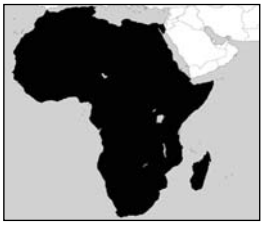

Unjust waters: climate change, flooding and the urban poor in Africa

IAN DOUGLAS, KURSHID ALAM, MARYANNE MAGHENDA, YASMIN MCDONNELL, LOUISE MCLEAN AND JACK CAMPBELL

Ian Douglas is Emeritus Professor of Physical Geography at the School of Environment and Development, University of Manchester, UK.

Address: School of Environment and Development, University of Manchester, M13 9PL, UK; e-mail: ian.douglas@manchester.ac.uk

Kurshid Alam is a consultant in disaster reduction, livelihoods and governance, based in Bangladesh.

Address: alam@khurshidalam.org

MaryAnne Maghenda is a Professor of Geography in Kenya.

Address: wughangamwalu@yahoo.com

Yasmin McDonnell is ActionAid's emergency policy analyst.

Address: ActionAid International, Hamlyn House, MacDonald Road, Archway, London N19 5PG, UK; e-mail: Yasmin.Mcdonnell@actionaid.org

Louise McLean is ActionAid's emergencies, communications and initiatives manager.

Address: ActionAid International, Hamlyn

ABSTRACT Many of the urban poor in Africa face growing problems of severe flooding. Increased storm frequency and intensity related to climate change are exacerbated by such local factors as the growing occupation of floodplains, increased runoff from hard surfaces, inadequate waste management and silted-up drainage. One can distinguish four types of flooding in urban areas: localized flooding due to inadequate drainage; flooding from small streams within the built-up area; flooding from major rivers; and coastal flooding. ActionAid undertook participatory vulnerability analysis in five African cities, to explore local people's perceptions of why floods occur, how they adjust to them, who is responsible for reducing the flood risk and what action the community itself can take. While local people adapt to floods, recognition of local, national and international governments' and organizations' responsibility to act to alleviate flooding and its causes, especially the consequences of climate change, is urgently needed.

KEYWORDS adaptation / Africa / climate change / communities / drainage / flooding / government / urban poor

I. INTRODUCTION

Poor communities often live in the most hazardous and unhealthy environments in urban areas.(1) Many build their homes and grow their food on river floodplains in towns and cities. Others construct their shelters on steep, unstable hillsides, or along the foreshore on former mangrove swamps or tidal flats. People suffering these poor conditions may find their difficulties compounded by the consequences of climate change. This paper considers the implications for the vulnerability of the urban poor in Africa.

In the large cities of low latitude countries, it is common for much of the low-income population to live in areas at risk from flooding,(2) and this population is most likely to be affected by factors related to climate change.(3) Floods are natural phenomena, but damage and losses from floods are the consequences of human action. Although climate change is driven largely by modernization and development, all human activities, including land degradation by poor farmers and grazing flocks, contribute to environmental change. However, on a per capita basis, the poor in Africa are far more the victims of change than contributors to global warming and land degradation.

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Flooding in urban areas is not just related to heavy rainfall and extreme climatic events; it is also related to changes in the built-up areas themselves. Urbanization restricts where floodwaters can go by covering large parts of the ground with roofs, roads and pavements, thus obstructing natural channels, and by building drains that ensure that water moves to rivers more rapidly than it did under natural conditions. Large-scale urbanization and population increases have led to large numbers of people, especially the poor, settling and living in floodplains in and around urban areas. In South Africa, for instance, Soweto-on-Sea near Port Elizabeth and Alexandra in Johannesburg illustrate this point.[4]

As people crowd into African cities, human impacts on urban land surfaces and drainage intensify. Even moderate storms now produce quite high flows in rivers because of surface runoff from hard surfaces and drains. Water flowing through a series of culverts and concrete channels cannot adjust to changes in the frequency of heavy rain, as natural streams do. They are often obstructed by silt and urban debris, particularly when houses are built close to the channels. Such situations frequently arise when poor people build on low-lying floodplains, over swamps or above the tidewater level on the coast.[5] The effects of climate change are superimposed on these people-driven local land surface modifications.

Separating local changes from global climate changes is not always easy. The populations of towns and cities may be swollen by in-migration from rural areas in times of drought. That drought might be caused by climate change, but the local changes in the city stem from the activities of the migrants as they build homes, compacting the ground and altering the ways in which rainfall collects and flows towards streams and rivers. As floods begin to occur with greater frequency, local authorities and other agencies may take protective measures to avoid the movement of floodwaters into certain areas of towns and cities, often giving priority to the main business and administrative centres. In many cases, the floodwaters spread into other areas, often those occupied by the poorest communities for want of safer land. To establish how climate change will intensify the impacts of urban growth on flooding, especially flooding affecting the urban poor, it is necessary to look at how climate change is likely to influence rainfall that is intense and long enough to produce floods; also to examine how urbanization itself alters flood regimes; and to consider how sea-level rise affects settlements built on the shoreline and in former mangrove areas.

In much of the tropics, most rainstorms are highly localized, often covering less than 10 square kilometres; they are intense and of short duration, usually lasting an hour or less. The most intense thunderstorm, occurring on average once every two years, can deposit as much as 90 millimetres of rain in just 30 minutes.[6] The volumes of water running off roofs and paved surfaces in urban areas from such storms are enormous. All too often, drains and culverts cannot cope and localized flash flooding occurs. These flash floods happen suddenly, with little lead time for warning; they are fast-moving and generally violent, resulting in a high threat to life and severe damage to property and infrastructure; and they are generally small in scale with regard to area of impact.[7] While European authors present flash floods as rare events in areas like the Alps, often in association with landslides and mudflows,[8] tropical authors think in terms of the rapid flooding produced by major thunderstorms,

House, MacDonald Road, Archway, London N19 5PG, UK; e-mail: Louise.McLean@actionaid.org

Jack Campbell is ActionAid's emergencies officer.

Address: ActionAid International, Hamlyn House, MacDonald Road, Archway, London N19 5PG, UK; e-mail: Jack.Campbell@actionaid.org

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which can occur several times a year. The latter are a major nuisance for urban residents in many African cities.

II. THE CHANGING CLIMATE IN AFRICA

"Africa is not a driver of climate change, but a victim."[9]

"The weather is becoming increasingly volatile in Africa."[10]

Any analysis of long-term rainfall records in Africa reveals great variability from year to year.[11] There is also great spatial variability in rainfall on any one day or over any one month or year. Thunderstorms producing heavy downpours that cause localized flooding may extend over as little as 2.5 square kilometres.[12]. In East Africa, rain can occur in isolated patches of less than 30 kilometres in diameter but, sometimes, broad bands of varying rain up to 500 kilometres across can develop. This spatial variability makes precise forecasting difficult and poses problems for delivering good flood warnings. In a way, it is fortunate that the most widespread, serious floods in major river basins such as the Zambezi are produced by widespread rain bands whose development and movement are readily detected by weather satellites. However, the more frequent flash floods in urban areas stem from the localized storms whose tracks and occurrence are difficult to predict. Urban areas can enhance the build up of thunderstorms through the urban heat island effect: as cities grow, the urban heat island becomes more marked, with possible increases in thunderstorm activity. Thus, even without the climatic changes due to global warming, urban extreme rainfall intensities may be increasing, along with their severe impacts on society.

Examining the history of these long-term changes in Africa is complicated because of gaps and irregularities in some climate data that are the result of relocations of stations and changes in instruments. But when errors and inconsistencies can be reduced or eliminated through instrumentation changes, tests for changes in the intensity of extreme events can be made, and tend to show significant increases in the intensity of extreme rainfall events.[13]

In the future, rising temperatures are projected to cause more frequent and more intense extreme weather events, such as heavy rainstorms, flooding, fires, hurricanes, tropical storms and El Niño events. It is **likely** that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and heavier precipitation. Over most sub-tropical regions, rainfall is likely to decrease by as much as 20 per cent. There is likely to be quite marked winter drying in southern and northern Africa, but an increase in December, January and February rainfall in equatorial East Africa.[14] At the major river basin level, forecasting is more difficult.[15]

III. TRENDS IN URBAN FLOODING IN AFRICA

"All countries are vulnerable to climate change and instability in weather patterns, but the poorest countries and the poorest people within them are most vulnerable, being the most exposed and having the least means to adapt."[16]

1. See, for example, Stephens, C, I Timaeus, M Akerman, S Avle, P B Maia, P Campanerio, B Doe, L Lush, D Tetteh and T Harpham (1994), *Environment and Health in Developing Countries: An Analysis of Intra-urban Differentials*, London School of Hygiene and Tropical Medicine, 141 pages; also Stephens, C (1996), "Healthy cities or unhealthy islands: the health and social implications of urban inequality", *Environment & Urbanization* Vol 8, No 2, October, pages 9–30.

2. Hardoy, J E, D Mitlin and D Satterthwaite (2001), *Environmental Problems in an Urbanizing World: Finding Solutions for Cities in Africa, Asia and Latin America*, Earthscan, London.

3. Adger, N and 63 others (2007), *Climate Change 2007: Impacts, Adaptation and Vulnerability, Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report, Summary for Policymakers*, Intergovernmental Panel on Climate Change, Geneva.

4. Viljoen, M and H Booysen (2006), "Planning and management of flood damage control: the South African experience", *Irrigation and Drainage* No 55, S83–S91.

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

6. Gupta, A and R Ahmad (1999), "Geomorphology and the urban tropics: building an interface between research and usage", *Geomorphology* Vol 31, pages 133–149.

Climate change appears to be altering the pattern of flooding in Africa. Modelling shows that the pattern of rare large floods is going to change much more than long-term average river flows. Prolonged heavy rains may increase in volume and occurrence.[17] Many African cities have experienced extreme flooding since 1995.

a. Examples of flooding in urban areas

Heavy rains and cyclones in February and March 2000 in Mozambique led to the worst flooding in 50 years and brought widespread devastation to the capital city, Maputo, as well as to the city of Matola. Upwards of one million people were directly affected. Water and sanitation services were disrupted, causing outbreaks of dysentery and cholera. Newspaper reports described the disaster as destroying the rehabilitation efforts of what had been, until only a few years before, the world's poorest country.

In 2002, heavy rains caused by unusually high temperatures over the Indian Ocean killed more than 112 people in East Africa. Floods and mudslides forced tens of thousands of people to leave their homes in Rwanda, Kenya, Burundi, Tanzania and Uganda. Rwanda suffered the heaviest toll, with more than 50 dead in 10 days, many of the deaths caused by landslides. At least 1,557 homes were destroyed and many cattle were killed. In Kenya, floods and mudslides killed 46 people in two weeks. In Tanzanian urban communities, hundreds of families were left homeless, and damage to crops threatened food security. In August 2006, in Addis Ababa, floods killed more than 100 people and destroyed homes in eastern Ethiopia after heavy rains caused a river to overflow.

There has also been damage in West Africa. Since 1995, floods have tended to cause increasing damage in Ghana, particularly in coastal areas. The cities of Accra and Kumasi have been particularly severely affected, with many forced to leave their homes. The perception of, impacts of, and adjustments to urban flooding in Nigeria have been extensively studied.[18] Several studies of the hydrological changes associated with urbanization[19] have described the contribution of topographic conditions, rainfall characteristics, land use changes (especially the expansion of paved impermeable areas), uncontrolled waste dumping and construction on the floodplain to local flooding.[20] The roles of rainfall amount and intensity have also been discussed.[21]

The two drivers, **climate change**, affecting storm occurrence and intensity, and **local urban change**, due to alterations to the urban land surface and water pathways as a result of such activities as construction, paving, soil compaction and the removal of vegetation, but also to blockage of drains and the diversion of natural flows, all combine to produce increased local runoff and higher flood frequency, magnitude and duration. The urban poor are suffering more from these changes than other urban residents.

The clear messages emerging are that:

- urban flooding is becoming an increasingly severe and more frequent problem for the urban poor;
- climate change is altering rainfall patterns, tending to increase storm frequency and intensity, thus increasing the potential for floods; and
- local human factors, especially urban growth, the occupation of floodplains and the lack of attention to waste management and to

7. Gruntfest, E and J Handmer (editors) (2001), *Coping with Flash Floods: Proceedings of the NATO Advanced Study Institute*, Ravello, Italy, 8–17 November 1999, NATO Science Partnership Sub-Series, 77, Springer, Berlin.

8. See reference 4.

9. Commission for Africa (2005), *Action for a Strong and Prosperous Africa*, London, page 249.

10. See reference 9, page 51.

11. See, for instance, Conway, D (2005), "From headwater tributaries to international river: observing and adapting to climate variability and change in the Nile basin", *Global Environmental Change* Vol 15, pages 99–114.

12. Jackson, I J (1989), *Climate, Water and Agriculture in the Tropics*, Longman, London (second edition).

13. For instance, between 1931 and 1990 there were significant increases in the intensity of extreme rainfall events in about 70 per cent of South Africa. Increases in the intensity of high rainfall events have been greatest for the most extreme events. See Mason, S J, P R Waylen, G M Mimmack, B Rajaratnam and M Harrison (1999), "Changes in extreme rainfall events in South Africa", *Climatic Change* Vol 41, pages 249–257.

14. IPCC (2007), *Climate Change 2007: The Physical Science Basis: Summary for Policymakers*, WHO, UNEP, accessible at www.aaas.org/news/press_room/climate_change/media/4th_spm2feb07.pdf.

15. For example, in the Blue Nile region of the Nile basin, predictive models produce divergent results for rainfall changes in the crucial summer monsoon season. In the White Nile system, the various models agree on a winter increase in rainfall but disagree on the size of that increase. They are inconsistent on how the summer monsoon will change. The models are consistent for small decreases in winter

rainfall in the Nile delta and for large decreases in the summer, but these are unlikely to be significant as rainfall is negligible in these months. See reference 13, Mason et al. (1999).

16. IMF and World Bank (2006), "Clean energy and development: towards an investment framework. DC2006–0002", Environmentally and Socially Sustainable Development Vice-Presidency and Infrastructure Vice-Presidency, The World Bank, Washington, DC, page viii.

17. Mason, S and A Joubert (1997), "Simulated changes in extreme rainfall over southern Africa", *International Journal of Climatology* Vol 17, pages 291–301.

18. Ayoade, J and F Akintola (1980), "Flood perception in two Nigerian cities", *Environment International* Vol 4, pages 227–280; also French, G, L Awosika and C Ibe (1994), "Sea-level rise in Nigeria: potential impacts and consequences", *Journal of Coastal Research* No 14, Special Issue, pages 1–45; Muoghalu, L and A Okonkwo (1998), "Effects of urban flooding in Akwa, Anambra state, Nigeria", *Environmental Review* Vol 2, pages 72–81; and Ologunorisa, E (1999), "Flood hazard perception and adjustment in Ondo, southwestern Nigeria", *Journal of Nigerian Affairs* Vol 4, pages 172–193.

19. Akintola, F (1994), "Flooding phenomenon", in M O Filani et al. (editors), *Ibadan Region*, Rex Charles Publications in association with Connel Publications, Ibadan, pages 244–255.

20. Babatolu, J (1997), "The June 24th 1995 flood in Ondo: its antecedents and incidents", *Ife Research Publication in Geography* Vol 6, pages 158–164; also Oriola, O (1994), "Strategies for combating urban flooding in a developing nation: a case study from Ondo", *The Environmentalist* Vol 14, pages 57–62.

the construction and maintenance of drainage channels are also aggravating the flooding problem. Particularly problematic is the unwillingness of government at all levels to engage in the provision of integrated drainage systems in informal settlements, which are often regarded as being outside accepted urban regulation and planning systems.

b. Four types of urban flooding in African towns and cities

Human settlements may be affected by four types of flooding:

- localized flooding due to inadequate drainage;
- flooding from small streams whose catchment areas lie almost entirely within built-up areas;
- flooding from major rivers on whose banks the towns and cities are built; and
- coastal flooding from the sea, or from a combination of high tides and high river flows from inland.

The first and second types of flooding occur much more frequently than flooding from major rivers. The fourth type of flooding occurs where settlements have been built on coastal wetlands and mangrove swamps.

Localized flooding. Localized flooding occurs many times a year in slum areas because there are few drains, most of the ground is highly compacted and pathways between dwellings become streams after heavy rain. Any drains and culverts that do exist are often blocked with waste and plastic debris because the slums lack adequate municipal garbage collection and cleaning services.

Small streams. The small streams in urban areas rise quickly after heavy rain, but often pass through small culverts under roads. Although adequate enough to deal with the existing flood flows when they were designed, changes in urban areas and in storm intensity now produce flows that exceed the capacity of the culverts. The stream channels themselves may contain so much debris and urban waste that their channels are effectively smaller than they were two decades ago. These changes combine to make flooding more frequent.

Major rivers. Major rivers flowing through urban areas are affected by land use changes and engineering works upstream. For example, dams can modify river flows. Most dams trap sediments, often causing rivers to erode their banks downstream more than they did in the past; and, although dam operation can lead to a greater regularity of flows, it may also lead to high flows when stored water is released suddenly to prepare for high flows upstream.

Often, natural levees along the river provide some protection to the towns and cities through which it passes. However, urban growth usually has expanded over some of the floodplain so that parts of the city are below flood level and the area into which floods can naturally overflow has also been reduced. Levees have been raised artificially, but with the risk that they may be breached and cause devastating urban flooding. Such flood events can cause severe losses and disrupt economic activity over large areas of the city. Depending on the size of the river, they may last several days or several weeks.

In lowland and coastal cities, wet season flooding may affect some areas for two or more months because rain and river water combine to raise water levels in swamps that would naturally have been inundated at certain times of the year. Dumping of waste beneath dwellings in these areas tends to help raise levels further. Storm waves can also bring flooding to such areas.

Coastal flooding. More than one-quarter of Africa's population resides within 100 kilometres of a sea coast,[22] with 12 per cent of the urban population living within the land area that may be affected by a 10-metre sea-level rise (the Low Elevation Coastal Zone or LECZ).[23] In coastal cites, many poor people live on former swamp land or in dwellings built on stilts in tidewater areas. Such communities are particularly vulnerable to increased storminess and rising sea levels. Modeling the effects of a 38-centimetre mean global sea-level rise in 2080 gives estimates that the average annual number of people in Africa impacted by flooding could increase from one million in 1990 to 25 million by 2050,[24] with a worst case scenario of 70 million in 2080.[25] Many, if not most, will be residents of poor urban communities. Examples of particularly vulnerable coastal lowland cities are Lagos and Port Harcourt in Nigeria[26] and the capital of The Gambia, Banjul.[27] There are also threats to coastal areas of Egypt[28] and to East African coastal settlements from sea-level rise.[29]

IV. LOCAL CASE STUDIES OF URBAN FLOODING

> "The 2003 World Development Report notes the pronounced difficulties the poor face when disaster strikes. Developing countries are particularly vulnerable because they have limited capacity to prevent and absorb…effects [of natural disasters]. People in low-income countries are four times as likely as people in high-income countries to die in a natural disaster…. Poor people and poor communities are frequently the primary victims of natural disasters; in part because they are priced out of the more disaster-proof areas and live in crowded, makeshift houses… poor families are hit particularly hard because injury, disability and loss of life directly affect their main asset, their labour. Disasters also destroy poor households' natural, physical and social assets, and disrupt social assistance programmes."[30]

To ascertain the dimensions of flood problems in poor communities, ActionAid undertook participatory vulnerability analysis (PVA)[31] with people living in vulnerable areas in five capital cities representing different areas of Africa where ActionAid had representatives who were able to help with the enquiry. Policy analysis was also carried out as a part of PVA, to understand whether there is a gap between poor urban people's experiences of climate change impacts and current disaster management policies. These analyses reveal much about the local factors that aggravate flooding and the views people hold about the causes of flooding and what might be done about it.

PVA is a tool developed by ActionAid that involves communities, local authorities and other stakeholders in an in-depth examination of what makes them vulnerable. PVA is essential to ActionAid's work on emergencies and conflict. The impact a disaster has on the people who are affected will depend on how vulnerable they are. By identifying the

21. Olaniran, O and J Babatolu (1996), "Recent changes in rainfall pattern and its implications for flood occurrence in Ondo, Nigeria", *Ondo Journal of Arts and Social Sciences* Vol 1, pages 125–136.

22. Singh, A, A Dieye, M Finco, M S Chenoweth, E A Fosnight, and A Allotey (1999), *Early Warning of Selected Emerging Environmental Issues in Africa: Change and Correlation from a Geographic Perspective*, United Nations Environment Programme, Nairobi, Kenya.

23. See reference 7.

24. Sachs, W (2006), "Climate change and human rights", *The Pontifical Academy of Sciences Scripta Varia* Vol 106, pages 349–368.

25. Nicholls, R, F Hoozemans and M Marchand (1999), Increasing flood risk and wetland losses due to global sea-level rise: regional and global analyses" *Global Environmental Change* Vol 9, S69–S87.

26. For instance, parts of Lagos are two metres below sea level. Many slum dwellings are built on stilts over swamps and other wetlands. An extreme 10-hour rainfall in Port Harcourt on 14 July 2006 drove out 10,000 residents and caused widespread traffic chaos. The Niger delta frequently experiences flood problems, aggravated by structures such as the Port Harcourt–Patani–Warri highway that cuts across natural drainage lines and acts as a barrier to floodwaters. The blockage of channels by debris and the obstruction of flood paths by new construction were seen as the main obstacles contributing to the Port Harcourt flooding. See Abam, T, C Ofoegbu, C Osadebe and A Gobo (2000), "Impact of hydrology on the Port Harcourt–Patani–Warri road", *Environmental Geology* Vol 40, pages 153–162.

27. Banjul could disappear in 50–60 years through coastal erosion and sea-level rise, putting more than 42,000 people at risk. See Jallow, B, S

causes of their vulnerability, communities can set up their own coping mechanisms to mitigate the effects of hazards such as floods. In this study, the local ActionAid representatives met with focus groups they had already established in poor communities and discussed a pre-planned set of topics on the flood problems of urban areas: why floods occur; how members of the community adjust to them; who is responsible for reducing the flood risk; and what action the community itself can take. The responses covered a wider range of ideas than the planned topics, providing some vivid descriptions of how individuals reacted to flooding. Inevitably, the detail in the reports from the five cities differed, but altogether there is a story of human courage and endurance in the face of quite terrible conditions that often last for months rather than days or weeks. After a brief description of the situation in these cities, the focus groups' responses to these questions will be presented.

a. The worsening situation in the five cities

Accra, Ghana. Women in Alajo, Accra, observed that patterns of rain and flooding have become unpredictable since the 1980s: "*In some years the rain will fall greatly and destroy everything; and other times nothing will happen*." They noted that it used to rain heavily in June and July, but since 2000 the heavy rains sometimes start earlier than June or continue beyond July, making it difficult to prepare for flooding.

Men in Alajo described the impact of the flooding on their lives: "*Flooding makes the inhabitants of Alajo unable to do anything*." Slum dwellers' livelihoods depend on such activities as small-scale commerce, petty trading and artisanal trades, which are disrupted by floods, thus affecting the capacity to buy food or pay bills, including those for children's education and healthcare: "*Flooding makes people go hungry for days*." Several Alajo residents spoke of engaging in petty trading and merchandising in wooden kiosks that cannot withstand the force of the floods.

Kampala, Uganda. In Kampala, construction of unregulated shelters by the poor, in such slums as Kalerwe, Katanga, Kivulu and Bwaise, has reduced infiltration of rainfall, increasing runoff to six times that which would occur in natural terrain. Some of the increase is probably due to climate change but some is also the direct result of land cover change. Local people claim that floods are now more frequent and more severe. The flooding used to occur in predictable cycles in the two main rainy seasons of April–May and October–November, but now occurrences have become erratic and unpredictable

Fifty-nine year-old Masitula Nabunya of Bwaise III parish said that after the 1960 floods a channel from Nsooba to Lubigi was dug and workers were employed to clean it regularly. There were no further flooding problems until the 1980s, but since then she has had to re-build her house after being flooded six times. Flooding in these places is now much more frequent, with every small downpour appearing to produce intense flooding. Some of this is because the main drainage channel, originally two metres deep, is now only 30 centimetres deep as a result of an accumulation of sediment and rubbish. The situation is also linked to the increased number of houses, yielding much more runoff from a given quantity of rain.

Toure, M Barrow and A Mathieu (1999), "Coastal zone of the Gambia and the Abidjan region in Cote d'Ivoire: sea-level rise vulnerability, response strategies and adaptation options", *Climate Research* No 6, Special Issue, pages 137–143.

28. El-Raey, M, K R Dewidar and M El-Hattab (2004), "Adaptation to the impacts of sea-level rise in Egypt", *Mitigation and Adaptation Strategies for Global Change* Vol 4, pages 343–361.

29. Magadza, C H D (2000), "Climate change impacts and human settlements in Africa: prospects for adaptation", *Environmental Monitoring and Assessment* Vol 61, pages 193–205.

30. Independent Evaluation Group (2006), *Hazards of Nature: Risks to Development. An IEG Evaluation of World Bank Assistance for Natural Disasters*, World Bank, Washington, DC, page 48.

31. Smit, B and J Wandel (2006), "Adaptation, adaptive capacity and vulnerability", *Global Environmental Change* Vol 16, pages 282–292.

Lagos, Nigeria. Residents of the low-lying coastal slum settlement of Iwaya/Makoko in Lagos argue that the climate is changing and flooding is becoming more frequent. In these settlements, homes are built on stilts above swamps that are natural flood basins. The increasing peak flows, combined with higher spring tides, are affecting more homes, more frequently. Local people are concerned about property damage and the impact on child health in an area with totally inadequate sanitation. Floodwaters can carry all sorts of organic waste into people's homes.

Maputo, Mozambique. In Block 40B of the Luis Cabral slum neighbourhood of Maputo, residents argue that flooding has become worse since 1980, pointing out that the 2000 floods completely destroyed the area. A single one-day rain event can cause floods that persist for three days. If the rains persist from three days to one week, the water depth rises to one metre and it may take a month to disappear.

Nairobi, Kenya. Flooding is a major problem in all informal settlements in Nairobi. In the Maili Saba slum, part of Dandora, next to the river, flooding is a normal occurrence. Poor people's houses are built of weak, inadequate building materials. Migration has led to more houses being built close to rivers, with consequent greater disruption when floods occur. To many residents, the El Niño-associated floods were particularly severe. Many local residents link increased flooding to both local activities and climate change. Many long-term inhabitants of slums such as Mabatini in Mathare agree that floods now occur in places where they did not two decades ago. Similar reports come from other African cities, whether inland or coastal. For the residents, floods are getting worse and climate change is contributing to this situation.

b. People's perceptions of the causes of flooding

Accra, Ghana. The poor residents of the district of Alajo in Accra were contacted in men's and women's groups and this provided a ranking of the importance of the causes of flooding, as they perceived them. Men pointed to:

- improper city planning with regard to layout of buildings and other structures;
- poor drainage;
- the lack of consultation by officials with the poor and an insensitivity to their problems:

  "Government and authorities take us for granted. Authorities do not respect us. They think they know it all and so will not ask for our opinion. They do not acknowledge the wisdom of the people. If they respected us and valued us, they will be sensitive to our plight and take simple but effective measures to solve the problem of flooding."

- overpopulation:

  "Numbers of people and their houses, offices and businesses have increased in our community. If the drainage will be fixed, population will not be a problem. Without a good drainage system, population increase facilitates flooding."

The women's group identified the same general issues, stressing the inadequate level of official attention to the problems of the poor:

> "In Alajo, there is no room created for floodwater to be properly contained. There is no way for the water to pass. The floods are not always caused by rains. Sometimes, even before the rains begin to fall, the drains are overflowing and the pathways obscured with wastewater flowing from other parts of the city and into Alajo from where there are no appropriate drains. So when it begins raining, things just worsen. At such times, if you want to take somebody to the hospital, he dies before your very eyes because you cannot carry him out."

Kampala, Uganda. People sampled in the Bwaise, Kalwerwe and Katanga districts of Kampala view flooding problems as arising from poor drainage conditions and the general flat terrain and lowlands. Bwaise, in particular, is surrounded by the hilly locations of Kawempe, Nsooba, Kamwokya, Mulago and Makerere. People cited the following causes of flooding:

- even when drainage channels are occasionally unblocked, the excavated silt is dumped alongside the channels and gets washed back in;
- acute poverty means day-to-day survival takes much higher priority than care for the environment;
- tree cutting for firewood, charcoal, mining and quarrying has contributed to changes in the weather patterns and hence to increased flooding;
- the expansion of commercial property and industrial developments in reclaimed wetlands where floodwaters used to drain has increased flooding elsewhere;
- the discriminatory enforcement of wetland policies that allow the rich to block natural drainage areas has greatly disadvantaged the poor through consequent flooding;
- factory building on wetlands has blocked water flows and polluted the water;
- the unregulated construction of shelters has blocked many small drainage channels;
- the failure to de-silt the main drainage regularly has greatly reduced its capacity;
- small culverts under road crossings are easily blocked by solid waste;
- bank erosion along open drains produces silting, thus reducing their capacity;
- the stone linings and concrete banks of poorly constructed drainage systems have become degraded and have started to collapse;
- the failure to de-silt the lower end of the main drain into the swamp causes floodwater to flow backwards into Bwaise settlement;
- rebuilding the main highway from Kampala to Gulu in a new location and the recent construction of the northern bypass road have interfered with water flows and aggravated flooding;
- the removal of eucalyptus trees along the main drainage channel that used to absorb some of the floodwater has led to increased flooding;
- the privatization of solid waste collection has led to much waste being dumped into the drainage channels, thus blocking them and aggravating flooding; and
- shelters built on hills around the city lack rain-harvesting facilities, which would have reduced the runoff water that contributes to flooding.

While the actual significance of some of these potential causes of flooding is not scientifically proven, this long list of locally perceived causes includes many drivers that could be dealt with by local action; but it also points to the lack of time the poor have to care for the environment.

Lagos, Nigeria. People in the Lagos PVA suggested the following causes of increased flooding:

- changes in the levels of high tides in the Lagos lagoon and the Atlantic Ocean, affecting certain streets;
- the indiscriminate erection of structures by residents, leading to impediments to the flow of water;
- subsidence of coastal land;
- the indiscriminate dumping of wastes into the lagoon, leading to the blockage of drains (many of the participants were reluctant to agree that this was a cause, although a few did); and
- insufficient depth and capacity of the drainage channels to carry all the urban runoff, thereby causing overflows and bank collapse.

The reluctance to accept waste dumping as a cause suggests an unwillingness to recognize personal responsibility. But lack of official attention to maintaining and improving an adequate drainage network for a rapidly growing megacity is also a major factor.

Maputo, Mozambique. In the Mafala neighbourhood of Maputo, residents noted both natural and local causes of flooding:

- although there was less rain overall, rare storms seemed more intense and led to more destructive flooding;
- a lack of adequate drainage infrastructure;
- no internal organization in the neighbourhood to maintain drainage channels, manage sewage, allocate land, or assist in evacuation at flood times;
- an absence of land planning; and
- no assistance for flood victims.

Clearly, here again the lack of national or local government involvement in developing integrated drainage or in planning the settlement to minimize flood damage is readily apparent. However, there seemed to be no cohesion within the community to organize mutual self-help.

Nairobi, Kenya. The causes of flooding identified by respondents included:

- heavy rainfall; residents said that whenever there were heavy downpours, either in Mathare or even upstream in Central province, they expected flooding;
- poor drainage systems; one woman commented that solid waste usually blocked the river, forming a dam that impeded the flow of water until it finally gave way and caused a flash flood;
- unplanned housing on the floodplain, which has restricted the capacity of the river;
- human activities near the river; for example, the Ngumba market in Mabatini is actually located in the river, which has been partly reclaimed by depositing sandbags in the channel;
- destruction of forests and lack of vegetation cover along river beds, with consequently reduced use of the river water; and
- changes in climatic conditions. One person commented that:

> "The presence of a lot of exhaust gases in the atmosphere has a negative impact on climatic conditions. This has led to erratic and unpredictable rains with the quantities becoming either more or less during given periods."

Within the five cities discussed in this section, focus group participants placed repeated emphasis on the lack of adequate drainage, poor management of existing drainage, the consequences of unplanned and unregulated urban development, lack of attention to the problem by governments, and changes in weather patterns. Those from coastal towns also emphasized changes on the shoreline, including subsidence, which often happens as coastal organic (peat) soils inland from mangrove swamps are drained and dry out. Some of the aggravating changes are seen as happening within the settlements themselves but others are totally external to the settlements and beyond the control of flood victims.

c. Adaptations to urban flooding

Accra, Ghana. In the Alajo community in Accra, people dealt with the June and July 2006 floods in a variety of ways:

- they used blocks, stones and furniture to create high places on which to put their most critical valuables;
- they put goods on top of wardrobes and in the small spaces between ceilings and roofs;
- they shared such high places with others who had no similar "safe" sites; and
- they temporarily moved away from the area to stay with friends and family.

One woman in Alajo described her experiences as follows:

> "As soon as the clouds gather I move with my family to Nima to spend the night there. When the rain starts falling abruptly, we turn off the electricity meter in the house. We climb on top of our wardrobes and stay awake till morning. Our house was built in such a way that ordinarily water should not flood our rooms, but this is not so. Our furniture has been custom made to help keep our things dry from the water. For instance, our tables are very high and so also are our wardrobes; they are made in such a way that we can climb and sit on top of them. These measures are adaptive strategies as old as I can recollect. I have two children but because of the flood, my first child has been taken to Kumasi to live with my sister in-law."

When residents of Alajo were in danger, they resorted to self-help or, for example, were rescued by other members of the community using locally manufactured boats, with no involvement by any government disaster agency. People said that their complaints to government authorities brought no results.

> "When the rain and the floods come, women and children suffer. You can be locked up for up to two days with the flood. Sometimes, we take our children out from the room to the rooftop. Then people bring boats to evacuate people."

Kampala, Uganda. Individuals in slums in Kampala adopted similar strategies. The response to floods in July 2006 was characterized by ad hoc individual short-term efforts to survive and protect property. In addition, some residents undertook collective work to open up drainage channels; some permanent residents temporarily moved to lodges and public places such as mosques and churches until the water levels receded; many residents constructed barriers against water entry at doorsteps; and some created outlets at the rear of their houses so that any water entering their homes flowed out quickly.

There were limited collective efforts at the community level and virtually no significant intervention by the relevant local government at the divisional level. What helped the residents most was the fact that the rains that caused the flooding were not the continuous peak rains that last several days, such as those experienced in April and November. What limited the response of the residents was the fact that almost all activities are uncoordinated, and are at the individual "survival of the fittest" level. Another big limitation is the significant backflow of water from the direction that the floodwater would naturally take, as a result of silting.

Lagos, Nigeria. At present, individual coping strategies include "*… bailing water out of the house with buckets*." Some wealthier community members use mechanical water pumps to remove water from their homes. People build temporary plank bridges between houses across the wetlands to be able to move about during flooding. The most helpful individual action at the household level has been to block water inlets with pieces of cloth to reduce the amount of water coming into the house, and then to remove the blockage after the level of the water has gone down to allow the water already inside the house to flow out.

The community seems unable to mobilize community efforts to tackle the flood problem. But even if they were able to mobilize, they believe they would not be able to combat the hazard owing to its enormity.

Maputo, Mozambique. The comments of Maria Sebastião Tivane from the Mafalala settlement typify the responses of Maputo residents:

> "If it rains, water rapidly accumulates, flooding the area. Generally, water remains for about two months. During that period, for our safety we put our belongings on bricks, namely beds and tables, to secure a place to sleep. Those who live in low areas suffer more. During the 2000 floods, I lost everything. My house was destroyed including the latrine, and everything, that is why I do not have a bed. My neighbours suffered too, but they managed to save their goods. Because of my age and being without a husband, I couldn't remove my goods and leave the area. I suffered a lot and I continue suffering because of living conditions. I survive because of family support. We don't have any assistance or support from the government or NGOs."

Nairobi, Kenya. In the slums of Nairobi, adaptations or responses to flooding include:

- bailing water out of houses to prevent damage to belongings;
- placing children initially on tables and later removing them to nearby unaffected dwellings;
- digging trenches around houses before and during floods;

- constructing temporary dykes or trenches to divert water away from the house;
- securing the structures with waterproof recycled materials;
- relocating to the highest parts of the dwelling that residents think are secure; and
- using sandbags to prevent the ingress of water.

Essentially, these are all individual coping strategies. Sometimes, people share protective storage or accommodation on higher ground. Spontaneous community action to unblock drainage channels is relatively rare. No coordinated action for emergency shelter or rapid response to flooding appears to exist in these cities. However, local people in poor communities have an acute awareness of the solutions that are necessary and are possible.

d. Perceptions of solutions to the flooding problem

Accra, Ghana. The key ideas expressed by community members were:

- the construction of a well-designed drainage system. The focus groups believe that:

  "If there is proper drainage, then we will have no floods. We need proper engineers to work on it. We have to engage the services of competent engineers, even if they are from abroad and are qualified to do the job."

It was also recognized that once the drains were constructed, the communities would have to take charge of keeping them clear, clean and well maintained;

- education, advocacy and sensitization of the community, together with assistance from non-governmental organizations;
- advocacy with government and policymakers to draw attention to the plight of residents in poor, flood-prone urban communities;
- the enforcement of municipal laws on planning and urban design. The community believes the Accra metropolitan assembly is too lax in enforcing the removal of illegal buildings that make the area more susceptible to flooding; and
- proper waste disposal; ensuring the availability and regular emptying of waste receptacles; eliminating the deliberate dumping of waste into drains.

Generally, when Accra slum residents think about solutions, it is in terms of medium- to long-term solutions that involve urban upgrading and major structural works that require relatively large capital expenditure.

Kampala, Uganda. Although opinions diverged about priorities and the order of remedial activities, there was an emerging consensus on what should be done:

- build planned new houses;
- construct a deeper and wider main drainage channel to accommodate the increased floodwaters;
- construct covered feeder channels to channel water into the main drainage system;

- have a permanent workforce to maintain and clean the drainage system;
- set up and promote the use and awareness of a proper garbage and solid waste disposal system;
- strictly enforce by-laws on the construction of houses and sanitation solutions;
- make stakeholders aware of their roles, responsibilities and duties in averting the floods, and of the danger if they neglect these roles;
- build public toilets in slum areas built over wetlands, where the construction of individual private household toilets is expensive;
- prohibit the construction of human settlements in the remaining existing swamps;
- strengthen and de-politicize the building inspection unit of Kawempe division, allowing it to take impartial action;
- increase advocacy for increased budgets for improving drainage channels and flood-related control activities; and
- plant more trees along the main drainage channels, as had been done previously.

Lagos, Nigeria. In Lagos, both the slum dwellers and the mainland local government council believe that constant clearance of the drainage channel running through Iwaya/Makoko would prevent the ponding of water from other parts of the metropolis. Standard drainage facilities along major streets within Iwaya/Makoko would help to solve the flooding problem. The slum dwellers have also suggested using sand to raise the entire area to a higher level.

Maputo, Mozambique. Solutions here included:

- building secondary drains that link to the already existing main one;
- cleaning up the main drainage channel, which at present is partially silted up;
- removing all housing built on natural flood paths;
- improving the drainage culverts under the N4 highway;
- ensuring that local drains feed effectively into the main drainage channel;
- conducting educational campaigns for communities on flood avoidance;
- creating industrial zones outside cities and towns; and
- increasing public participation and involvement in resolving environmental issues.

Nairobi, Kenya. Slum tenants thought there was limited potential for intervention on their part because of their high level of individual vulnerability and their exclusion from decision-making processes. However, they felt some measures were possible on their part:

- forming residents' associations to improve their welfare and responses to emergencies;
- partnering with others to plant trees along the riverbank and dig canals, trenches and drainage next to their houses; and
- prevailing on landlords to build humane and habitable houses and business premises, away from the river and able to withstand floods, as well as toilets to avert the outbreak of disease.

Recommendations for government at different levels included:

- government reform of housing policy to compel landlords to provide basic services such as toilets, drainage systems and other sanitation facilities;
- the inclusion of informal settlements in the city's waste management programmes;
- proper planning and provision of essential services that can sustain people's lives and their livelihoods;
- the development of infrastructure, including bridges, access roads and dykes along the riverbank;
- relocation by national government of people living along the river; and
- land reclamation, as in the case of the adjacent upgraded Mathare 4A project.

People are aware of the solutions and have strong views on who is responsible for taking action. However, there are different levels at which the various stakeholders in flood mitigation can operate to contribute to creating solutions. This requires an analysis of responsibilities and actions, which is the subject of the next section.

V. GENERAL GUIDELINES ON ADAPTATIONS TO CLIMATE CHANGE

The general literature on adaptations recognizes that flood warning systems are necessary for people living on floodplains; that human settlements should be planned to avoid flooding as far as possible; and that adequate evacuation procedures should be in place to assist flood victims. Integrated river basin planning, incorporating flood storage into reservoirs, is recommended for most large African river basins.

Flash floods require a different approach to reducing vulnerability than most other natural hazards, including other kinds of floods. Death and property loss per unit area can be very high and flood mitigation strategies alone are not sufficient. Flash floods require a different way of thinking, based on an informed public and a system for detecting a rain event that has the potential to cause a flash flood. For the most part, research efforts, whether basic or applied, have dealt with one or another of the components of the system, and we have learned a great deal. Yet uncertainty about individual elements of the system remains high.[32]

Coastal defense systems will require long-term investment for the future. Action should begin now, because several African coastal areas are already experiencing significant impacts. Investment now will help to safeguard the next generation of coastal residents, but that generation will have to continue the investment to protect its successors. Caring for the people and the environments of the future is an obligation that the people and the governments of today must not avoid. Failure will impose immense costs on our posterity.

For flooding in general, three types of action[33] are particularly relevant to poor urban communities:

- **Informed action at the local level**. Local initiatives to reduce vulnerability and increase community participation may be facilitated by

32. Montz, B E and E Gruntfest (2002), "Flash flood mitigation: recommendations for research and applications", *Environmental Hazards* Vol 4, pages 15–22.

33.Comfort, L, B Wisner, S Cutter, R Pulwarty, K Hewitt, A Oliver-Smith, J Wiener, M Fordham, W Peacock and F Krimgold (1999), "Reframing disaster policy: the global evolution of vulnerable communities", *Environmental Hazards* Vol 1, pages 39–44.

training, capacity building and resource transfers. These kinds of efforts may require outside support and can be sustained through a network of organizations engaged in economic, social, political and scientific action and inter-organizational learning.

- **Maps of the decision processes for disaster mitigation, preparedness, response and recovery**. Such devices would identify: critical actors at each jurisdictional level; their risk assumptions; their different types of information needs; and the design of an information infrastructure that would support their decisions. Only by making the complexities of environmental risk management explicit will it be possible to transform the destructive spiral of disaster into a learning process for responsible management of the environment.
- **Enablement of affected populations**. Global initiatives for adaptation to climate change and for disaster reduction should be more specifically addressed towards assisting the people who face hazards to manage their own environments more responsibly and equitably over the long term. Flood victims often feel neglected by the authorities and cut off from major national and international initiatives to alleviate flood impacts and reduce the frequency of flood events.

While megacities can suffer large quantitative losses and damage to life and property, the proportion of the population and properties affected may be far greater in small urban settlements. If we compare the diverse sizes of towns that share similar political economies, and communities of similar sizes with different political economies, a clear case can be made that small communities experience a far different exposure to hazard than do large metropolitan areas.[34]

In terms of poverty reduction, the Independent Evaluation Group of the World Bank notes that:

> "Disaster risks do not make it into the CAS or PRSP[35] as often as country exposure to such risks would seem to warrant. When a CAS does discuss natural disasters, it is likely to discuss activities related to vulnerability reduction (such as strengthening disaster management, long-term planning and early warning systems)."[36]

The IEG also notes that the first challenge for the World Bank in relation to disasters is "*…to ensure that the poor do not miss out on the recovery or, worse, lose the little they have left.*"[37]

34. Cross, J A (2001), "Megacities and small towns: different perspectives on hazard vulnerability", *Environmental Hazards* Vol 3, pages 63–80.

35. CAS = Country Assistance Strategy; PRSP = Poverty Reduction Strategy Paper.

36. See reference 30, page 35.

37. See reference 30, page 67.

VI. RESPONSIBILITIES AND ACTIONS

> "Following a disaster, solutions that will directly benefit the poor are found at the micro level. As one disaster expert interviewed by the study team put it, governments have 'thick fingers' for such fine-scale work."[38]

38. See reference 30, page 49.

a. Responsibility: theoretical framework

The principle of local, regional or national action at the appropriate scale applies to managing urban flooding. Where the problems are essentially internal to a specific community, then that community should manage them. Where they lie totally within the boundaries of a single local

authority, then the local authority should manage them. Where they cut across many administrations, then national governments, or even international consortia, should manage them.

Applying this principle of management as close to the communities as possible, the management of localized flooding as a result of inadequate drainage should be undertaken by the local communities themselves. This is where local voluntary groups, assisted by national or international NGOs and with support from both local government and national disaster reduction organizations, could be highly effective. Local communities are stakeholders in the good drainage of and the rapid water removal from their own areas. They would benefit from improving and maintaining drainage channels, thus preventing the blocking of waterways and culverts by waste, from installing roof rainwater collection tanks for their own use, and avoiding construction on drainage lines. They could also organize local shelter for the people in their communities who are most affected by flooding.

Local authorities are best placed to cope with flooding from small streams whose catchment areas lie almost entirely within the built-up area. They administer the regulations and by-laws concerned with land use planning and should be involved in local disaster management. However, most African local authorities lack the human resources and financial power to carry out such responsibilities effectively. They may be able to form partnerships with NGOs but they should be supported by national governments and regional agencies to map flood risk areas, maintain urban stream channels, control building in flood channels and on floodplains and provide emergency assistance.

Where towns and cities are flooded by major rivers overtopping their banks, their flood protection has to be seen in the context of the entire river basin, which may include more than one state. Where a river basin lies within a single nation state, integrated river basin management principles should be applied by an agency cutting across ministries concerned with both rural and urban interests, to ensure that activities in upstream areas do not worsen the flood situation for towns and cities downstream. For large, international rivers, river basin commissions are required to manage the water resources of the entire basin for the benefit of all communities in the different nations occupying the basin. Individual urban authorities may campaign for, or act to build, extra flood protection embankments. However, such works only serve to direct the floodwaters elsewhere. The natural floodplain should be retained to hold floodwaters and should not be built upon.

Cities faced with coastal flooding from the sea, or from a combination of high tides and high river flows from inland, have to integrate both river basin and coastal zone management, ensuring that the natural wetlands can continue to function as flood storage areas as far as possible. Where settlements already exist, filling those areas to prevent flooding may be desirable, but the implications for adjacent areas need to be considered. Social factors may lead people to move on to other nearby wetlands.

b. Required actions

More needs to be done to focus on the urban poor in international action on adaptation to climate change and disaster reduction. Seldom do the

needs of the urban poor feature in responses to the National Adaptation Programme of Action (NAPA) on vulnerability to climate change, funded by the Global Environment Facility (GEF) for least-developed countries. The Hyogo Declaration (so named after the Japanese prefecture where the world conference on disaster reduction was held in 2005), in its international plan of action points out that "*…disasters in Africa pose a major obstacle to the African continent's efforts to achieve sustainable development.*"[39] However, national Hyogo reports make scant reference to the needs of the urban poor. To achieve the inter-sectoral partnerships suggested by the Hyogo framework, steps are needed to create awareness and build capacity within city councils for the application of the framework and other relevant protocols and conventions for the needs of the urban poor.

Climate change is aggravating the problems caused by urban flooding that poor people in African towns and cities regularly face. The detailed reports from the cities studied by ActionAid confirm the general view in the literature on political ecology approaches, which demonstrate, for example, that when faced with a flood risk, residents of marginalized but risky areas have only a limited set of adaptation options.[40] As elsewhere, in some African countries the state allows such risks to exist as part of the politicized nature of urban planning and control. In some cases, the poor form associations to initiate some adaptations, but everywhere the poor need urgent help to increase their ability to avoid these problems. They need help at the local community level to improve their options for emergency action and evacuation. They need help at the municipal level to improve drainage, to regulate developments upstream and elsewhere that increase flooding in their communities, and to give them greater security of tenure so that they can invest in making their homes more flood resistant. They need help at the national level – particularly to ensure that their needs are included in national disaster reduction plans and that these and other impacts of climate change are included in poverty reduction strategies. They also need international help to see that funding for adaptation to climate change is directed towards their problems. If Africa generally is a victim of climate change, the African poor are where the outcomes of that victimization are mainly focused.

39. United Nations (2005), Report of the World Conference on Disaster Reduction, Kobe, Hyogo, Japan, 18–22 January 2005, A,Conf 206/6, United Nations, New York, page 19.

40. Adger, W, S Huq, K Brown, D Conway and M Hulme (2003), "Adaptation to climate change in the developing world", *Progress in Development Studies* Vol 3, pages 179–195; also Pelling, M (1999), "The political ecology of flood hazard in urban Guyana", *Geoforum* Vol 30, pages 240–261.

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