Vulnerability of poor urban coastal communities to flooding in Lagos, Nigeria

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ABSTRACT This paper considers the risks from and vulnerabilities to flooding in four urban poor communities close to the coast in Lagos, Nigeria. Drawing on interviews with inhabitants and key informants and also on group discussions, it documents the scale and frequency of flooding in these settlements and the impacts, as well as the individual, household and community responses. It also considers the factors that have contributed to increasing flood risks in Lagos, including the uncontrolled expansion of the built-up area, the lack of infrastructure and the failure not only to expand stormwater drainage but also to maintain existing drainage systems. The paper also considers changes in the frequency and intensity of rainstorms on Lagos Island between 1971 and 2005, which suggest that on average these have become less frequent but more intense.

KEYWORDS climate change / coastal communities / flooding / Lagos / urban poor / vulnerability

I. INTRODUCTION

Coastal cities are by far the most developed of Africa's urban areas, and by implication have a high concentration of residential, industrial, commercial, educational and military facilities.[1] One such coastal city is Lagos, the foremost manufacturing and port city in West Africa. Lagos is the hub of business and economic development in Nigeria, housing around 65 per cent of the country's industrial establishments, more than 65 per cent of all commercial activities and around 60 per cent of Nigeria's non-oil economy; it is also home to four of the country's eight seaports. However, indications point to urban development as being a large creator of risk for much of the urban population, most especially the urban poor who live in more hazardous physical and human environments along the coast. Rising sea levels consequent to climate change pose real threats to coastal populations along low-lying coastal sites because of the increased likelihood of flood events;[2] furthermore, the frequency of storm surges may also be exacerbated by sea-level rise.

The Nigerian coast is likely to experience severe effects from flooding. The low elevation and topography of the entire Nigerian coastline area make it highly susceptible to flooding, especially at high tides and during the rainy season. Nigeria has been recognized as one of 11 countries with global port cities with high exposure and vulnerability to sea-level rise

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and storm surges.[3] Sea-level rise is indicated to have significant impacts on Africa's many large coastal cities because of the concentration of poor populations in potentially hazardous areas that are more vulnerable to such changes.[4]

Lagos has been categorized as one of 50 cities most exposed to extreme sea levels, and is projected to experience a more than 800 per cent increase in population exposure by the 2070s. In an assessment of 136 port cities, Lagos ranks thirtieth for exposed population to flooding within the current climate scenario (the situation in 2005) and fifteenth in a future climate scenario (scenario for the 2070s).[5]

Flooding has been identified as one of the major factors preventing Africa's growing population of city dwellers from escaping poverty, and it stands in the way of the Millennium Development Goal of achieving significant improvement in the lives of urban slum dwellers.[6] This is because many African cities lack the infrastructure to withstand extreme weather conditions. Poor urban planning, together with other urban governance challenges, contributes towards placing African urban slum dwellers at highest risk. Poor urban planning, or the lack of planning for urban expansion, leads to new development in areas at risk of flooding or in areas that should be left undeveloped (for instance, wetlands) because of their role as buffers against flooding risks. The fact that low-income groups cannot find safer sites contributes to these increased risks. While economic activity and urban development often increase the environmental pressures that lead to flooding, it is the low-income settlements and poor groups within settlements that tend to be most at risk.[7] In Lagos, for example, it is estimated that 70 per cent of the city's population lives in slums characterized by extremely poor environmental conditions, including regular flooding of homes that lasts several hours and that sweeps raw sewage and refuse inside.[8] Urban poor populations face a worsening situation because of the increasing frequency of storm surges, combined with heavy rainfall of long duration or high intensity and the increasing inadequacy of drainage systems.

Although the risks faced by urban populations from climate change impacts, especially in low- and middle-income nations, have been acknowledged in various regional assessments, vulnerability cannot be reliably estimated without detailed knowledge of local contexts, since vulnerabilities are so specific to each location and societal context. Too little attention has been paid to the vulnerability of urban populations to climate change, and especially to the vulnerability of their low-income populations.[9] A participatory vulnerability analysis to ascertain the dimensions of flood problems in poor communities in five African cities, including Accra, Kampala, Lagos, Maputo and Nairobi, sought to address this knowledge gap.[10] The analysis was an assessment of local people's perceptions of why floods occur, how they adjust to them, who is responsible for reducing flood risk and what action the community itself can take. This paper seeks to contribute to a better understanding of the vulnerability of poor urban communities in Lagos by exploring the links between city development (with particular reference to the growth of slums) and flood risks. The impacts on, and vulnerability of, residents of selected poor urban communities along the coast of Lagos as a result of the increasing risks of floods arising from climate variability and climate change are assessed within an integrated assessment framework.

1. UN–Habitat (2008), "Cities at risk from rising sea levels", in UN–Habitat, *State of the World's Cities 2008/2009*, Earthscan, London, 224 pages, pages 140–155.

2. Kabat, P and H van Schaik (2003), "Climate changes the water rules: how water managers can cope with today's climate variability and tomorrow's climate change", available at www.waterandclimate.org.

3. Nicholls, R J, P P Wong, V R Burkett, J O Codignotto, J E Hay, S Ragoonaden and C D Woodroffe (2007), "Coastal systems and low-lying areas", in M L Parry et al. (editors), *Climate Change 2007: Impacts, Adaptation and Vulnerability*, Contribution of Working Group II to the Fourth Assessment Report of the IPCC, Cambridge University Press, Cambridge and New York, 976 pages, pages 315–356.

4. Nicholls, R J (2004), "Coastal flooding and wetland loss in the 21st century: changes under the SRES climate and socioeconomic scenarios", *Global Environmental Change* Vol 14, No 1, pages 69–86.

5. Nicholls, R J, S Hanson, C Herweijer, N Patmore, S Hallegatte, J Corfee-Morlot, J Château and R Muir-Wood (2007), *Ranking Port Cities with High Exposure and Vulnerabilitiy to Climate Extremes: Exposure Estimates*, OECD Environment Working Paper No 1, available at www.oecd.org/env/workingpapers.

6. ActionAid (2006), "Climate change, urban flooding and the rights of the urban poor in Africa: key findings from six African cities", Report by ActionAid International, available at www.actionaid.org, 8 pages.

7. McGranahan, G, D Balk and B Anderson (2007), "The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones", *Environment and Urbanization* Vol 19, No 1, April, pages 17–37.

8. World Bank (2006), *Project Appraisal Document to the*

a. Conceptual framework

The concept of vulnerability is central to the discourse on environmental risks in the context of climate change and offers a valuable framework for this study. The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as the extent to which a natural or social system is susceptible to sustaining damage from climate change. Vulnerability is a function of the sensitivity of a system to changes in climate and the system's ability to adapt to these changes. These factors are considered to be largely determined by the development context, which has a strong influence on households' income, education and access to information, on people's exposure to environmental hazards in their homes and workplaces, and on the quality and extent of provision for infrastructure and services.[11] In urban areas, vulnerability is also greatly influenced by the extent and quality of infrastructure and public services, especially for vulnerable populations.[12] Within climate change and hazards research, three perspectives on vulnerability are identified.[13] The first characterizes vulnerability in terms of exposure to hazardous events and how this affects people and structures; the second views vulnerability in terms of human relationships rather than as physical, i.e. social vulnerability; and the third integrates the physical event and the underlying characteristics of populations that lead to risk exposure and limited capacity of communities to respond. This paper adopts the integrated approach using the integrated vulnerability framework (Figure 1), which is considered suitable in cities where inherent susceptibilities and resiliencies of both biophysical and social environments interact to result in observed vulnerability.

b. Data and method

Four poor urban communities (Makoko, Ilaje-Bariga, Ijora-Oloye and Marine Beach-Apapa) in Lagos were selected specifically for the study based on their proximity to the coastline, their official classification as urban poor communities and their annual experience of floods (Figure 2). These four communities are potentially vulnerable to sea-level rise and climate change given their location in a sensitive landscape. In each community, a random sample of buildings was chosen from several streets/roads to ensure representative coverage of the community. In each building, only one household was interviewed since the majority of buildings in the communities are multiple-occupancy types, sometimes housing as many as 10 households. A total of 486 households representing approximately 14 per cent of the total population of households in the sample communities were surveyed by trained personnel using a semi-structured questionnaire designed for the research (Table 1). In each household, one adult who was considered to have good knowledge of the research topic was interviewed.

The questionnaire was designed to elicit information on some of the variables identified in the integrated vulnerability framework adopted for the study, including the socioeconomic and demographic characteristics of respondents, their flood experiences, flood perception, impacts and coping strategies.

Interviews were held with key informants including leaders of community development associations and senior government officials in

Federal Republic of Nigeria for the Lagos Metropolitan Development and Governance Project, World Bank, Washington DC, available at www.worldbank.org, 127 pages.

9. Satterthwaite, D, S Huq, M Pelling, H Reid and P R Lankao (2007), *Adapting to Climate Change in Urban Areas: the Possibilities and Constraints in Low- and Middle-income Nations*", Discussion Paper Series, Climate Change and Cities 1, IIED, London, accessed 15 September 2008 at www.iied.org, 112 pages.

10. Douglas I, K Alam, M Maghenda, Y McDonnell, L McLean and J Campbell (2008), "Climate change, flooding and the urban poor in Africa", *Environment and Urbanization* Vol 20, No 1, April, pages 187–205.

11. Wilbanks, T, P R Lankao, M Bao, F Berkhout, S Cairncross et al. (2007), "Industry, settlement and society", in Parry et al. (editors), see reference 3, pages 357–390.

12. See reference 9.

13. Dolan, A H and I J Walker (2004), "Understanding vulnerability of coastal communities to climate change-related risks", *Journal of Coastal Research* Vol 39, pages 1317–1324.

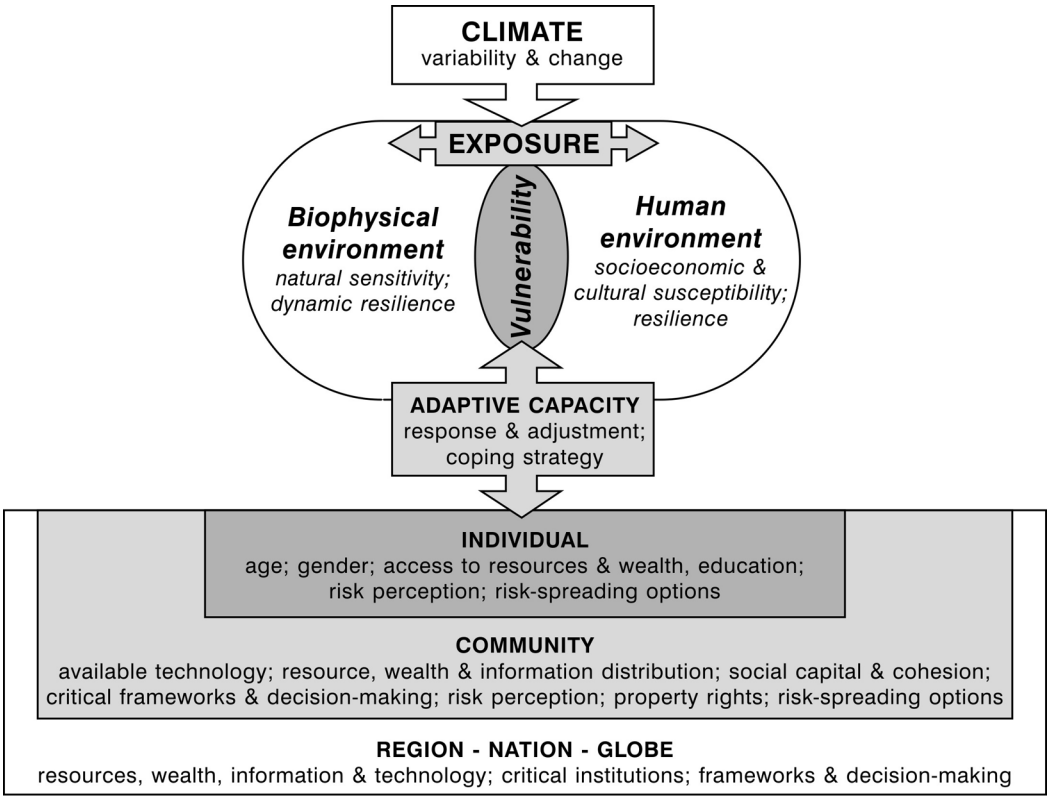

FIGURE 1
Integrated vulnerability framework

SOURCE: Dolan, A H and I J Walker (2004), "Understanding vulnerability of coastal communities to climate change-related risks", *Journal of Coastal Research* Vol 39, pages 1317–1324.

TABLE 1
Distribution of respondents

Community	Number of households in the community*	Households surveyed	Male	Female
Makoko	1,449	101	53	48
Ilaje-Bariga	1,042	160	90	70
Ijora-Oloye	513	139	99	40
Marine Beach-Apapa	524	86	45	41
Total	**3,528**	**486**	**287**	**199**

SOURCE: Author's field survey data; *Central Office of Statistics (2006), *Lagos Household Survey 2006,* Ministry of Economic Planning and Budget, Lagos State.

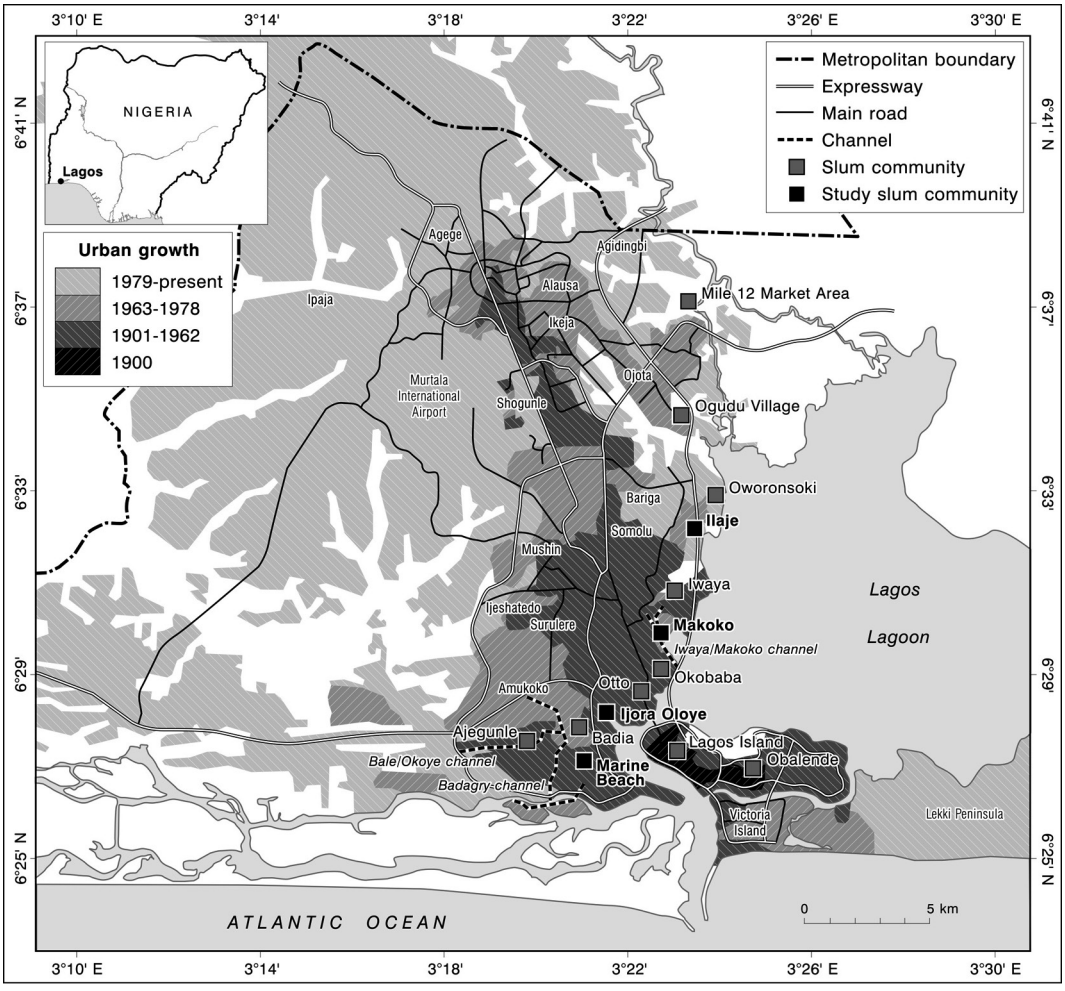

FIGURE 2
Growth of metropolitan Lagos (1900–present) and location of coastal slum communities

SOURCE: Adapted from Gandy, M (2005), "Learning from Lagos", *New Left Review* Vol 33, pages 36–52 and World Bank (2006), Project Appraisal Document to the Federal Republic of Nigeria for the Lagos Metropolitan Development and Governance Project, World Bank, Washington DC, available at www.worldbank.org, 127 pages.

the Lagos State Ministry of Physical Planning. Group discussions with community members were also conducted to obtain further insights into the impacts of, and vulnerability to, floods in the different communities. Impacts were examined at three levels – individual, household and community. Other information that was analyzed related to the physical characteristics of the study areas and included percentage of wetlands and flood-prone areas, sub-standard urban planning and infrastructure. The rainfall characteristics of particularly heavy rainstorms were also examined.

II. THE COASTAL CITY OF LAGOS

Lagos is situated within latitudes 6°23′N and 6°41′N and longitudes 2°42′E and 3°42′E. The city grew from 305,000 inhabitants in 1950 to 5.3 million in 1991 and 9.1 million in 2006.[14] The United Nations *World Urbanization Prospects*[15] projected that total population in 2010 would be 10.5 million. The growth of Lagos is primarily the result of its location on the west coast of Africa, which has promoted the development of trade within its hinterland and with neighbouring and other countries; the role of Lagos as the administrative capital of Nigeria until December 1991 also contributed to its growth. The majority of the population of Lagos lives within the boundaries of the six drainage basins in the eastern sections of the mainland, where the primary areas of flooding affecting the most people are located.

The high population growth rate of Lagos has led to unusual pressure on, and unprecedented demand for, land. The inadequacy of private and public institutions in providing housing or land for housing the increasing population, especially those in the low-income socioeconomic groups, has contributed to the development of slum communities. By 1981, 42 slum communities or "blighted areas" had been identified in Lagos metropolis.[16] At present, the number of slums in the city is estimated at about 100, housing almost 70 per cent of Lagos' population. The majority of slum communities are located in the oldest settled areas of mainland Lagos, especially in marshy areas and near the lagoons.[17] Of the world's largest cities, Lagos has among the highest proportion of population below the poverty line, with 70 per cent of its population living in slums. Population densities in these slum communities range from 790 to 1,240 people per hectare, and more than 75 per cent of urban poor slum dwellers live in one-room households with an average of 4.6 persons per room. It is common for 8–10 households to live in one house structure, sharing common cooking and sanitation facilities.

a. Urban development

Metropolitan Lagos, situated on the narrow lowland coastal stretch bordering the Atlantic Ocean and originally covered with mangrove swamps, has experienced significant land cover changes as a result of past and present reclamation activities to secure land for urban development. Land reclamation is achieved through filling in swamps and floodplains, and the destruction of mangroves and wetlands has reduced the flood storage capacity of this land. In 1960, Lagos covered an area of about 200 square kilometres, but by the beginning of the twenty-first century its contiguously built-up area was estimated at about 1,140 square kilometres, (Figure 2) and sections of the metropolis along the coastline have high population densities (Table 2). With the exception of Eti-Osa local government area (Lagos' newly developing area of expansion that at present has 43.45 per cent of its total area built up), other local government areas (LGA) with coastlines have more than 50 per cent of their total area built up; at 90 per cent, Shomolu LGA has the largest proportion. Much urban development has taken place in Eti-Osa LGA, especially since 1983 when the Lagos state government began to allocate the Lekki Peninsula for urban development.

14. National Population Commission (1998), *1991 Population Census of the Federal Republic of Nigeria*, National Population Commission Vol 6, Abuja, Nigeria; also Federal Republic of Nigeria (2009), *2006 Census Final Results*, Federal Republic of Nigeria Official Gazette Vol 96, No 2, Abuja, Nigeria.

15. United Nations (2008), *World Urbanization Prospects: The 2007 Revision Population Database*, Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, http://esa.un.org/unup.

16. Documentation for this World Bank Urban Renewal Project is not available. A systematic analysis of Lagos slums was undertaken in a 1984 UNDP study, which identified 42 settlements. This analysis of the 42 areas was updated in 1995 in a study for the Lagos State Urban Renewal Board by SNC Lavalin, known as the Lavalin Report, which confirmed the existence of the 42 settlements. See SNC Lavalin International (1995), *Lagos State Urban Renewal Board, Community Infrastructure Upgrading Programme*, study funded under World Bank-assisted Lagos Drainage and Sanitation Project (CR2517), September 1995.

17. Lagos Metropolitan Development and Governance Project (LMDGP) (2006), *Main Report*, *Lagos State Urban Upgrading Project Confirmation Survey*, LMDGP, report written by O Soyombo.

However, alongside the planned development of this peninsula, fast-growing poor urban neighbourhoods have emerged around existing rural settlements. Examples of these are Aoyaya, Agugi, Ajah and Badore.

The present development of the Lekki Peninsula has been undertaken with little or no consideration for sea-level rise and the possible risks of flooding, making this rapidly urbanizing area and its growing population vulnerable to sea-level rise and climate change.

An analysis of the changing land cover in the Lagos coastal area shows that between 1986 and 2002, the amount of developed land comprising residential, industrial, commercial, transportation and other use increased from 85.4 square kilometres (43.36 per cent) to 111.9 square kilometres (56.8 per cent).[18] Similarly, natural vegetation cover, including mangrove and swamp thicket, was reduced from 59.2 square kilometres (30.1 per cent) to 38.3 square kilometres (19.4 per cent), while naturally occurring water bodies, including the ocean, lagoons and streams, was reduced from 52.4 square kilometres (26.6 per cent) to 46.9 square kilometres (23.8 per cent) during the same period. Furthermore, between 1986 and 2006, wetlands cover, which is an important buffer against coastal floods, had significantly reduced in coastal Lagos (Table 3); in four coastal LGAs, there was wetlands loss of 38–100 per cent during that period.[19]

18. Okude, A S and I A Ademiluyi (2006), "Implications of the changing pattern of land cover of the Lagos coastal area of Nigeria", *American-Eurasian Journal of Scientific Research* Vol 1, No 1, pages 31–37.

19. Taiwo, O J (2009), "Socioeconomic correlates of the spatio-temporal variations in wetland loss in Lagos state, Nigeria", PhD thesis, University of Ibadan, Nigeria.

TABLE 2
Urban characteristics of local government areas in coastal Lagos

Local government area (LGA)	Total area (km^2)	Built-up area (km^2)	Built-up area as % of total area	Population (2006)*	Population density of built-up area (per km^2)
Apapa	26.44	13.90	52.57	222,986	15,632
Eti-Osa	193.47	84.07	43.45	283,791	3,423
Lagos Island	8.59	5.28	61.47	212,700	39,661
Lagos mainland	19.81	11.29	56.99	326,700	28,154
Shomolu	11.46	10.31	89.97	403569	39,053

SOURCE: *Federal Republic of Nigeria (2009), *2006 Census Final Results*, Federal Republic of Nigeria Official Gazette Vol 96, No 2, Abuja, Nigeria.

TABLE 3
Wetlands loss in coastal Lagos (1986–2006)

Coastal local government area (LGA)	Wetlands within LGA (%)		Wetlands loss (%) (1986–2006)
	1986	2006	
Apapa	14.0	8.6	38.6
Eti-Osa	41.8	25.2	39.7
Lagos Island	0	0	0
Lagos mainland	17.0	6.7	60.6
Shomolu	4.4	0	100

SOURCE: Adapted from Taiwo, O J (2009), "Socioeconomic correlates of the spatio-temporal variations in wetland loss in Lagos state, Nigeria", PhD thesis, University of Ibadan, Nigeria.

b. Environmental change and flooding

The humid tropical climate of Lagos is influenced by its coastal location and proximity to the equator and is characterized by two distinct seasons. The wet season occurs mainly between April and October and the dry season during the remaining months of the year. During the rainy season, many parts of Lagos are susceptible to flooding. The major causes of floods in built-up areas include:

- uncontrolled expansion of impermeable surfaces resulting in increased run-off;
- run-off responses[20] under high intensity rainfall;
- building on floodplains;
- lack of stormwater drainage;
- failure to maintain existing drainage systems; and
- weak institutional capacity of the urban administration.

20. Excess waterflow over the land surface to lower levels as a result of high intensity rainfall and impervious surfaces.

Changes in the intensity and pattern of storms have also been listed as factors that may influence the risks of flooding. A study of rainstorms in Lagos for 1960–1980 showed that most were relatively light during this period, yielding less than 12.7 millimetres of rainfall.[21] Analyses of rainstorms on Lagos Island for the period 1971–2005 show that in more recent years (1996–2005), rainstorms have been heavier, even though the number of rain days per annum has decreased. A comparison of rainfall characteristics for the two periods 1971–1995 and 1996–2005 show marked differences (Table 4). While the mean annual rainfall is similar (1,697.8 millimetres for 1971–1995 and 1,647.3 millimetres for 1996–2005), fewer rain days were recorded during the more recent 10-year period, indicating that rainstorms in the latter period were much heavier than those of the earlier period and resulted in more flooding.

21. Ayoade, J O and F O Akintola (1980), "Public perception of flood hazard in two Nigerian cities", *Environment International* Vol 4, pages 277–280.

Land use changes and subsequent changes in the hydrological fluxes of the urban watershed have caused increasing flood hazards and risks in many parts of the metropolis, most especially in slum communities. A study of nine poor urban communities in different parts of metropolitan Lagos showed that flooding is a major problem in most of them and appears to have worsened between 2002 and 2006, with 71 per cent of respondents reporting flooding of their streets in 2006 compared with 54 per cent in 2002.[22] Flooding in most of Lagos is compounded by the inadequacy of the drainage network within the city, which is neither functional nor complete. Lately, the problem has reached such alarming proportions that it has prompted the state government to put structures in place aimed at reducing the incidence of flooding. The newly introduced programme,

22. Ministry of Economic Planning and Budget (2004), "State of Lagos megacity and other Nigerian cities", Lagos State Government, 134 pages.

TABLE 4
Rainfall characteristics for Lagos Island

Rainfall characteristics	1971–1995	1996–2005
Mean number of rain days	112	82
Maximum number of rain days	163	105
Minimum number of rain days	76	69
Mean rainfall (mm)	1,697.8	1,647.3

SOURCE: Author's analysis of daily rainfall data obtained from Nigerian Meteorological Agency.

Operation De-flood Lagos, involves the massive de-silting and clearing of major drainage channels through two government bodies, namely Drain Ducks and the Emergency Flood Abatement Gang, which operate citywide.

III. VULNERABILITY IN LOW-INCOME SETTLEMENTS

Provision of good quality urban infrastructure is requisite for limiting the risk of flooding for the whole city area, and most especially for coastal slum settlements. Provision of basic infrastructure facilities in metropolitan Lagos has not kept up with urban growth, including unplanned expansion. Many residents, especially in high-density, low-income areas, live in environmentally degraded conditions and lack basic infrastructure and services including water supply, electricity, roads, stormwater drainage, solid waste disposal, sanitation and quality housing. Road systems within the slum communities are poorly maintained; apart from the major roads that lead into the communities, most roads are in a state of disrepair and lack all-weather surfaces. There is also the constant challenge of stormwater management, a problem that results from inadequate drainage channels, siltation of the existing channels and indiscriminate dumping of solid waste within communities and drainage channels/canals as a result of inadequate provision for solid waste collection. Although a number of streets in the communities have gutters, these are uncovered and constantly full of solid waste (Table 5). The flow capacities of most drains are also inadequate for the amount of stormwater generated during heavy rainfall. An assessment of conditions and facilities in communities conducted by the Lagos Metropolitan Development and Governance Project in 2006[23] showed that the majority of slum communities, including Makoko and Ilaje-Bariga, ranked the provision of drainage/dredging of canals foremost in their prioritization of needed facilities, followed by roads.

23. See reference 17.

In the four communities surveyed, more than 50 per cent of respondents live less than 500 metres from the coastline. In two of the communities, Ijora-Oloye and Marine Beach-Apapa, an even larger proportion lives less than this distance from the ocean/lagoon coastline – 79 per cent and 71 per cent, respectively. Large sections of the surveyed communities have been built on land reclaimed by sand infill, which therefore cannot support solid structures. In Makoko, the dominant housing type is wooden houses/shacks (35 per cent) followed by one-storey concrete bungalows

TABLE 5
Prevalence of street drainage

Local government area (LGA)	Uncovered concrete drains as % of available drains
Apapa	96
Eti-Osa	65
Lagos Island	74
Lagos mainland	88
Shomolu	98

SOURCE: Lagos State Government Household Survey (2008).

TABLE 6
Types of buildings in the community

Building type	Makoko (%)	Ilaje-Bariga (%)	Ijora-Oloye (%)	Marine Beach-Apapa (%)
Wooden house/shack	34.7	25.6	11.7	6.2
Wooden house on stilts	9.9	5.6	4.4	3.7
One storey (concrete)	21.8	39.4	19.7	16.0
Two or more storeys (concrete)	10.9	8.8	1.5	8.6
Zinc	12.9	8.8	62.0	65.4
Mud	9.9	11.9	0.7	0

SOURCE: Author's field survey data.

TABLE 7
Respondents' reasons for living in the slum communities

Reason	Makoko (%)	Ilaje-Bariga (%)	Ijora-Oloye (%)	Marine Beach-Apapa (%)
Born in the community	9.9	8.1	30.9	32.6
Family ties	16.8	31.3	18.7	22.1
Business/livelihood	14.9	18.8	35.3	20.9
Low cost of housing	34.7	19.4	2.9	16.3
Economic situation	5.9	15.6	6.5	0
No response	2.0	1.9	2.2	8.1

SOURCE: Author's field survey data.

(22 per cent); Ilaje-Bariga is characterized by one-storey concrete bungalows (39 per cent) and wooden shacks (26 per cent). In Ijora-Oloye and Marine Beach-Apapa, 62 per cent and 65 per cent of houses, respectively, are built with zinc sheeting (Table 6).

a. Socioeconomic characteristics of respondents

Respondents gave various reasons for living in the surveyed slum communities. About 42 per cent cited existing family ties, including by reason of birth. The low cost of housing was also a factor and in Makoko was listed by 35.3 per cent of respondents. Economic activities were an important factor influencing place of residence for 23 per cent of all respondents, and in Ijora-Oloye this was important to 35.3 per cent of respondents (Table 7).

The majority of respondents in the sampled slum communities are tenants – 68 per cent in Ijora-Oloye and more than 80 per cent in the other communities. The remainder are owners or squatters (Figure 3). While 60 per cent or more of respondents in Makoko and Ilaje-Bariga have lived in these communities for 2–10 years, more than 65 per cent of respondents in Ijora-Oloye and Marine Beach-Apapa have lived in the communities for upward of 11 years.

Fifty per cent of households in all four communities comprise between four and six persons. In Ijora Oloye and Marine Beach-Apapa

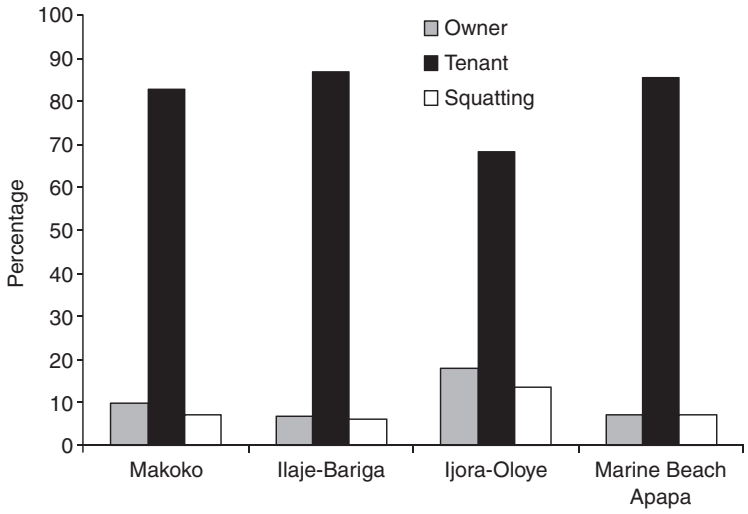

FIGURE 3
Status of respondents

SOURCE: Author's field survey data.

communities, however, up to 24 per cent of households comprise six to nine persons. In all communities, an average of six per cent of households include 10 persons or more.

A large proportion of respondents in all four slum communities are engaged in the informal sector, with one-third being traders. In Ijora-Oloye and Marine Beach-Apapa in particular, significant numbers of respondents are employed as daily-paid wharf workers servicing the ports industry, while only very few are engaged in fishing. However, in Makoko and Ilaje-Bariga, more respondents fish the waters of the lagoon. Other respondents are engaged in government employment (15 per cent) and as artisans (13.6 per cent). The proportion of unemployed is relatively high in all four communities, especially in Makoko and Marine Beach-Apapa, where about 26 per cent of respondents are unemployed. The majority of respondents (73 per cent) in the four slum communities have no more than a secondary school education and eight per cent have no formal education. Only 19 per cent have some form of tertiary education. The low educational level of respondents is closely linked to their occupations and consequent poor financial status.

Monthly incomes are low. In Ilaje-Bariga and Makoko, about one-quarter of respondents earned less than N5,000 a month and fewer than 10 per cent earned more than N20,000. Income levels are relatively higher in Ijora-Oloye and Marine Beach-Apapa, with no respondent earning less than N5,000. About half the respondents in Ijora-Oloye earned between N20,000 and N50,000 a month, while in Marine Beach-Apapa, 40 per cent of respondents earned between N10,000 and N20,000. High unemployment rates and low income levels in these communities increase their vulnerability to environmental hazards, including floods.

b. Perception of floods

Of the problems listed by respondents in the surveyed communities, flooding was ranked foremost. Other problems included bad roads, environmental pollution/dirty environment, infestation by mosquitoes, neighbourhood insecurity, poor electricity supplies, unemployment and prevalence of disease. Many of these problems, for example bad roads, water pollution, mosquito infestations and disease, are largely the result of flooding in the communities. During floods, refuse and raw sewage from dumpsites and drainage channels is swept into homes, which results in all kinds of diseases. Floodwater also pollutes wells and contaminates the water that flows through municipal pipes, which are usually damaged, causing typhoid, cholera and hepatitis.

Flooding is more of a problem in the two communities that straddle the ocean than in the two by the lagoon. This is because the houses in Ilaje-Bariga and Makoko that are occupied by fisherfolk are built on stilts in the water. For this category of urban poor, the problem of flooding does not exist. Respondents noted that floods affected some parts of their communities more than others. Areas close to canals/drainage channels are especially susceptible to flooding, partly because solid wastes block the drainage channels. In these areas, flood levels outside houses and in the streets can be knee high or sometimes waist high depending on the intensity of the rains and the location. Where the drainage system is poor, flooding was noted to be more of a problem.

The year 2008 has been assessed as being the worst in Lagos since 2004 with respect to flooding.[24] In all four coastal communities, more than 80 per cent of respondents indicated that their communities and houses were flooded three or four times in 2008. Each flood event usually leaves communities flooded for up to four days. Almost all respondents noted that during each flood event, the level of water in their community was at least knee high (Makoko 100 per cent of respondents, Ijora-Oloye 91 per cent, Ilaje-Bariga 100 per cent and Marine Beach-Apapa 98 per cent).

24. *Daily Sun* (2008), "Taming the raging floods", 23 July, page 8.

Respondents attributed flooding to a range of causes (Table 8). More than 60 per cent mentioned the poor drainage system. "Overpopulation" of communities was the second most cited reason for the occurrence of floods – with its effects being observed in the increased generation of solid wastes, which are disposed of on the streets and in drains, and the encroachment of buildings and structures onto otherwise illegal or prohibited land, such as alongside drainage channels. Although Makoko residents noted that heavy rainfall and surges from the lagoon contributed to the occurrence of floods, fewer than one per cent of respondents saw changing climatic conditions as a contributing factor. Makoko residents explained that changes in the lagoon's on-shore movement[25] were caused by the sand infill activities seen in recent times. Other factors contributing to flooding listed by respondents included:

25. This is the wave overwash that occurs during on-shore storms.

- the presence of the lagoon and increases in its water level;
- overflowing of rivers;
- sand infill and land reclamation activities;
- government neglect; and
- supernatural factors.

When asked whether the frequency of flood events had increased or decreased in the last five years, more than 75 per cent of respondents in

TABLE 8
Respondents' perceptions of the causes of floods

Perception	Makoko (%)	Ilaje-Bariga (%)	Ijora-Oloye (%)	Marine Beach-Apapa (%)
"Overpopulation" and indiscriminate dumping of solid waste	14.9	8.1	9.4	9.3
Poor drainage system	69.3	74.4	66.9	64.0
Negligence by government	0	0	2.9	2.3
No response/other	15.8	17.5	20.9	24.4

SOURCE: Author's field survey data.

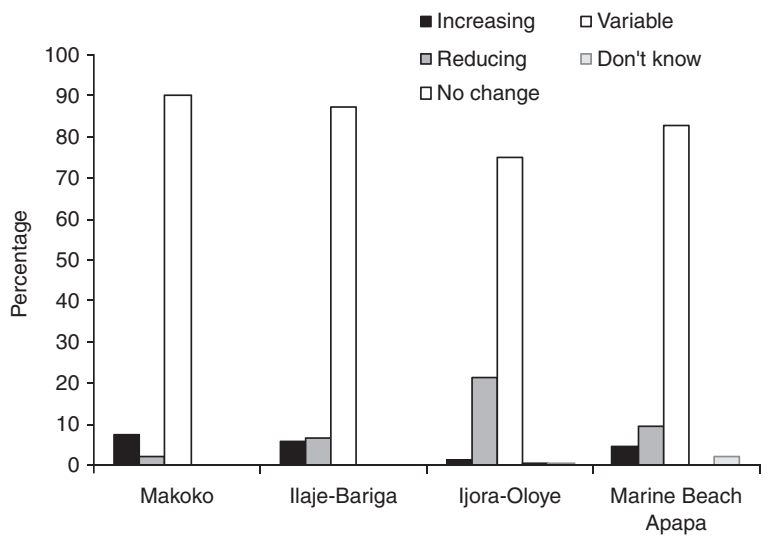

FIGURE 4
Perception of flood frequency

SOURCE: Author's field survey data.

all four communities were of the opinion that there had been no change (Figure 4). This response could be interpreted as either state government efforts to address the issue of flooding through various structural measures not having yielded noticeable reductions in flooding within the metropolis; or that people may be adapting to the changes in flood occurrence despite the increase in frequency of heavy rainstorms and more floods.

c. Impacts, preventative measures and coping strategies

The impacts of floods appear to be similar at the individual, household and community levels (Tables 9, 10 and 11). At the community level, the

impacts are grave and affect the functioning of the community and its members. Because of the worsened environmental conditions that result from flood events, waterborne diseases, hepatitis, intestinal diseases and malaria are endemic, and all forms of productive activities are also affected by floods. Nevertheless, respondents noted that within communities, the impacts varied. In Makoko, for example, residents said that sections of the community that have benefited from an improved drainage system experienced less flooding than areas where the drainage system was poor.

At the household level, the impacts of floods on the social and economic well-being of household members are evident. Floodwater, a mix of drainage, surface run-off and sewage, flows into many houses, sometimes reaching waist height. Most respondents (91 per cent) in all four communities noted recurrent visits to health centres because of ill-health and an increase in medical expenses as a major outcome of floods. In addition, potable water shortages, which may be due to water pollution and damage to water pipes following flood events, were noted by 94.5 per cent of respondents. In terms of economic/livelihood activities, 85.6 per cent of respondents in the four communities indicated that flood events denied them job opportunities, while 8.8 per cent noted that floods disturbed their economic activities. Because the majority of the population in these communities depends on wages from daily work, any restrictions on economic activities as a result of floods makes them highly vulnerable.

An impact of flooding in these poor urban communities that is worth noting relates to the mental health of residents. Respondents in the different communities noted that as a result of the annual flooding of their communities, they lived in perpetual fear of future flood events and the possible outbreak of an epidemic. The consequences of this included loss of peace of mind, the inability to sleep well, loss of appetite, discouragement and a feeling of being neglected. This can lead to depression as the flood-affected population feels helpless due to the overwhelming impacts. The mental health aspects and consequences of repeated flooding can therefore be far-reaching, difficult to cope with, and call for some consideration in the planning of formal responses.

TABLE 9
Community level impacts, measures and strategies

Impact	Preventative/limitation measures	Coping strategies
Damage to roads	Filling roads with sand using sandbags; putting wood shavings on roads	Filling roads with sand using sandbags; putting wood shavings on roads
Disruption of movement	Construction of wooden bridges	Use of canoes for transportation; use of rain boots; taking unaffected routes if available
Dirty environment	Periodic environmental sanitation measures by community	Communal cleaning of surroundings after flood events
Flooding of community	Community members clear blocked drainage channels	Staying indoors; use of wooden bridges to aid movement; opening up blocked drainage channels
School children prevented from going to school		Children remain at home until floodwaters subside

SOURCE: Author's field survey data.

TABLE 10
Household level impacts, measures and strategies

Impact	Preventative/limitation measures	Coping strategies
Damage to, and deterioration of, buildings	Construct drains in front of houses; renovate buildings; build high walls to prevent floodwater from entering houses	
Flooded houses and rooms	Fill rooms with sand/sawdust; construct trenches around houses; build high walls to prevent floodwater from entering houses	Relocate to neighbour's or relative's house; raise household property to higher levels; get rid of water using buckets
Water springing from the ground into rooms	Use "sandcrete" blocks to cover water outlets in the ground; raise floor levels with sand/sawdust	Get rid of water using containers; raise floor levels with sand/sawdust
Lack of potable water	Rely on borehole water provided by LMDGP where available	Purchase packaged water
Displacement from homes		Temporarily relocate to stay with family/ friends; makeshift shelters in locations not affected by flood
Loss or damage to household property	Relocate moveable property outside the community; keep property above flood level	Repair or replace damaged property
Prevalence of malaria and other diseases	Self-medication; use of mosquito nets and insecticide sprays	Use of local herbs and drugs; use of anti-malaria drugs; visit health centres
Income loss due to sickness and medical expenses	Use of structural measures to limit floodwater entering houses	

SOURCE: Author's field survey data.

TABLE 11
Individual level impacts, measures and strategies

Impact	Preventative/limitation measures	Coping strategies
Poor health status resulting from preventable sickness, including different skin diseases	Self-medication for preventative purposes, e.g. use of antibiotics; ensure personal hygiene	Relocate to unaffected community; use of medicines
Social relationships affected as friends and family cannot visit or be invited to the house		Flood-affected persons go out to meet contacts
Depression arising from economic and social costs		
Disruption of economic and livelihood activities		Depend on sale of goods to buyers within dwelling place
Scarcity of food/loss of food items	Food items stored above anticipated flood level	Do without cooked food until situation improves; make do with available resources
More money is spent on treatment of diseases		

SOURCE: Author's field survey data.

An important preventative measure/coping strategy for households is the purchase of substantial quantities of sand and broken sandcrete blocks, in order to raise the floor levels within dwelling units. This costs between N6,000 and N15,000 per wet season, depending on the level of flooding experienced within the houses. Many lower-income level and unemployed households cannot avail themselves of this coping measure and are therefore very vulnerable to flood impacts. Another measure used by households (82.2 per cent) is to deposit sand around buildings in order to reduce the depth of the flood. It is estimated that households in flooded areas incur cleaning and repair costs averaging N8,500 per household per year.[26]

26. See reference 8, page 90. At the time of the survey, the exchange rate was US$ 1:145 Naira.

d. Sources of assistance

An important source of support during flood events for poor urban households in the communities surveyed comes from family and social networks, including community members. In the four communities, a total of 75.3 per cent of respondents received assistance from family and friends. Only in Ijora-Oloye and Ilaje-Bariga did respondents indicate that they received additional help from government (10.8 per cent) and religious organizations (6.5 per cent). The main form of assistance is the joint clearing of waterways and drainage channels in Makoko and Ilaje-Bariga (98 per cent) and in Marine Beach-Apapa (58.3 per cent). Five per cent of respondents in Marine Beach-Apapa benefited from additional aid in the form of material donations.

IV. CONCLUSIONS

Metropolitan Lagos is expanding rapidly both in area and population, with a concomitant increase in the urban poor population in coastal areas being at risk of flooding. Despite the challenges posed by flooding, which are exacerbated by urban development, the vulnerability of the urban poor to floods has not been taken into consideration in urban planning and development. Since flooding in communities is very much linked to the provision of adequate infrastructure and management of the environment (including land use management), the vulnerability of the poor urban population is highly linked to poor urban management and government's inability to deal adequately with the issues. An added vulnerability faced by large sections of the urban poor in metropolitan Lagos is the fear that the state government may evict them from land sites deemed to be vulnerable to floods, with very inadequate or no provision for finding alternative accommodation that meets their needs. This was aptly exemplified by the demolition in 1991 of Maroko, a major slum located on Victoria Island, after the forceful eviction by the Lagos state government of the more than 300,000 residents. Among a list of reasons given for the demolition of Maroko was the low-lying nature of the land, which is 1.5 metres above sea level and therefore liable to flooding, and which in the longer term, with sea-level rise, would be at risk of complete submergence. However, this same land area was subsequently developed into a high-income residential district of Lagos.

The concentration of current and likely future population on land sites at risk from sea-level rise and storm surges and more intense rainstorms (consequences of climate change) underscores the need to integrate a consideration of climate into coastal flood risk management and urban development strategies. The findings of this study can help inform urban planners and government structures in supporting informed adaptation to flood risks in this highly populated and expanding coastal city. There is an opportunity to integrate climate change risk reduction into the urban development of Lagos as more coastal settlements emerge, learning from the current vulnerability of the urban poor population. A range of measures to increase the adaptive capacity of the urban poor that governments at different levels should pursue include:

- enforcement of urban planning laws;
- restrictions on land reclamation activities in newly developing areas;
- construction of more primary, secondary and tertiary drainage systems, taking into account storm run-off responses under high intensity rainfall;
- proper solid waste collection; and
- management and environmental education for citizens.

The enforcement of building guidelines in coastal locations is also particularly important; but most importantly, it is imperative that a land policy is developed that encourages the development of housing schemes on safe sites that are affordable by low-income groups. Good urban governance that responds to local context and characteristics is therefore the solution to meeting the challenges experienced by poor urban communities in the face of changing climate in a megacity such as Lagos.

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