.5
Community members	4.6
Family and Friends	9.0
State Emergency Management Agency	0.3
NGOs/CSOs	0.7
Community organizations	3.1
Religious institutions	1.5
None	71.3
Total	100.0

Source: Author's Fieldwork

4.2.3 Real Estate Developers

Property developers who build and maintain real estate property for residents in the high-income group have to a large extent been able to put infrastructures in place to minimize flood risks. Some of the risk reduction measures adopted as identified by Adelekan (2013) include:

- Insurance of properties
- The use of piles in building to reinforce the strength of foundations; where lands are sold to private individuals, buildings are laid on deep raft foundation due to the cost of the former. This however predisposes the deep-raft foundation buildings to flood risks and impacts than the former.

 Enforcement of appropriate setbacks and reservation of flood-prone areas prone as conservation or recreational centres.

 Provision of adequate drainage to convey excess runoff through underground canal to adjoining lagoon.

4.2.4 Insurance Industry

The role of the insurance industry in flood risk management has not been given the deserved recognition in Nigeria. Flood risk is presently covered under fire and special peril and is therefore not well rated. Although Section 64/65 of the Insurance Act 2003 makes it mandatory for all public buildings to be insured majority are not. In 2010, Lagos State enacted a law on the insurance of public buildings against hazards; this has not been enforced. Only multi-national corporations and large manufacturing companies and some real estate property owners have been able to benefit from the provisions of insurance in managing flood risks.

5. DISCUSSION AND CONCLUSION

It is only recently that the Lagos state government begun to develop substantive flood management strategies, collaborate locally and globally, and learn from other global coastal cities on flood management. Although measures have been undertaken by the state government to identify and address risk factors, management strategies adopted are, to a large extent, structural. With respect to flood preparedness, there is need for improved meteorological forecasts at the city level and proper dissemination of flood warnings and awareness of flood risks among the public and how their habits/activities contribute to flooding. Although the Nigerian Meteorological Agency suggests that it is possible to predict three days ahead how heavy an expected rainfall would be, such specific forecast has not been made available to the public. There is therefore need for the improvement of climate and forecasting services.

To a large extent, future flood risks have not been taken into consideration in charting future action plans for flood risk management in the city. The city government therefore needs a clear, robust and forward-looking strategic plan that is informed by rigorous research, administrative data gathering, dialogue with the public, evaluation and learning. There is need to prepare at the local and city-wide levels for larger floods and the disasters that may ensue. Such preparations can include strengthening disaster planning measures, including early warning and evacuation systems, and other forms of post-disaster response to quickly rebuild affected communities (Hallegate et al, 2013). A revision of the risk rating of flood hazard, and enablement of the insurance sector in flood risk management is also needed. Non-structural measures of public education and warning are also highly favoured, in terms of efficiency, in managing flood risks (e.g. Castillo-Rodríguez, 2014).

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