# The potential for Water Sensitivity, sustainable drainage and adaptive management in West Africa using Lagos, Nigeria, as a case study

## Les potentialités de la gestion durable et adaptable du drainage en Afrique occidentale utilisant le Lagos Nigeria comme étude de cas

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## RÉSUMÉ

Actuellement, on assiste à un changement de paradigme allant dans le sens d'une gestion plus durable, intégrée, adaptative et participative des eaux pluviales, ce qui mène à l'adoption de nouvelles politiques dans de nombreux pays développés. Cependant, dans les pays en développement, ces approches soulèvent de nombreux défis complexes dans leur mise en œuvre. Elles ont néanmoins l'avantage de pouvoir s'établir sur des bases relativement neuves puisque les infrastructures de traitement des eaux de surface y sont au mieux fragmentaires, inexistantes au pire, alors que pour les pays développés, ce réseau est bien implanté mais vieillissant, inefficace et manquant de capacité. Les villes des pays développés peuvent aspirer à une gestion holistique de l'eau en ville (Water Sensitivity) mais actuellement, certaines villes au Nigéria ne se sont même pas en mesure d'assurer l'approvisionnement en eau, en particulier celles qui présentent des habitats informels denses, pauvres et non réglementés dans leurs périphéries. En utilisant le Lagos, au Nigéria, comme étude de cas, cet article examine donc la capacité et la volonté d'une ville d'Afrique de l'Ouest, comprenant une part importante d'habitats informels, de s'engager dans la gestion durable des eaux de surface. Les opinions des décideurs politiques, des représentants des gouvernements locaux, et des acteurs de Lagos, ont été recueillies concernant la mise en œuvre de systèmes de drainage durables (SUDs) comme point de départ pour une prise de conscience des enjeux liés à l'eau par les habitants de Lagos.

## ABSTRACT

Currently, there would appear to be a paradigm shift towards more sustainable, integrated, adaptive and participatory management leading to new policies for stormwater being adopted by many developed countries. However, in undeveloped countries, the problems are highly complex and challenging when considering the implementation of such approaches. On the one hand, the slate is reasonably clean since the infrastructure for dealing with surface water is fragmentary at best, non-existent at worst, whereas for developed countries this network is in place, but ageing, inefficient and lacking in capacity. Cities in developed countries can aspire to Water Sensitivity, but some in Nigeria are presently not even a Water Supply City, particularly those with dense, poor and unregulated informal settlements on their periphery. Using Lagos, Nigeria as a case study, this paper therefore examines the ability and willingness of a city in West Africa, with a substantial informal settlement, to engage in sustainable surface water management. The views of policy makers, Local Government officials, and stakeholders in Lagos, Nigeria, have been sought on the implementation of Sustainable Drainage systems (SUDs) as a starting point for the development of sensitivity towards water for residents of Lagos.

## KEYWORDS

Adaptive management, Sustainable Drainage Systems, water sensitivity, less developed countries, informal settlements

# 1 INTRODUCTION

In an attempt to reduce levels of surface runoff from urbanisation, many developed countries are implementing sustainable management systems to address flooding issues. These techniques consider excess stormwater as a resource, but unfortunately the same cannot be said for most developing countries. In these countries, conventional drainage is at best inadequate but in general is absent. Natural drainage becomes blocked, and unchecked development, in large part because of the lack of sufficient planning controls, is a significant factor affecting stormwater management. Due to their tropical climates, many cities in these countries, particularly in West Africa, have yearly floods. This problem is further exacerbated by progressive urbanisation and the associated increase in impermeable surfaces, but by adding predicted potential changes in climate it can only get worse. Very often exacerbating all these problems are the informal settlements whereby people are attracted to cities, and settle on the periphery in unplanned and haphazard communities (Mardeusz, 2014). Kolawole et al., 2012, defined these as being densely populated comprising self-built shelters or shacks built informally or under traditional land tenure. One example of the many cities with such settlements is Lagos, a hub for commerce in Nigeria specifically (Olajide, 2010), but across West Africa in general, where several informal settlements have grown around the formal built environment. According to Funsho et al., 2013, on average 6,000 people relocate to Lagos every day, adding to the current population of 18 million, which the United Nations has estimated will increase to 25 million by 2015. Environmental degradation in general and flooding in particular are serious problems for the whole of Lagos, as illustrated in Kolawole et al., 2012. This paper investigates the likelihood of a sustainable approach to surface water management being adopted in Lagos; where it is in the context of Water Sensitive Urban Design (Brown et al., 2008; Brown et al., 2009) and whether it will be able to achieve Water Sensitive city status. However, according to Fischer-Jeffes et al (2014), most developing countries are currently at a “water wasteful” status and have a long way to go before being able to claim they are Water Sensitive.

# 2 METHODOLOGY

Lagos, Nigeria was chosen because approximately two-thirds of the population of Lagos currently live in slums (Agbola and Agunbiade, 2009) and therefore the city has many informal settlements, according to Gandy, 2006, up to 200, of which those shown on Fig 1 were chosen as the focus for this study since they suffer major flooding incidences on an annual basis. A formal settlement, Ikeja, was chosen as a comparator and is also shown on Fig 1.

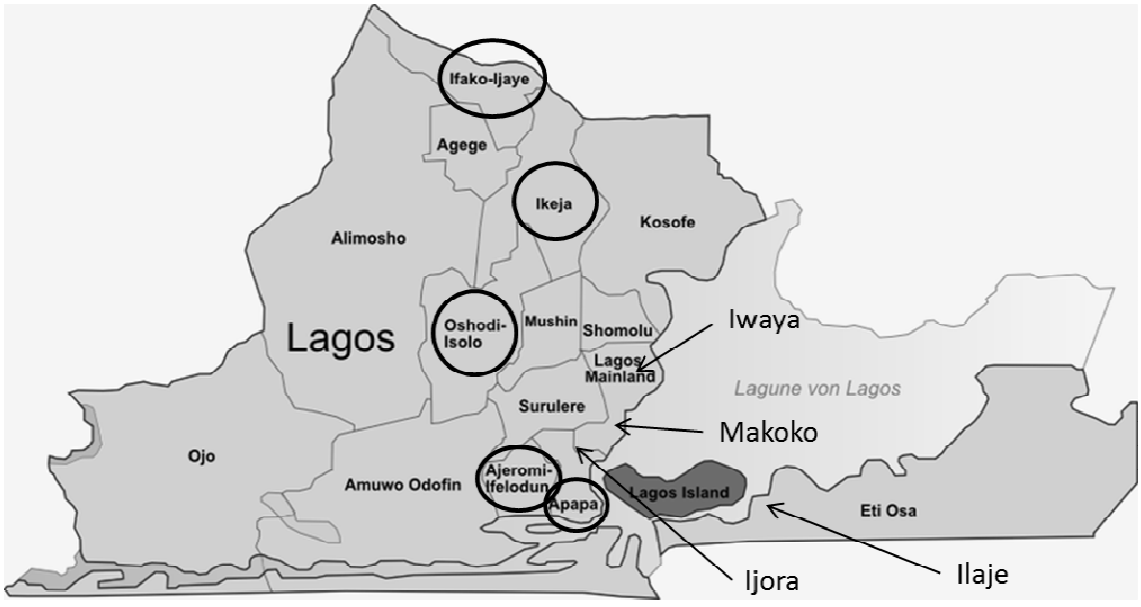
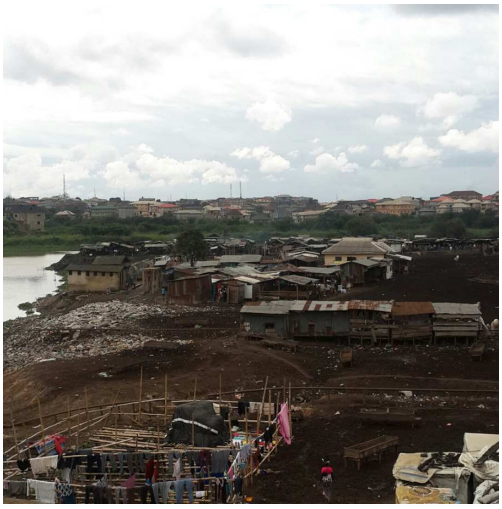



Fig 1 Location of field sites, Lagos, Nigeria (adapted from Wikimedia Commons (Bohr))

A case study methodology was used in order to be able to examine in depth issues of drainage in informal settlements. Settlements were chosen due to their differences in environment and community structure, Figure 2 shows a typical informal settlement in Lagos. Data was generated from both primary and secondary sources and this is described in the following section.

Fig 2 Typical view of informal settlement, Lagos, Nigeria



## 2.1 Data collection

In areas such as informal settlements, no formal records exist, for example of the extent or occurrence of historical flooding. Thus semi-structured questionnaires, focus groups, interviews and field observations were designed to gauge respondents' perceptions and perspectives on the issues of flooding, to collate data on historical flooding events in the area as well as ascertain their readiness to accept SUDS. Informing the study therefore, was a focus on key stakeholders such as government officials e.g. from the Ministry of the Environment, drainage engineers etc, but also and most importantly, members of the community and community heads. Two field visits were made between April and August 2015, the first for the purposes of a pilot study to gauge the potential for the community acceptance of SUDs and the second to extend the survey to 2 different areas: Apapa Igamu and Ifelogdun. The questionnaires were structured around four phases:

1. The gathering of evidence of historical flooding events, their occurrence, extent and frequency.
2. The impacts of flooding on the community as a whole and on individuals in the community.
3. Establishing existing stormwater management, and any rationale behind them.
4. Receptiveness of the community to the use of SUDS to manage runoff and their potential involvement in their construction, management and operation.

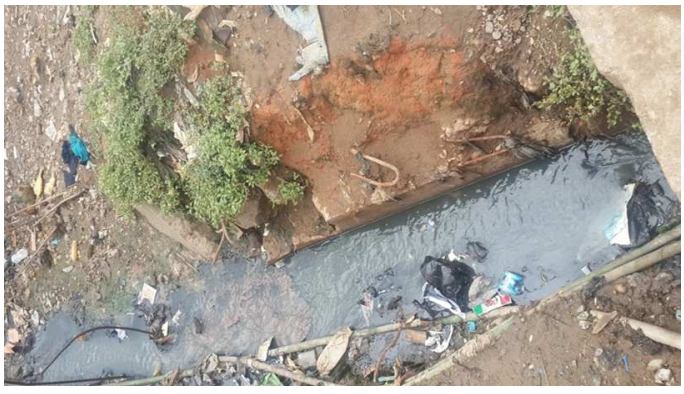
In April and August, 150 and 200 questionnaires respectively were distributed to randomly selected residents in the different study sites, with response rates of 50.6% and 77% respectively. A total of 30 interviews were conducted with Government officials and engineers. Responses were collated, exported to excel, and then analysed with SPSS frequencies and cross tabulation functions.

# 3 RESULTS AND DISCUSSION

It was found that flooding was a serious problem, with "extreme" flooding reported from all the informal settlements on a regular basis (at least yearly) and that this was in part due to either the lack of drainage infrastructure or the lack of maintenance of what storm sewers there were, leading to them blocking and becoming inefficient (see Fig 3). However, according to residents, it "barely" flooded at all in Ikeja, the formal area in which some storm water management structures were in place.

## 3.1 Results of community engagement

Fig 3. Blocked and inefficient storm sewer, Ijora, Lagos



Results of the pilot study showed that both the community and stakeholders were ready to be proactive in changing their standard of living by adopting more sustainable methods to manage surface run off with 63% of residents expressing an interest; however 28% did not respond. Self-installed site control techniques included, in order of numbers used in the settlements: gutters, channels, sandbags and sand, drums and tyres. Rainwater harvesting was also being used to a limited extent by some of residents to control run off and provide alternative sources of water. An engineer stated that rainwater harvesting was mainly used in rural areas, rather than in the settlements. However, with 78% of the residents admitting only a "basic" understanding of flooding, and any expertise gained from "personal experience" (80%), it is unlikely these interventions will continue to function in the long term, or at a large scale. Residents and government officials alike identified problems that were caused by either any existing, failing conventional water management infrastructure, or the lack of such systems. Half of the government officials interviewed were aware of SUDs and were interested in its use, however an engineer was of

the opinion that simple techniques, such as rainwater harvesting were of no benefit in terms of flood attenuation. There was general agreement that the self-installed approaches, which could be considered a form of adaptive management, were more efficient than existing drainage infrastructure in alleviating flooding in informal settlements. The Director of the Lagos State Emergency Management Department (Dr Osanyitolu) stated: "We are continually searching for more efficient and reliable ways to manage flooding issues and will explore alternative methods" – the will is therefore clear.

## 3.2 Comparison with the Water Sensitive City

In comparison with the WSUD concept of Brown et al., 2009, the formal settlement (Ikeja) falls within both a water supply and a sewered city. However the informal settlements investigated had not even reached the water supply city stage due to the lack of even basic amenities, conforming instead to the water wasteful city as described by Fischer-Jeffes et al., 2014. However, some of the residents in the informal settlements were making use of rainwater harvesting, and were aware of various sustainable approaches to stormwater management, so perhaps the first step on the journey to Water Sensitivity is Water Awareness The challenges faced by residents in informal settlements, however, are numerous and varied. The lack of basic amenities is often due to a lack of agency by local authorities and utility suppliers. Informal settlements are not intended to be formalised, rather governments would generally prefer such residents to migrate to formal housing provision, where amenities are already established.

# 4. CONCLUSIONS

Flooding and environmental degradation impact the quality of life of those residing in informal settlements in Lagos. Self-installed infrastructure is very short term and does not address the frequent flooding taking place across all of the settlements studied. However, residents appeared to be open to a more sustainable approach to managing these problems, although there is a very long way to go before any area of Lagos could be considered to be managing their flooding crises in a sustainable manner. The challenges of informality, including lack of political will in the provision of suitable infrastructure, as well as an often shifting population, mean that up to now, responses to managing excessive flooding has been difficult. However, the residents appear to be installing their own versions of adaptive management to provide some limited, small scale flood protection.

# REFERENCES

Agbola T. and Agunbiade, E.M. (2009) Urbanization, slum development and security of tenure: the challenges of meeting Millennium Development Goal 7 in Metropolitan Lagos, Nigeria. In: de Sherbiniin, A., A. Rahman, A. Barbieri, J.C. Fotso, and Y. Zhu (eds.). Urban Population-Environment Dynamics in the Developing World: Case Studies and Lessons Learned. Paris: Committee for International Cooperation in National Research in Demography (CICRED) 77-106. Available at: http://www.populationenvironmentresearch.org/workshops.jsp#W2007 accessed 15 November 2015.

Brown, R. R., N. Keath and T. H. F. Wong (2008) Transitioning to Water Sensitive Cities: historical, current and future transition states. 11th International Conference on Urban Drainage, Edinburgh, Scotland, UK.

Brown, R. R., N. Keath and T. H. F. Wong (2009) Urban water management in cities: historical, current and future regimes. Water Sci Technol. 59, 5, 847-55.

Fisher-Jeffes, L., K. Carden, & N.P. Armitage (2014) The future of urban water management in South Africa – achieving water sensitivity. Water Science & Technology: Water Supply, 1-10. Doi:10.2166/ws.2014.060.

Funsho, S.R., Adegoke, A.K., Adewale B.A (2013) Slum settlements regeneration in Lagos Mega-city: an overview of a waterfront, Makoko Community. International Journal of Education and Research 1, 3, 1-16.

Gandy, M. (2006). Planning, anti-planning and the infrastructure crisis facing Metropolitan Lagos. Urban Studies 43,2, 371-396.

Kolawole, M.O., Ogunrayewa, M.O., Koleosho B.O. and Adenubi, O.O. (2012) Urban Slums as Spatial Manifestations of Urbanization in Sub-Saharan Africa: A Case Study of Ajegunle Slum Settlement, Lagos, Nigeria. Developing Country Studies. 2,11, 1-10.

Mardeusz, J. (2014) Housing Policy and Formalization Strategies in Africa's Growing Cities: A Case for the Informal Settlement. The Trinity Papers. Trinity College Digital Repository, Hartford, CT. Available at: http://digitalrepository.trincoll.edu/trinitypapers/32 Accessed 15 November 2015.

Olajide, O. (2010) Urban Poverty and Environmental Conditions in Informal Settlements of Ajegunle, Lagos Nigeria. Proceedings/Tagungsband. REAL CORP. Cities for everyone. Liveable, Healthy, Prosperous. Vienna, 18-20 May 2010 – http://www.corp.at. M. Schrenk, V. V. Popovich, P. Zeile (eds). 827-836.