

Adaptation to climate change in African coastal cities

With climatic changes and growing populations, coastal cities are increasingly facing environmental issues such as flooding (storm surges and rainstorms), sea level rise, and ground water salinization. These challenges are magnified by lack of effective planning and provision of basic services, worsening the vulnerability of poor urban people. In response, IDRC research is supporting better urban planning, capacity enhancement for climate change adaptation, and developing coping strategies for flood victims and hard-pressed fishing communities in Africa.



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A project in Egypt assessed the main physical impacts of climate change and sea level rise, their economic effects and their consequences for communities.

Summary

Coastal cities in Africa, which comprise some of the continent's most important hubs of industry and commerce, are also experiencing rapid population growth. As these cities grow, problems with inadequate housing, water and sanitation infrastructure are worsening. Lack of effective planning is also increasing the vulnerability of poor urban people, which is often made worse by impacts of climate change, such as flooding (storm surges and rainstorms), sea level rise, and ground water salinization. Many African countries do not have the capacity and financial resources to tackle these issues effectively. Disaster preparedness and risk management plans are vital components required for effective climate change adaptation.

IDRC's Climate Change and Water program has supported research on urban adaptation processes in various coastal areas around the developing world. This brief synthesizes the lessons

from this body of research, provides recommendations for future work, and references case studies in four countries: Angola, Egypt, Ghana and Senegal.

The problem

While many of Africa's coastal cities are the location for high levels of economic activity, these areas are also seeing rapid growth in informal settlements, characterized by seriously sub-standard housing and limited access to basic services such as power, clean water and sewage disposal. Every year, according to the State of the World's Cities Report (2010/11) 10 million people are added to the urban population of sub-Saharan Africa, and of these, 7 million (70%) move to informal settlements or slums. Already, around 62% of Africa's urban population live in such settlements, typically situated on marginal land and particularly vulnerable to climatic extremes. With urban populations in the continent expected to double over the next two decades, both the number and proportion of Africa's population living in informal urban settlements are therefore set to rise significantly.

In Angola, for example, decades of civil war have led to extensive migration from the country's interior to environmentally fragile locations within coastal cities. The rapid growth of informal urban settlements, which are now home to 77% of the population of Luanda (6.5 million people), has resulted in occupation of high risk, low value land in swampy coastal locations and on precariously steep slopes. With poor drainage infrastructure, flooding is a particular threat and such challenges are worsened by climatic changes. Intensity and variability of rainstorms and flooding have more than doubled in coastal regions of Angola over the last 60 years. In Pikine, a suburb of the Senegalese capital Dakar, recurrent seasonal flooding affects 44% of the population. Floods in 2009 caused damage to 30,000 houses and 130 schools in the Dakar region. In Yeumbeul North, a flood-affected suburb of northern Dakar, two-thirds of families have irregular income, which restricts their ability to pay for flood prevention and response strategies. While many flood victims look to the municipal authorities to provide them with assistance,

poor organization and limited resources generally lead to a disappointing response. Meanwhile in Egypt, 11 of the 18 coastal cities and towns in the Nile Delta (over 60%) are predicted to be at high risk of flooding due to sea level rise, with rising groundwater levels also predicted to threaten buildings and infrastructure. Despite this, new building projects continue to expand into areas that are prone to future flooding, without corresponding adjustments to building codes to take account of projected climatic impacts.

Cholera, malaria and other diseases are increasingly serious problems linked to a lack of safe water and adequate environmental sanitation in informal settlements. In Angola, 40% to 50% of the population in coastal areas live without adequate access to freshwater, while in Ghana, most urban development in coastal areas takes the form of unplanned settlements that typically suffer from poor waste and sanitation services and blocked drains filled with stagnant water. Heavy rains and rising temperatures resulting from climate change have exacerbated such conditions, creating numerous places for mosquitoes to breed and increasing malaria prevalence. Enforcement of local bylaws on environmental cleanliness tends to be weak and little public education is done to improve the situation. The same is true elsewhere in Africa, with city governments failing to keep pace with booming populations and slum dwellers lacking the political power to influence decisions on land tenure, infrastructure, and essential services. Demanding clean water and sanitation, for example, requires



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Research examined how changing seasonal patterns of temperature and rainfall are impacting on fish catch in Ghana.

a degree of cohesion that many poor communities simply do not have.

Beyond such challenges for infrastructure, sanitation and health, climatic changes are also impacting on employment opportunities and food supply. In coastal parts of Ghana's capital, Accra, fish catch has significantly decreased over the last 20 years, as average sea surface temperatures have steadily risen. For example, catch of round sardinella, a climate-sensitive species, decreased by 75% between 1992 and 2010. Increasing climate variability and changing rainfall patterns are making it more difficult for fishers to predict the start of the main fishing season. This is increasing both the risks and costs associated with fishing, which, combined with reduced fish catch, is leading many fishers into debt. Thus poverty among fisherfolks in coastal Accra is worsening, with few alternative sources of livelihood available. In Egypt, urban food supplies and jobs are also under threat. The Nile Delta is source of 40% of Egypt's agricultural production, 50% of its fish catch, and 60% of industrial production. However, salt water intrusion, due to sea level rise, is leading to loss of valuable farmland and infrastructure degradation.

Despite the gravity of the situation for communities in the Nile Delta, there have been few efforts to quantify the future impact of climate change on towns and cities in the area, and most of the research results to date are scattered among different institutions and projects. In other parts of Africa, a critical lack of meteorological data is hampering scientists' ability to assess the potential and likely impact of climatic hazards and recommend appropriate action. In Angola, for example, the majority of meteorological and hydrological stations and facilities were destroyed during the civil war, with only seven remaining operational (less than 2%) by the end of the conflict in 2002. Strengthening research on climate impacts and addressing this lack of historical data are just some of the activities being supported by IDRC, through its work in the four countries cited above.

Research focus

Through the Climate Change and Water program, IDRC has supported research focused on finding practical and affordable solutions to the challenges that coastal cities and communities face in the context of climate change; research that is locally relevant, strengthens scientific knowledge, engages multidisciplinary teams, and can inform public policy and planning processes. Research in four coastal regions in Africa has taken the following approaches:

Angola

This project addressed climatic risks and inadequate access to quality water faced by informal settlements in three Angolan coastal urban regions: Luanda, Cabinda, and Benguela/Lobito. Through participatory research and satellite imagery the project mapped areas and communities at risk of flooding and other climate-related hazards, making this data available in a useable format to those responsible for urban planning.

Egypt

This project supported the establishment of the Alexandria Research Centre for Adaptation to Climate Change (ARCA) at the University of Alexandria, in order to build research capacity in climate change adaptation through scholarships, training workshops and mentorship. The core team at ARCA is focussing on socio-economic aspects of adaptation in the Nile Delta, including assessment of the main physical impacts of climate change and sea level rise, their economic value and their consequences for communities.

Ghana

This project built capacity for research, teaching and learning in climate change science at the University of Ghana and helped to inform adaptation strategies that protect the health, livelihoods and food security of people living in the coastal township of Ga Mashie in Accra. Through focus group discussions and questionnaires, the project investigated

community perceptions of climate change and malaria, in order to guide activities aimed at reducing the influence of climate change on malaria prevalence. In the context of fisheries, research has examined how changing seasonal patterns of temperature and rainfall are impacting on fish catch. The findings are being used to support coping strategies, including construction of fish smoking facilities to reduce losses; the development of community groups and activities; and access to credit to reduce the vulnerability of those who depend on fish.

Senegal

This project carried out participatory research among 800 households in 20 districts of Dakar's Yeumbeul North suburb, investigating their exposure to flooding and their coping strategies. In collaboration with these communities, and in consultation with local authorities, the project identified and tested a number of practical strategies for reducing the impact of flooding on poor urban households in Dakar's suburbs.

Adaptation solutions

Engaging communities in adaptation efforts

Adapting to climate change and variability will, in many cases, be strongly rooted in community action. Communities may need to take coordinated action to clear drainage channels or to manage their freshwater resources.



In Ghana, community and institutional involvement, coupled with health education and improved malaria control programs, have reduced the incidence and spread of malaria.

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The formation of community clubs can help to galvanize local action, whether in environmental education, malaria control or waste management. Communities may also be involved in informing local and national authorities, for example about best-bet adaptation options. Such authorities, including planning departments, will also need information provided by researchers.

In parts of Luanda, participatory methods developed by the Angola project team have contributed to improved water governance, resulting in significant changes in the management of public water points, widening access to clean water and reducing water costs by 90% (from \$0.50 to \$0.05 per bucket). The Angolan government has adopted and replicated the community management model across the country, ensuring that ongoing maintenance is financed by locally elected committees, who collect fees for services and promote hygiene and basic sanitation.

In Ghana, community and institutional involvement in clearing the environment and de-silting choked drains, coupled with health education and improved malaria control programs, has been critical for reducing the breeding grounds for mosquitoes and incidence of malaria. One such initiative involved providing 800 households with bins for organic and inorganic waste separation. These households are contributing approximately US\$5 monthly for waste collection and disposal, which also serves as a source of income generation for youths, who have formed a company to offer services by carrying out the door-to-door waste collection. Similarly, in Angola, community-based actions have included the removal of garbage, regular maintenance of drainage channels and the greening of the banks of intermittent water-courses to prevent flash flooding.

Improving infrastructure resilience

Input from research can help to inform building codes and standards, to ensure new buildings are



DEVELOPMENT WORKSHOP

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protected against factors such as rising groundwater levels. In Egypt, ARCA has focused on enhancing the resilience of buildings and infrastructure in urban areas, which has been the subject of research papers and a quarterly series of working papers covering climate change vulnerability and adaptation. Identifying best practices amongst communities in the Yeumbeul North district of Dakar has been the focus of research in Senegal, in order to sensitize the government on what works best. Adaptations include raising the septic tank or toilet above the likely level of flooding, raising the house, and changing the roof slope, material and guttering.

Protecting resources and livelihoods

For Accra's fishing communities struggling with declining catches, a partial solution lies in the construction of fish smoking or cold storage facilities. These have enabled fish processors to reduce post-harvest wastage and preserve a greater proportion of the catch, partly compensating for the smaller numbers of fish being caught. Formation of cooperatives for fish processors, typically women, has also helped them to access credit and expand their businesses, helping to offset some of the hardship that results from declining catches. To protect urban food supplies in the Nile Delta, developing plans to address high groundwater levels and salt-water intrusion will be vital, given the impact these are



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Discussions with fishers have informed research in Egypt on the economic impacts of climate change in the Nile Delta.

having on soil health and crop yields. In some cases, large areas can be protected through a mixture of moderate protective engineering works and 'soft' adaptation options, such as enrichment of coastal sand dunes.

Preparing risk maps to inform decision making

Adaptation strategies depend on planners having access to detailed and accurate information, including environmental risk maps, which can inform them on how and where to allocate scarce resources. In Angola, such maps produced by the project team are increasingly being used by local government to support city planners in preventing the expansion of coastal cities into environmentally risky areas and also help identify where remedial actions are necessary in existing settlements. Mapped data also provides government and civil society with a good basis for dialogue on how settlements can be improved to meet climatic risks, without resorting to the wholesale removal and demolition of existing communities. Similarly in Egypt, IDRC research is helping to raise awareness of the need for coastal development plans to assess and incorporate flood risk in the Nile Delta. Zoning plans are now needed in order to restrict urban development in areas at high risk of flooding by sea level rise.

Future investments and research priorities

Urban planning processes need to be revised and strengthened, taking into account the varying impacts of climate variability and change. This may involve researching and testing participatory approaches for engaging communities in adaptation processes and exploring alternative strategies for dealing with climate change variability. In cases where resettlement of communities out of climate-vulnerable areas is necessary, participatory resettlement approaches should be developed.

Participatory planning should also be considered when upgrading settlement infrastructure, with communities potentially involved in implementation, using a combination of external resources and their own. In this context, credit needs to be available, via microfinance institutions, which specifically enables people to make their homes more climate resilient. On a larger scale, municipalities need to allocate funds for secondary drainage networks and other infrastructure improvements, including sanitary burial facilities and household waste disposal. Sharing of knowledge between countries on methods for upgrading urban infrastructure is recommended.

There is need to develop and increase the use of mapping tools to identify climate change hotspots and guide interventions. The development of mobile applications can also help to track the performance of adaptation options; this is already happening, for example in malaria mapping and monitoring.



AGU

New drainage systems reduced the impact of flooding on households in Yeumbeul North, Senegal.

There are a number of important research gaps that merit further exploration, including:

- the economics of different adaptation options, including upgrades to urban infrastructure;
- current levels of urban resilience and how these can be improved;
- the extent to which existing protective structures will withstand future climate threats;
- barriers to livelihood diversification in areas that are dependent on industries affected by climate change (such as fisheries);
- community and scientific knowledge related to monitoring, forecasting and communicating climate-related information (e.g. the start and productivity of fishing seasons); and
- limits on household adaptation imposed by current availability of microfinance.

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More information

To learn more about climate change research funded through IDRC, please visit: www.idrc.ca/ccw

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Produced by WRENmedia in May 2015