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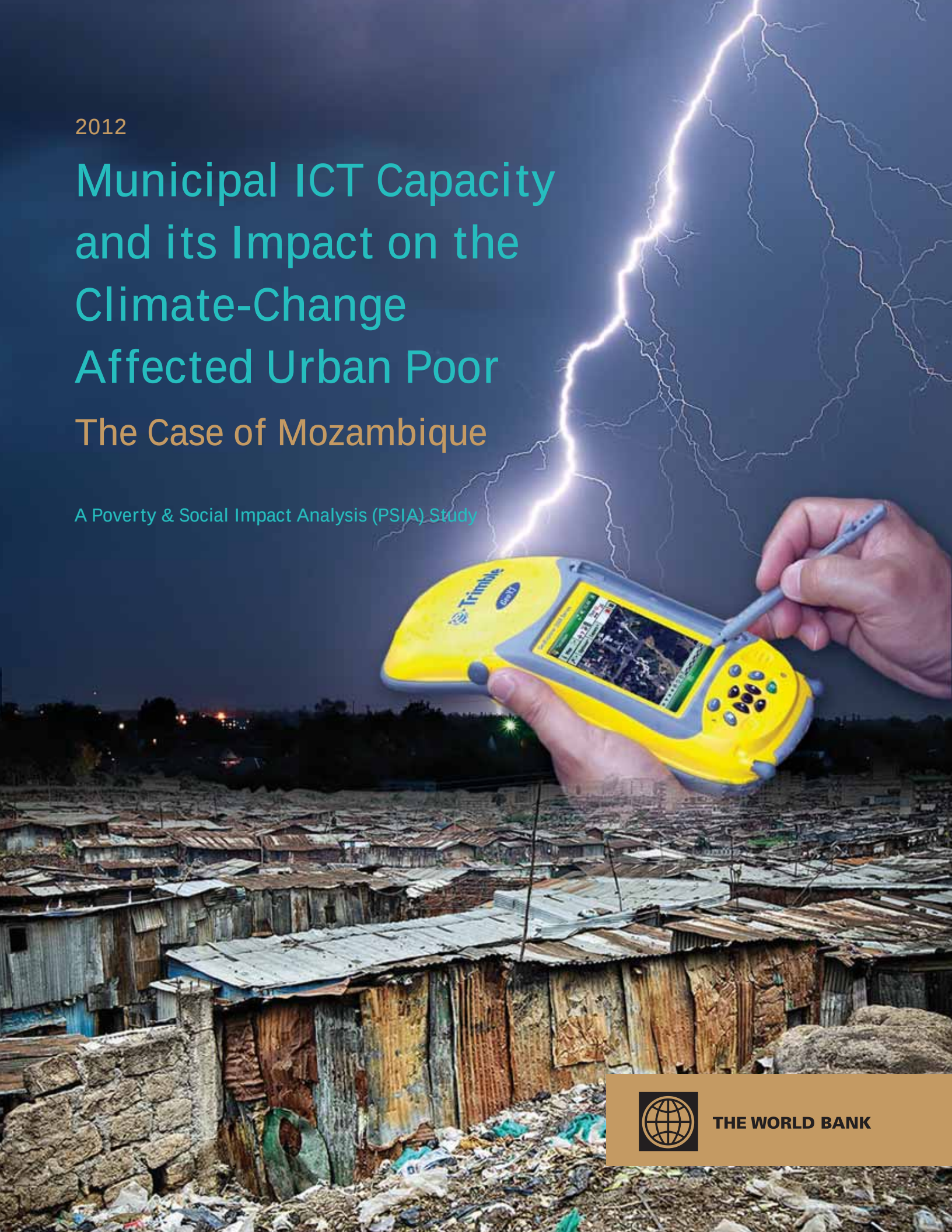
The Case of Mozambique

A Poverty & Social Impact Analysis (PSIA) Study



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Africa Urban & Water Unit (AFTUW)
The World Bank Group

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Abbreviations

ARA	Administração Regional de Águas
CENOI	Centro Nacional Operativo de Emergência
DUAT	Direito de Uso e Aproveitamento da Terra
DSG	Demand Side Governance
DNTF	Directorate of Land & Forests
DNA	Direcção Nacional de Àguas
EWS	Early Warning Systems
E-SISTAFE	Financial Administrative and Management System
FEWSNET	Famine Early Warning Systems Network
GCM	General Circulation Models
GeoSFM	Geospatial Stream Flow Model
GHG	Global Greenhouse Gas
GIS	Geographic Information System
GIZ	Gesellschaft für Internationale Zusammenarbeit
GovNet	Government Electronic Network
GoM	Government of Mozambique
GPS	Global Positioning System
ICT	Information & Communication Technology
ICT4DSG	ICT for Demand Side Governance
IT	Information Technologies
INAM	Instituto Naciona de Meteorologia
INGC	Instituto Nacional de Gestão de Calamidades
IPCC	Intergovernmental Panel on Climate Change
ISPs	Internet service providers
LIMS	Computerized Land Management Information System
MCA	Millennium Challenge Account
MDG	Millennium Development Goals
PARPA	Action Plan for the Reduction of Absolute Poverty
PSIA	Poverty & Social Impact Analysis
SCADA	Supervisory Control and Data Acquisition
SIGEM	Sistema de Informação de Gestão Municipal
SIP	State Personnel Information System
SMS	Short Messaging System
SSG	Supply Side Governance
TDM	Telecomunicações de Moçambique
UNPAN	United Nations Public Administration Network

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Introduction

Driven by rapid rural migrant influx, Mozambique's unprecedented urbanization is testament to the symbiotic relationship that exists between cities and the poor –which is, the urban poor invigorate cities into engines of growth through abundant rendition of their manpower and vitality, and cities in return render a refuge for shelter, growth, and other socio-economic opportunities. But in Mozambique such symbiosis is under duress due to vulnerability of the country's key cities to climatic hazards. Commonplace challenges faced by the urban poor such as safe housing, sanitation, and drinking water access are being exacerbated by the impacts of climate change, which include more frequent and intense flooding, disease, and livelihood loss. In this light, local governments in Mozambique are under increasing pressure to improve their cities' livability conditions and are thus seeking solutions to make their city management more responsive to the needs of citizens.

Significantly, Information & Communication Technology (ICT) has evolved into an effective means for helping institutions and citizens mitigate, and if possible, prevent severe impacts from shocks and emergencies that affect physical and economic well-being. To refine ICT's role in the public sector, Mozambique has since long embraced policies aimed at leveraging ICT as a poverty alleviation tool through its rendition of better service delivery capabilities and transparency in public-sector institutions. Under the lens of such policy framework, in an effort to enhance safety nets for cities and urban denizens, Mozambique is upgrading its local governments' capabilities using various ICT tools such as Geographic Information Systems, E-Governance, Wireless Communications, and Early Warning Systems. But while the country has made progress towards applying ICT in this direction, the impact on the poor has been unknown.

Against such backdrop, this Poverty & Social Impact Analysis (PSIA) study performs a spatial analysis of Mozambique's ICT policy framework to assess the impact of local government-level ICT on the poor. Given the socio-economic importance of Mozambique's coastal cities and their susceptibility to regular climate hazards, the country's ICT policy framework is evaluated by analyzing the efficacy of the aforementioned ICT tools along a dimension that disproportionately affects the poor more, namely vulnerability to flooding -- a reality worsening each year due to the effects of climate change. The spatial analysis approach adopted by this study involves comparing key coastal cities with each other to discern differences in respective ICT capabilities and effectiveness that derive from policy as well as scale.

The objective of conducting this case study on Mozambique is to uncover the pattern of municipal ICT impact that may exist in other low-capacity countries with analogous political economy structures in relation to leveraging ICT in public sectors. The study concludes by suggesting measures to link the

continent's ICT boom in citizen-based mobile telephony and internet usage with the rapid rise of public-sector ICT phenomena as a promising means to plug service delivery gaps. In view of these highlights, this report stands to serve as a valuable resource guide to a wide audience of practitioners, including policy wonks, urban specialists, ICT and climate change enthusiasts, as well as social accountability activists.

This report consists of five sections. Section 1 details the impact of climate change on Mozambique's urban poor while also providing an overview of the country's disaster response system. In view of the decentralization of much of Mozambique's ICT and other resources among municipal governments, Section 2 sheds light on leveraging local government -level ICT towards enhancing urban climate resilience and disseminates awareness on the 'ICT-PARPA' framework. Section 3 describes the four ICT tools most widely being used towards climate-change adaptation, while Section 4 seeks to quantify the level to which municipal ICT growth is having an impact on urban climate resilience generally, and seeks to answer the question of whether it is having an equitable impact on the poor. Upon measuring the extent to which urban climate resilience is being enhanced and analyzing differential impact on the urban poor, Section 5 recommends targeted reform in ICT-PARPA framework such that ICT impact is equitable for all communities, and postulates how such reform can be realized.

Any comments, questions, feedback, and suggestions on the report are welcome and may be sent to grelhan@worldbank.org. On Facebook, post your suggestions to the World Bank Africa page. On Twitter, reply to @WorldBankAfrica .

Section 1
Urbanization in Mozambique, Climate Change, and its Impact on the Urban Poor

1.1. The Urbanization Phenomenon

With an annual per capita income of only USD 330 in 2007 and with 54 percent of its population still below the poverty line, Mozambique is a poor country facing considerable social and economic challenges. Yet, Mozambique has been a strong economic and social performer in Africa and is regarded by donors as a growth success story. Since the devastating civil war ended in 1992, the country has enjoyed a remarkable recovery, achieving an average annual rate of economic growth of 8 percent between 1996 and 2008. As a result, the country's poverty headcount index fell by 15 percentage points between 1997 and 2003, bringing almost 3 million people above the poverty line and out of extreme poverty (out of a total population of 20 million at 2003 levels). From the human development perspective, this has meant a significant improvement in various indices and progress toward achieving the Millennium Development Goals (MDGs). [a]

This stable political climate followed by increasing privatization and deregulation of markets has sparked surging capital growth in non-agricultural sectors, as a result of which cities in the country are particularly in expansion mode. Urbanization in Mozambique is increasing at roughly 4.5 percent annually, with cities now housing almost 20 percent of the country's population and contributing almost 75 percent to its GDP. Today, Mozambique joins Botswana, Tanzania, and Swaziland, as a country whose urban population is growing more than twice as fast as the natural rate of increase of their countries' overall populations.[1] Approximately 3.5 million people live in ten of Mozambique's coastal cities, and 70 percent of those live in the cities of the Maputo metropolitan area, Beira and Nacala.[2] Box 1 describes in further detail the significance of Mozambique's coastal cities to the country's development.

The benefits of urban agglomeration, underscored by rising productivity, fluid labor markets, and greater market access, have led to the recognition that urbanization can indeed be a vital force for growth and poverty reduction.[3] But while rapid urbanization is transforming urban centers into drivers of economic growth, it can also increase poverty if not handled well. In particular, urban mismanagement and haphazard planning severely affect the wellbeing of residents by exacerbating vulnerability of cities to natural disasters on account of cities' often hazard-prone locations along coastal areas or rivers. As discussed in the following paragraphs, risks are especially high for the urban poor in low- and middle-

[a] Some key indicators: a 35% decrease in infant and under-five mortality, a 65% increase in net primary school enrollment, and relatively low inequality (UN MDG report, 2011).

income countries, almost a billion of whom live in disaster-prone settlements in and adjacent to cities.[4] Today, these risks are being further aggravated for the poor due to the effects of climate change.

Box 1. A Glimpse at Mozambique's Largest Cities

The country's largest cities are fundamental to its development strategy. They host and support the country's major economic corridors, where most of its GDP is produced and where considerable new public and private investments are underway. Most manufacturing and services activities take place in its key coastal cities, all of them significant regional trade hubs due to their harbors. The following are useful highlights of the five major cities considered in this study. All population figures are based on 2010 estimates.

- Maputo is not only the capital but the largest city in Mozambique, with an estimated population of 1.5 million citizens, more than twice the size of the next largest city. The capital stretches across Maputo Bay which sits at the confluence of the Umbeuluzi River. The river flows north-eastward from its origins in Swaziland and supplies the majority of the water for urban use. Among the country's major exports that leave Maputo's harbor are cotton, sugar, chromite, sisal, copra, aluminum and hardwood. The city itself manufactures cement, pottery, furniture, shoes, and rubber.

- *Matola*, with a population of 758,000, lies adjacent to Maputo along the northern shore of Maputo Bay. Matola has its own port and hosts the biggest industrial area in Mozambique. It is an important port for mineral and other exports from Swaziland and South Africa. It is also home to a major aluminum smelter, petroleum refineries and diverse manufacturing industries that produce soap, cement, and agricultural materials, among other basic commodities.

- *Beira*, in the country's central region, is home to 620,000 denizens. The Port of Beira is regionally significant, acting as a gateway for both the central interior portion of the country and the land-locked nations of Zimbabwe, Zambia, and Malawi. The corridor linking Zimbabwe to Beira and its port is a growth engine in its own right, providing a backbone of railways, roads, and a gas pipeline.

- *Pemba* is a small city with a population of 156,000 and a regional tourist center due to its beaches, coral reef, and close access to Quirimbas National Park, a major natural area. It currently has an active hospitality sector and is being reviewed as a potential site for a deep water port, potentially serving Mozambique's land-locked neighbors Zimbabwe, Zambia, and Malawi. Recent offshore natural gas finds in Cabo Delgado province (of which Pemba is the capital) are likely to further invigorate the city's economy.

- *Xai Xai*, with a population of 128,000, is a port city situated on the outflow of the Limpopo River in a low-lying rice-growing plain, just a few miles above the river's outlet to the sea. In addition to the cultivation of agricultural produce, especially rice and cashew nuts, the city has become a center of services including banking, tourism, healthcare, and public administration.

In light of the above facts, it becomes clear that these coastal urban regions constitute Mozambique's engines of economic growth and therefore need to be protected from the impacts of natural disasters and climate change for the country to maintain its growth trajectory. But strong evidence shows that Mozambique's development is severely handicapped by natural disasters – a fact amply

illustrated by its recurring major floods – with susceptibility to such hazards not likely to abate given the projections of climate scientists, as is discussed below.

1.2. Understanding the Nexus of Cities, Climate Change, and the Urban Poor

Mozambique is already one of the world's most vulnerable to the impacts of climate variability, ranking third in the continent among countries most exposed to risks from multiple weather-related hazards.[5] A major disaster has struck Mozambique every five years, translating to an average loss of GDP growth of 1 percent per year. During the past 50 years, the country has experienced more than 68 natural disasters, which have caused the death of more than 100,000 people and afflicted either physical or economic harm to as many as 28 million.[6] The General Circulation Models (GCM) approved by the United Nations' Intergovernmental Panel on Climate Change (IPCC) suggest a dramatic increase in inter-annual climate variability for Mozambique -- implying that extreme weather events such as intense floods and droughts may become more frequent.[7] This long-term outlook places further pressure on cash-strapped local governments, as urban agencies must increasingly adapt to migrations of people displaced by climate crises taking place elsewhere.

Worldwide, energy use for urban electricity, transport, and industry contributes up to 77 percent of global greenhouse gas (GHG) emissions, rendering cities as a major contributor to GHG emissions[8] with rapidly rising carbon footprints. But while cities are significant contributors to climate change, they are also disproportionately vulnerable to suffering its catastrophic consequences on account of their proximity to water bodies, which combined with poor planning and infrastructure in low-income countries, makes them highly susceptible to flooding and drought.[9] Regrettably, cities worst affected by climate-change induced hazards and least capable of coping with natural disasters are often the unfortunate victims of major GHG emissions from other parts of the continent or the globe. Climate-change induced floods have already wrought havoc across Mozambique's major urban centers, all located along its Indian Ocean coastline.[b]

In their vulnerability to climate-related disasters, the urban poor are on the front line. This is especially true of flood events, since, as in the case of Maputo, Mozambique (shown in Figure 1 below), it is the poorest who must find or build homes in the least desirable, highest-risk locales, such as those most

[b] To illustrate: Heavy floods devastated capital Maputo in 2000 killing over 700 citizens. In Beira, increasing flooding and coastal erosion already impact most of the area, disrupting the city's functioning and threatening its strategic regional role and development opportunities. In Nacala, coastal erosion is increasing at an alarming rate, shrinking the city's useful territory and affecting both public infrastructure investments and the ongoing rapid influx of private investments in the special industrial zone, which the city hosts.

prone to flooding along rivers or seacoasts. Further, basic physical infrastructure being weak in informal settlements, during floods these localities suffer the compounded disadvantage of poor or even absent storm drainage and sanitation facilities and difficult access to roads and hospitals. As depicted in Figure 2, drainage and sanitation systems are often overwhelmingly concentrated in cities' formal, well-off areas.

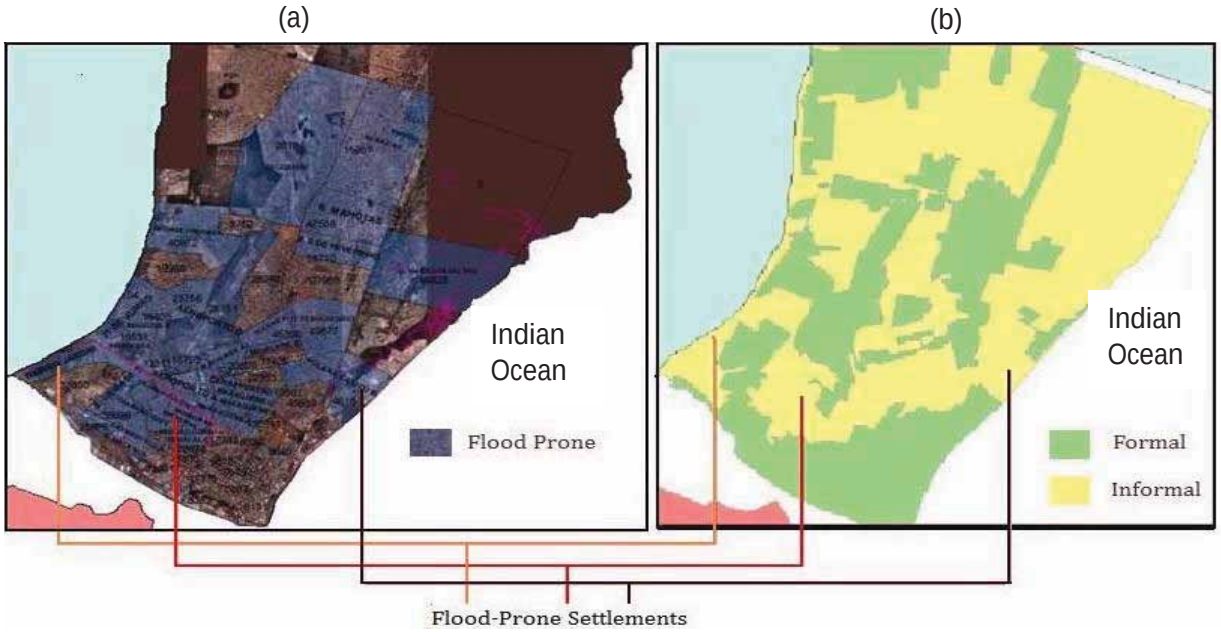


Figure 1. Geographic Information System (GIS) Maps of Maputo: Flood-Prone Elevation
Map (a) depicts regions of the city usually prone to flooding. Map (b) depicts location of formal and informal settlements. A cross-comparison is made to depict flood-prone zones.
Image Courtesy: GIS departments of INGC (Maputo), Maputo Municipal Corporation

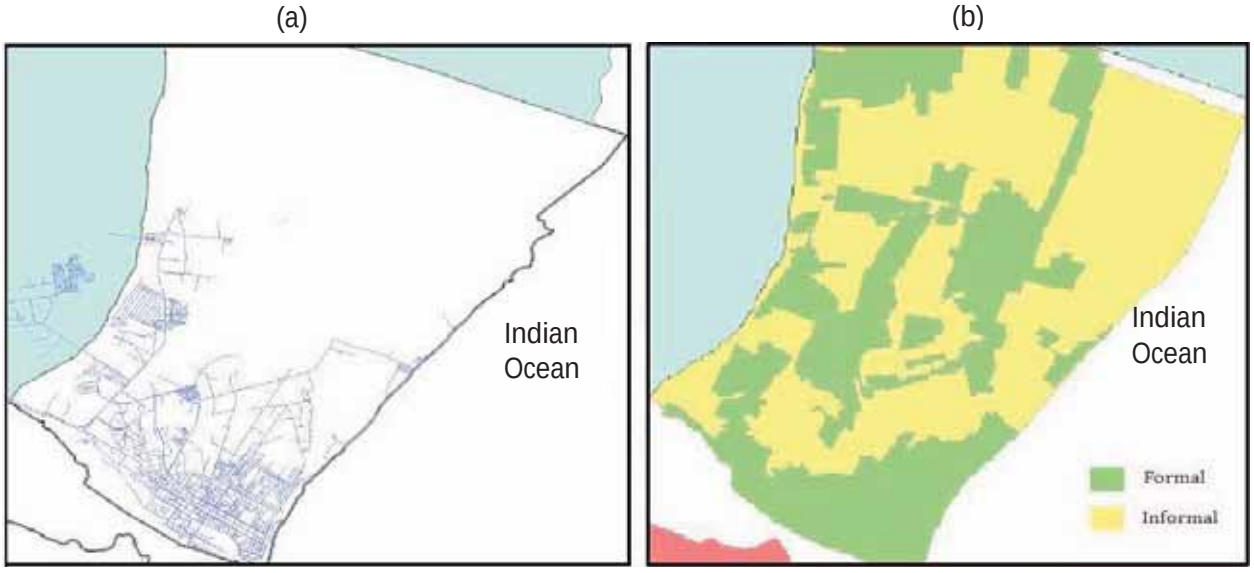


Figure 2. GIS Maps of Maputo: Location of Drainage and Sanitation Networks
Map (a) depicts regions of the city served by drainage & sanitation infrastructure. Map (b) depicts location of Formal and Informal settlements
Image Courtesy: GIS Department of Maputo Municipal Corporation

1.3. Growth of the Vulnerable Urban Poor

In view of the economic activity generated in Mozambique's cities, they are not only major markets for goods but also a magnet for a growing number of poor rural migrants. This migration is driven in large part by the country's low and continually declining agricultural productivity. To illustrate, while 80 percent of the population engages in agriculture, this sector accounts for only 25 percent of national GDP. As shown in Table 1, the overwhelming majority of citizens in Mozambique's cities today live in informal settlements. The prevalence and size of these settlements also owes in part to the country's long and devastating civil war, when many people fled rural areas to seek refuge in towns. According to Mozambique's National Directorate of Land & Forests (DNTF), given the humanitarian crisis at the time, local governments permitted the refugees to occupy land in restrictive zones, places that were either disaster-prone or else undesirable due to being too close to infrastructure such as abutting railway lines. Over time, as these refugees stayed on, the settlements became de facto communities despite their vulnerable setting, poor infrastructure, and regular flooding.

Table 1. Estimated Populations in Informal Settlements in Eight Coastal Cities, Mozambique, 2010

	Maputo	Matola	Beira	Pemba	Xai-Xai	Chibuto	Manica	Macia
Population	1,430,000	758,000	620,000	156,000	128,000	61,000	56,000	40,000
Percent of population living in informal settlements	70%	70%	75%	80%	85%	90%	90%	90%
Number of people living in informal settlements	1,001,000	530,600	465,000	124,800	108,800	54,900	50,400	36,000
Susceptibility to flooding	High	High	High	High	Moderate	Low	Low	Low

The inadequacy of basic services, such as drainage and sanitation, that these vulnerable poor communities must make do with only amplifies the effects of climate-related hazards, for example turning a heavy rain into a disastrous flood that, in turn, damages infrastructure and leads to water scarcity, water contamination, and epidemic disease. More than 700 people, most of them poor, lost their lives across cities in Mozambique during the floods in 2000 on account of poor infrastructure.

Analyses of both climate-change and urban development models suggest that even if coastal flooding in Mozambique due to inland rainfall were to remain stable over the coming decades (i.e., not taking into account any effect of climate change), the expansion and densification of informal settlements around coastal cities will itself severely escalate the economic and human costs of regular (that is, non-climate-change-induced) flooding, which will undoubtedly continue to occur.

1.4. Flood Response Mechanism in Mozambique

While heavy rainfall is a significant cause of flooding in Mozambique's coastal cities, other factors include poor drainage infrastructure, upstream dam releases on the many rivers that flow through or near these cities, wind-driven tidal surges, and seawater intrusion. Globally, the response to imminent or ongoing floods is normally taken up, first and foremost, by local authorities. Cities mobilize their municipal emergency systems, from police to hospitals to evacuation teams. In Mozambique, flood response involves an inverted pyramid of increasingly well-resourced public agencies. If a flood is too large for a municipality to handle, responsibility moves upward to the regional authority, and if that authority's resources are inadequate, it rests finally with the national-level authority. Effective response requires rapid communication among agencies and transparent sharing of accurate data. Box 2 provides a glimpse of the various agencies involved in organizing relief in the event of disaster.

Box 2. An Overview of Flood Response Agencies in Mozambique

- **Disaster Response: National Disaster Management Institute (*Instituto Nacional de Gestão de Calamidades*, or INGC).** To tackle natural calamities that endanger communities, it becomes the responsibility of the Government of Mozambique (GoM) to provide effective response. INGC is the face of GoM in this direction. INGC's role in cities is to work towards disaster prevention, mitigation, and reconstruction measures in coordination with the local government. To predict and tackle water disasters, from droughts to floods, this agency collaborates with the hydrological agencies (DNA and the five ARAs) as well as meteorological agency (INAM) for data gathering purposes. INGC maintains countrywide field representation at every district and provincial level, as well as at the national level.

- **Forecasting: National Institute of Meteorology (*Instituto Naciona de Meteorologia*, or INAM).** The accuracy and timeliness of weather forecasting, as well as its reach to the public through broadcasting and other news sources, is another line of defense. In the event of upcoming weather-related hazards, INAM issues warnings from its weather stations regarding conditions, which are then conveyed to citizens and relief agencies through a variety of channels, including radio, e-mail, webpage and fax. INAM's weather stations do not all have the same resources at their disposal. In remote outposts, where telecom infrastructure is particularly weak, voice-based high-frequency radios are used to convey weather conditions from stations. Stations in the provincial capitals, though, are well connected to the Internet, and dedicated connectivity exists for the stations in Beira, Nampula and Xai-Xai.

- **Planning and Relief: Local Government.** Although severe flooding is almost always triggered by natural events, the flooding of towns and cities is often a preventable or at least manageable problem. In this regard, municipalities in Mozambique are the drivers for addressing the direct risks that climate change poses to their populations. Through urban planning and development initiatives, this level of government aims to provide basic disaster relief services by building and managing relevant infrastructure (such as drainage and sanitation systems) and service delivery for all urban residents. In addition, public relief agencies such as fire and law enforcement are also associated with the local government.

- **Water Control and Management: The Regional Water Authorities (*Administração Regional de Águas*, or ARA).** There are five ARAs that are organized according to groups of river basins and regions (ARA-Sul, ARA-Centro, ARA-Zambeze, ARA-Centro Norte and ARA-Norte). Because Mozambique's coast is the endpoint of 13 major rivers, river management plays a vital role in flood control. The ARAs are charged with managing and monitoring surface and sub-surface water resources. Monitoring is done both manually and automatically (by taking scale readings of water-levels or through telemetric systems). Collectively, there are approximately three functioning telemetric systems applied nationally: one on the Umbeluzi catchment (using high-frequency radio), one in the Limpopo catchment (using GSM) and one in the Zambezi River.

- **Hydro-Meteorological Management: The National Directorate of Water (Direcção Nacional de Àguas, or DNA).** The DNA combines the responsibility for policy making, implementation, planning and management of water resources, as well as provision of water supply and sanitation services. DNA governs the information exchange with agencies or dam operators in upstream countries, which is in parallel operationalised through participation by the ARAs in regional forums.

- **Response Coordination: National Emergency Operations Center (*Centro Nacional Operativo de Emergência*, or CENOI).** If an upcoming natural disaster is predicted to affect two or more provinces then it is the regional CENOI committee that undertakes relief response, with each committee responsible for its own respective geographic region. A CENOI committee typically includes representatives from the Municipalities, INGC, ARA, INAM, as well as members from the community TV or radio media. These committee members strategize and coordinate appropriate disaster relief responses. The CENOI committee for the south is located at Vilanculos in Inhambane province (responsible for Maputo, Gaza, and Inhambane provinces); for the Central region, it is at Caia in Sofala province (covering Tete, Manica, Sofala, and Zambezi provinces); for the North region, the CENOI outpost is at Nacala (handling Nampula, Cabo Delgado, and Niassa provinces).

Section 2
Municipal ICT Phenomena and Policy Goals

2.1. ICT in Africa and the Situation in Mozambique

Growth in access to and use of ICT across the developing world has been exponential. This includes the entire range of telecommunications networks, information technologies (IT), and electronic services (e-services). The growth of ICT has been particularly strong in Africa. One study found that between 2002 and 2008, while the French telecom market grew at an annual rate of 7.5 percent and the Brazilian market at a rate of 28 percent, the African market experienced 49.3 percent annual growth. During the same period, the African continent's mobile phone use grew at an annual rate of 65 percent, which was twice the global average.[c] Internet penetration, while still low in Africa, registered the world's highest growth rate at 9 percent in 2009, with public-sector institutions fast embracing the use of Internet in their daily operations.

In Mozambique, the telecommunications and ICT sectors are in a strong expansion, mirroring the overall sectoral progress taking place across the continent. Mobile service penetration in Mozambique has increased dramatically over the past 10 years, with the number of subscribers growing from 0.1 percent of the population to 20 percent, reaching a total of 4.2 million subscribers in 2008. This high level of growth is forecast to continue the next few years, and it may even accelerate with the recent introduction, in 2011, of a third mobile operator.[d] Mobile coverage is particularly strong in urban areas, including provincial capitals and cities, and along corridors of development. While Internet access remains limited with only 2.8 percent user penetration, web usage is in expansion mode. New international connectivity exists via undersea cables, and more than 20 Internet service providers (ISPs) are providing Internet access today.[10] Recognizing that ICT is a viable tool for strengthening governance mechanisms and rendering urban management more efficient, a range of actors, both foreign and domestic, are investing millions of dollars into upgrading local governments' ICT capacities in Mozambique.

2.2. The ICT Phenomenon in Urban Governance

With the Africa Region adding an estimated 35 million people to its cities each year, its local governments are facing increasing demands to improve their cities' livability and competitiveness. To

[c] These findings are from Ernst & Young's research, conducted in the third quarter of 2008, as cited by the online periodical *afrol News*, May 5, 2011 (available at http://afrol.com/articles/12176).
[d] Vodafone, mCel, and (now) Viettel offer mobile services in Mozambique

cope with this rising urbanization, many African countries have transferred power, resources, and responsibilities to their subnational urban governments through the process of decentralization. While such decentralization has transferred greater fiscal autonomy and responsibility to local governments, giving them a larger say in formulating ordinances, collecting revenue, and allocating budget, these governments now find themselves often lacking sufficient resources and capacities to fulfill their mandates. To cope with both their expanded responsibilities in the wake of decentralization and the increasing importance of their cities as engines of growth, Africa's local governments are searching for more effective urban governance solutions, with sustainable development as a key goal. To this end, municipalities across the region are seeking greater assistance in strengthening their governance mechanisms, planning their service strategies, and making their city management more responsive in ensuring the delivery of vital services to urban residents, in particular the poor.

Worldwide, the growing prevalence of Information & Communication Technology (ICT) is being leveraged by governments to extend the reach, quality, and efficiency of public services delivery. Successful e-initiatives across regions have demonstrated that ICT tools involving the use of PCs (including related software applications), the internet, and mobile phones can trigger a range of positive outcomes when integrated within local governments. These outcomes include streamlined municipal communication (e.g., via email or SMS correspondence), more secure data storage, and better accounting (e.g., by using Excel spreadsheets), leading to enhanced institutional management and transparency. Building a strong foundation for municipal ICT, as demonstrated by well-functioning PCs and laptops, good Internet facilities, and skilled technicians and IT specialists, is also fundamental for enabling more advanced municipal ICT capabilities--such as IFMIS (for strengthened financial management), Geographic Information Systems or GIS (for better urban design and disaster response planning), and social accountability initiatives, among others. Interestingly, the ICT sector itself can have a significant economic impact on urban communities. It is estimated that every 10 percent increase in the market penetration of mobile phones boosts GDP growth by 6 percentage points.[11] Another estimate suggests that for every 10 percent increase in broadband penetration in a particular area, employment increases 2 to 3 percentage points per year.[12]

2.3. The Role of ICT in Urban Climate Resilience

ICT has evolved into a powerful set of tools that enable governments to be more transparent, more responsive, and better equipped to handle challenging needs. Its adoption is being applied both to the normal business of running public services, such as planning land use, as well as for the rapid-response work vital to handling natural disasters. It is thereby regarded as a great toolset for helping cities

and people mitigate and, under the right conditions, even prevent severe impacts on life, safety, and well-being from environmental shocks and emergencies. In this light, it is no accident that ICT is being adopted by both central and municipal governments across Africa. Cities have found that properly installed ICT systems can ultimately save lives as well as minimize the costs of recovery. Table 2 shows some of the ways ICT can serve as a powerful tool to protect the environment, enhance response to climate-change- induced disasters, and assist with other environmental issues.

Table 2. ICT for Urban Environment

Objective	Salient ICT Applications
Better Urban Planning	• Digitized land records and topographical data can control further mushrooming of slums in flood-prone regions by enabling the rapid classification of city zones. • Regular surveillance conducted with ICT tools makes it possible to conveniently cross-check and validate new encroachments and unauthorized/illegal constructions, which can block the flow of water systems. • ICT tools like GIS make possible well informed planning of drainage systems for the rapid discharge of flood waters.
Reduced Pollution	• Large-scale telecommuting enabled by broadband infrastructure can help reduce vehicular emissions. • Reductions in paper consumption enabled by ICT, such as through paperless government and paperless office operations, can help prevent deforestation.
More Efficient Natural Resource Utilization	ICT tools such as SCADA/Telemetry, SmartGrid, and Smart Logistics systems can help reduce the consumption of energy, water, and other essential natural resources through real-time monitoring and by improving the efficiency of household and industrial resource uses. Further, by providing and enabling more useful metrics and information, ICT systems can play an important role in the systematic generation and sharing of data for natural resource management.
Better Environmental Disaster Management	• Through constant real-time monitoring of water-level rises and flow in rivers and drainage systems (via automated sensors, Telemetry mechanisms) and of natural weather phenomena (via satellite imagery), ICT can be deployed extensively to predict and respond to environmental disasters. • ICT tools can help bring to a municipality's attention the location of leaking pipes, garbage accumulation, and other problems in slum areas. • ICT tools such as online mapping and mobile phone-based applications can strengthen the coordination mechanisms of relief agencies during disasters.
Enhanced Environmental Awareness and Capacity Building	Cities and communities can harness Internet or mobile-phone based "social accountability" platforms to communicate environmental knowledge, facilitate citizen monitoring of environmental issues, and encourage environmental activism.

2.4. The Digital Divide Risk

Although ICT tools are increasingly being adopted worldwide for a range of purposes, global experience suggests that ICT policies sometimes leave out the poorest populations at both the macro and micro levels. Uninformed or misguided ICT policies can actually lead to "digital divides" such that the poor, or services oriented towards the poor, may benefit from little if any ICT capacity.

Among developing countries, a digital divide visibly sets apart the technologically more advanced countries from the less advanced ones. Whereas a few developing countries still have Internet penetration rates of less than 1 percent, in Brazil almost 41 percent of the population has access to the Internet.[13] Within a given region, too, some countries have a stronger information and communication infrastructure than others. In Sub-Saharan Africa, the number of Internet hosts (i.e., computers connected to the internet having an IP address) per 1,000 population ranges from only 0.01 in Burundi to 25 in South Africa.[14] Regional disparities in ICT can exist within countries as well. For instance, the southern Indian cities of Bangalore and Hyderabad are more advanced in their overall broadband infrastructure and e-services adoption than Kolkata in the east. Most strikingly, and in the context of this report most importantly, within both developed and developing countries technological change and its costs often mean that groups already disadvantaged or excluded—low-income families, rural populations, women, minorities, and the elderly—fall farther behind. In India, for example, only 1.2 percent of the rural population has Internet access, compared with 12 percent of the population in India's urban centers.[15]

It is clear, therefore, that investments in local government-level ICT capabilities and ICT-based service delivery mechanisms (such as e-registration) may have little or no impact on the poor and disadvantaged so long as these populations lack the means to access them. Moreover, failing to take into account the poor and their conditions in the design and usage of these municipal level ICT systems (for instance, in depicting poor communities on GIS maps) may also result in *widening* rather than narrowing the well-being gap between the poorest and the wealthiest. So, as ICT is steadily being ramped up within agencies and communities globally and as access is becoming wider and more affordable, this paper represents an example of gauging whether and which groups of people are being excluded from the advantages and to ensure that steps are taken to bridge the gaps.

2.5. Mozambique's ICT Policy Goals

Public sector reform, wherever it occurs, aims to improve the governance capabilities of government institutions with a view to improving agencies' efficiency, transparency, and accountability. The Government of Mozambique is well aware of ICT's potential in this regard and, indeed, has been

investing heavily in upgrading its public-sector ICT capabilities. It is also committed to furthering ICT-sector reform, especially in the telecom arena. Advancements in ICT have been made at the local government level to enhance the delivery of urban services, although as this report will discuss, much ground remains to be covered. The central government is assisting the autonomously governed municipalities in developing their ICT capabilities under the umbrella of a National ICT Policy, adopted in 2000, which positioned ICT as a vehicle for national development. Within this policy, improved governance and service delivery via ICT adoption within public-sector institutions are assigned as essential priority areas. It is hoped that two other goals of national policy--reduction in absolute poverty and improved transparency and effectiveness in governance--will be reached in tandem with this leveraging of ICT towards improved public sector capabilities.

The will to make progress on ICT projects in general, and on e-government projects in particular, is evident today among high-profile officials and ministries. Reducing dire poverty, the goal of the country's Action Plan for the Reduction of Absolute Poverty (PARPA), is the government's primary objective. To sharpen ICT's role as a tool for reducing poverty, in 2002 an ICT Implementation Strategy was approved, linking the National ICT Policy with PARPA objectives (Figure 3).

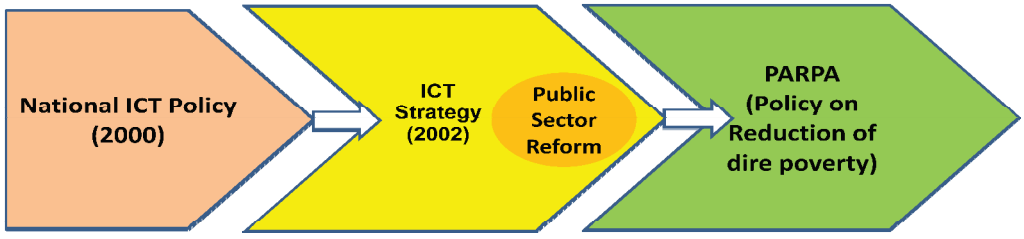


Figure 3. E-Government as a Driving Force for Government Programs in Mozambique

Recognizing that ICT at the public-sector level (or *e-government*) could be a 'pillar' for alleviating poverty, for example by facilitating improved service delivery, transparency, and efficient response mechanisms, the ushering in of public-sector reform via ICT was made a fundamental objective of the 2002 ICT Implementation Strategy. Mozambique's leadership adopted that Strategy to provide an operating framework for the phased implementation of a series of linked projects. In 2009, it also approved an 'E-Government Interoperability Framework', which aims to support the implementation of technological platforms to facilitate greater collaboration among government entities by achieving semantic interoperability between e-government systems.

2.6. Study Objectives

Although Mozambique's population is still largely rural and agricultural, the rapid growth of informal settlements in cities as well as the special vulnerability and density of urban populations magnify the need for attention in making cities more livable through better planning, effective flood prevention responses, and targeted poverty reduction strategies. Under the lens of the ICT-PARPA framework outlined in the preceding paragraphs, a number of ICT projects for improving governance have been launched both at the level of central ministries and agencies and at the local government level, often funded by external donors and institutions. A range of such ICT initiatives now allow local governments and national agencies to apply advanced solutions for better urban planning and effective response mechanisms, very critical in the event of disaster.

In this light, the objective of this Poverty & Social Impact Analysis (PSIA) study is to assess the performance of the ICT-poverty reduction framework since its inception in 2002. Given the importance of Mozambique's coastal cities and their susceptibility to regular climate hazards, one way to evaluate this framework is to analyze the effectiveness of ICT advancements made at the local government level in key cities along a dimension that disproportionately affects the poor. Flooding is such a dimension -- a reality that is getting worse each year due, very possibly, to the effects of climate change. Recognizing the social reality of digital divides (as discussed in Section 1), this study sets out to answer three key questions:

- Is municipal ICT growth having an equitable impact on the urban poor?
- To what extent is the use of local government -level ICT proving effective in enhancing urban climate resilience in the country?
- What policy reform and measures are needed to bridge any digital divides?

Section 3
ICT for Climate Resilience – Four Tools

There are four types of ICT tools, namely, *Geographic Information Systems (GIS), E-Governance, Early Warning Systems (including telemetry),* and *Wireless communications* commonly adopted by local governments worldwide for helping their cities adapt to the effects of climate change. Of these, GIS and E-Governance are commonly leveraged for disaster prevention and recovery purposes, while Wireless communications and Early Warning Systems are adopted to facilitate efficient disaster warning and emergency response. Recognizing ICT's potential in rendering urban environmental management more effective, a range of actors, both foreign and domestic, are investing heavily in upgrading local governments' capacities of these four ICT tools in Mozambique. To enable readers gain a better understanding of these tools' impact on the urban poor (as analyzed in Section 4), a brief overview of each ICT tool is being provided in this section.

3.1. ICT in Disaster Prevention and Recovery

1. Geographic Information Systems (GIS)

GIS systems allow the viewing, understanding, interpreting, and visualizing of data in ways that reveal relationships, patterns, and trends in the form of maps, reports, and charts. In its simplest form, a GIS system can be thought of as a digital map that contains a database of valuable information embedded within it. It is by nature interactive, so that location-based data can readily be called up and viewed in a geographic display. Maps in GIS can be displayed in layers-- as shown in Figure 4, a city map might have a primary layer showing zone demarcations, another showing median income levels of neighborhoods, another showing the location and percentage of uncredentialed teachers.

In the context of urban flood-risk reduction, GIS can furnish municipal officials and relief agencies with in-depth clues on the location of the most at-risk residents based on the low-lying topography of their settlements, their type of housing structures, their proximity to drainage systems and canals, and so on. For example, through survey of river flows, storm tides, rainfall, and other topographical features, the city of Honolulu created a GIS (Figure 5) allowing any resident with Internet access to find out the flood-vulnerability level of any spot in the city. Also, the digital display of information related to the proximity of these residents to roads, hospitals, and emergency centers enables the development of effective evacuation strategies for vulnerable communities in no time.

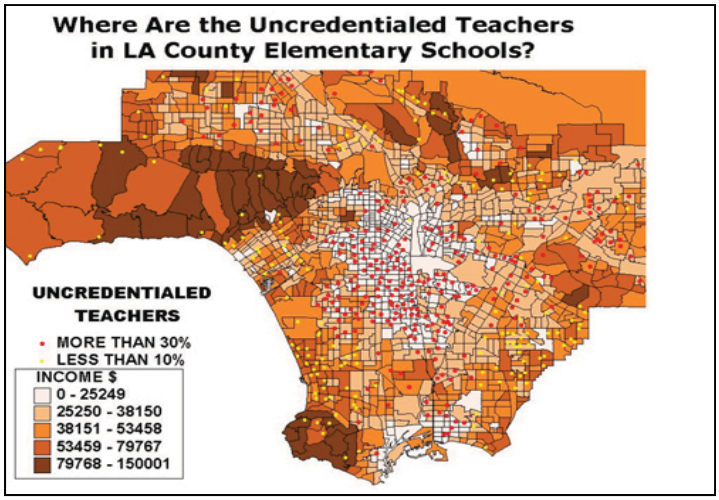


Figure 4. A GIS Mapping of Urban Zones Showing Concentrations of Uncredentialed Teachers
(Image courtesy: Teaching to Change LA (TCLA))

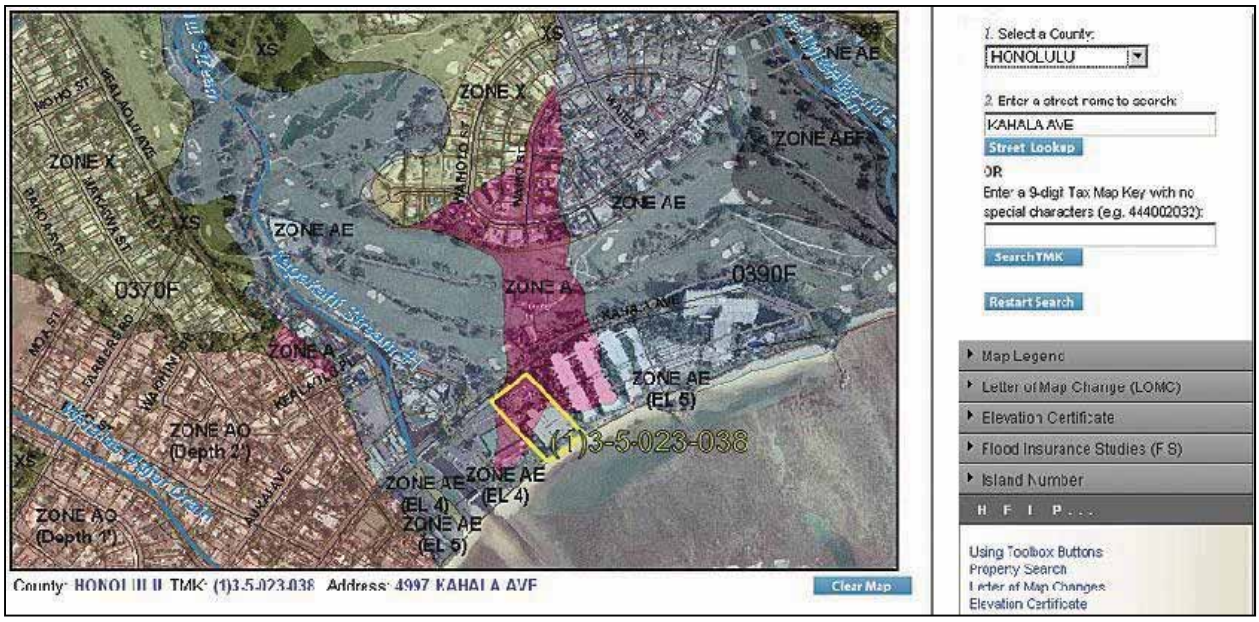


Figure 5. Honolulu's GIS Mapping of Low-to-High Flood Risk Zone Classifications
(Image courtesy: ESRI)

2. E-Governance

E-Governance encompasses both computerization and Internet-based sharing of information by governments in order to improve efficiency, accuracy, reliability, and transparency in government services. It can be applied in two distinct ways: to the sharing and updating of information between government and citizenry/businesses, and to the storage and sharing of information among and within

government ministries and offices. By eliminating intermediaries and simplifying government-to-government and government-to- citizen and -business transactions, making them more accessible to a wider audience, e-governance reduces opportunities for corruption by supporting transparency and accountability measures. The ability of any citizen to efficiently and securely access municipal services or information round-the-clock and from any location reduces the potential for bribery, which can especially harm the poor, and opportunities for discrimination, which can dissuade minorities from using services. Along with PCs, widely diffused mobile telephones now also allow more citizens to deepen their interactions with public-sector urban agencies. As a result, mainstreaming e-governance systems into the functions of sub-national level entities can transform municipalities by supporting officials with better governance and management capabilities.

In the context of enhancing urban climate resilience, in municipalities worldwide, e-governance tools such as E-Land Planning and E-Registration are used for various land and building management purposes, such as issuance of construction licenses, land titling/registration, and land purchases. Often, these tools automatically perform functions such as validation of plot topography (to check flooding susceptibility), violation of environmental regulations, and so on, before granting any certification. Therefore, by curbing unauthorized construction on low-lying plots or the illegal sale of flood-prone plots, e-governance tools can reduce the vulnerability of cities and communities to flooding. Box 4 discusses one such example.

Box 4. E-Land Planning Portal in Denmark

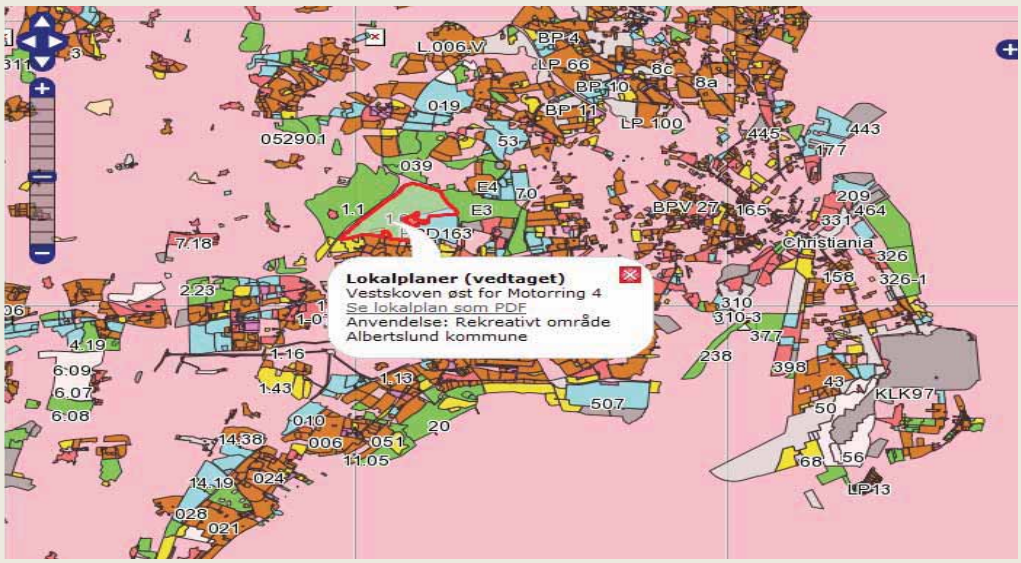


Figure 6. Zonal developmental plans for the Copenhagen metropolitan region

Denmark's online land management system provides public access to all nation-wide land-use plans such as municipal plans and development plans (called a *lokalplan*), both adopted or proposed. The map-based interface provides a range of navigation tools, including address, cadastral parcel number, municipality, and area polygons. The areas of the development plans can be displayed in combination with cadastral maps, topographic maps, and other kind of land-use constraints, such as conservation areas and coastal protection zones. Citizens preparing to build or extend their house can use the system to determine what planning restrictions and constraints apply in their area, and are thereby sensitized against undertaking any construction activity that could subject their areas to environmental hazards. Once the citizen has identified the development plan of interest, the system provides direct access to an electronic copy of the *lokalplan* and can display and generate a list of all properties (cadastral parcel numbers) impacted by the development plan. *Source*: www.plansystemdk.dk

3.2. ICT in Disaster Warning and Emergency Response

1. Wireless: Mobile Telephony and Radio

In the realm of urban climate change adaptation, the scope of wireless technology, including mobile and radio, is mainly due to the interplay of four elements that can lead to a virtuous circle of government-citizen engagement: *access*, *affordability*, *appliance innovation*, and *application*.

Regarding *access*, already the wireless footprint covers a great majority of the population in urban areas. Improvement in *affordability* has been due to the combination of prepaid service plans and cheaper mobile handsets. *Appliance innovation* is evident in making these devices more adaptable to a growing range of needs and services relevant to all citizens. *Applications* have experienced a vast increase in a few years in the development and roll-out of mobile applications. These conditions, in concert, enable stakeholders to instantaneously monitor environment –related issues and communicate these issues with one another, thereby encouraging environmental activism.

SMS is often used during emergencies by local governments to convey emergency messages to citizens (as shown in Figure 7), and also in a reverse fashion, enabling widely scattered residents to send instant messages to emergency centers or local authorities so that they, in turn, can assemble an accurate, minute-by-minute picture of changing needs. For instance, in the aftermath of the 2010 earthquake in Haiti, an NGO named Ushahidi launched a mobile-based disaster response system to assist fire, police, medical personnel coordinate relief efforts. This online tool aggregated information collected from local witnesses, citizens and on-the-spot relief agencies using SMS messages and pinpointed relevant data on interactive maps, saving over 100 lives. Also, to stop the spread of cholera in Port-Au-Prince, aid agencies joined forces with mobile telecom providers to raise awareness on clean water and sanitation by using SMS to convey relevant information, including precautionary measures, to refugee camp residents.

Figure 7. Disseminating Disaster Warning Messages using SMS Technology

2. Early Warning Systems (EWS)

EWS involving the use of technology such as telemetry (also known as Supervisory Control and Data Acquisition or SCADA), precipitation simulation software, and sensor-induced alarm mechanisms can help prevent the loss of lives by forecasting in advance upcoming floods, typhoons, landslides, tsunamis, and other associated disasters. Such systems provide timely estimates of the potential risk faced by communities, economies and the environment through their monitoring and predicting capabilities. EWS systems are often applied to make automated measurements of changing data, such as river/drainage levels and atmospheric conditions, which could lead to prediction of natural disasters with a high degree of accuracy. These updated conditions can be rapidly communicated to disaster management agencies, preparing them in time for adequate response. For instance, in Westminster, U.K., sensors were installed to monitor drainage and sewage flows, with corresponding data relayed to GIS mapping tools in real time. The pin-pointing of accurate bottleneck locations using this technique vastly improved the city's ability to deal with escalating overflow problems in densely populated sectors. Figure 8 illustrates another example, a proposed EWS system for Alexandria, Egypt, employing "smart buoys" linked to satellites, intended to enable that coastal city lower any potential damage from sea surges, storms and tsunamis.

But while EWS technology can play a key role in early prediction of hydro-meteorological hazards, it is important to remember that institutional coordination and appropriate action plans are equally essential for an early warning system to succeed.

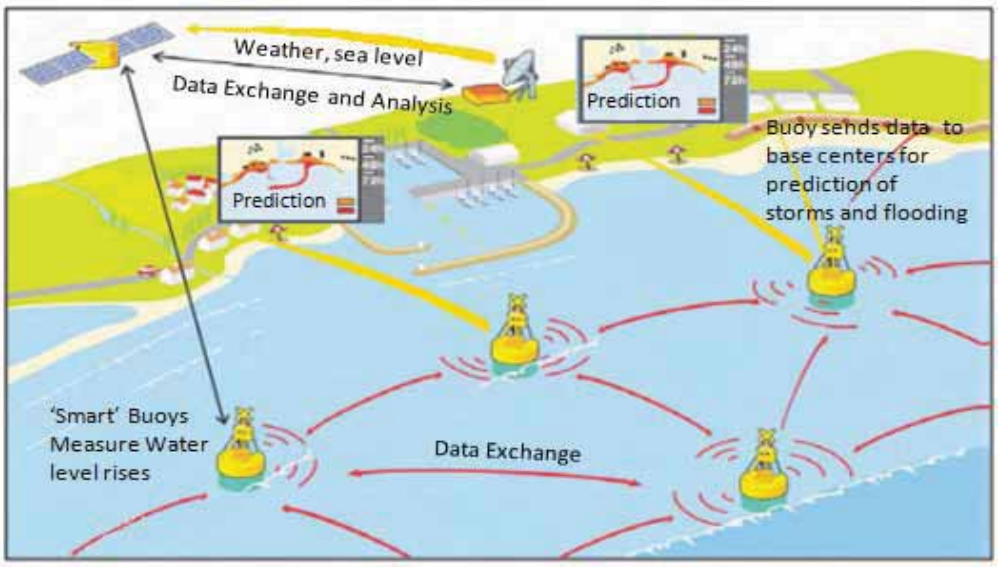


Figure 8: Proposed EWS for Alexandria, Egypt

Section 4
Assessment and Findings

In light of ICT's potential for enhancing urban service delivery and disaster response mechanisms, significant resources have been invested in raising the ICT capabilities of Mozambique's sub-national agencies since the country's national ICT policy was introduced in 2000. But the impact of such sub-national-level ICT investments on the poor in Mozambique and elsewhere remains largely unknown. Given Mozambique's vulnerability to climate variability and its standing as a country undergoing rapid urbanization and ICT growth, this section of the report attempts to analyze the impact of local-government-level ICT deployments on the poor by evaluating their efficacy over a dimension that disproportionately affects underprivileged communities most, namely their susceptibility to flooding – a situation worsening each year due to possible climate change-related effects.

To assess the current status of ICT adoption towards enhancing urban climate resilience, existing ICT capabilities in this direction associated with overall local government-level IT infrastructure, GIS, e-governance, wireless communications, and early warning systems have been surveyed in eight coastal cities of Mozambique: Maputo, Matola, Beira, Pemba, Xai-Xai, Chibuto, Maçia, and Manhiça (Figure 9). A spatial analysis approach is applied to assess impacts on the poor and the creation of digital divides, if any. The assessment methodology and findings are elaborated in the ensuing sections.

Figure 9: Location of the Eight Cities Surveyed

4.1. ICT Infrastructure

Generally, a strong municipal ICT core is demonstrated by the availability of well-functioning PCs/laptops, good internet connections, and skilled technicians and IT specialists. All of this is fundamental to ensuring that advanced ICT applications including GIS, e-governance tools, Early Warning Systems, etc. can be effectively implemented and harnessed within municipalities. Having this infrastructure in place also makes it possible to integrate other valuable advantages offered by IT, such as streamlined municipal communication via email correspondence, secure and reliable data storage, and improved accuracy of accounting (e.g., using Excel spreadsheets).

Methodology

The quality of IT infrastructure was measured by assessing parameters related to the number of functional computer systems installed in municipalities; the speed of internet connections; the general IT skill level of municipal officials; the technical support available from the local community (needed to ensure that the infrastructure can be sustainably used and maintained); and so forth. Table 3 provides a complete baseline pertaining to fundamental IT infrastructure existing in the eight surveyed cities.

Assessment Findings

- ***Computers:*** Desktop computers existed in all the municipal governments, although laptops were rare. Only the economically very prominent cities of Maputo and Matola had an ample number of computers relative to the size of their municipal staffs, with roughly 75 percent of staff having direct access to a computer. In other cities, less than 10 percent had access. Examined by rank of employee, computers were available to both senior officials and mid-level employees, such as urban planners, in every city. In most smaller cities, lower-level employees, such as secretaries, did not have computers.
- ***Internet use*****:** Every city except Pemba had Internet access but most were limited to a slow connection speed of 128 kbps. Internet speeds in the large Maputo and Matola municipalities were the fastest, at 8 mbps and 2 mbps respectively. In Maputo and Matola, moreover, every municipal computer was linked to the Internet, but in most of the other cities only one or two computers were linked. In Beira, however, the problem is solved with staff utilizing their personally-owned USB modem sticks.
- ***Email*****:** Every city except Pemba incorporated email for internal communications, but only Beira *required* staff to use email for this purpose.

	Maputo	Matola	Beira	Xai-Xai	Pemba	Macia	Manhica	Chibuto
No. of municipal desktops	100+	21+	8	5	4	6	* 15+	5
No. of municipal laptops	10+	5+	0	2	1	2	1	1
No. of municipal desktops+laptops connected to the internet	All	All	2 (Note: Most officials use their personal USB modem sticks for internet access)	1	0	2	4	1
Municipal internet adoption:								
Type of internet connection: Direct/Network?	Network	Network	Direct	Direct	NA	Direct	Direct	Direct
Speed of internet connection?	8 mbps	8 mbps	2 mbps	128 kbps	NA	128 kbps	128 kbps	128 kbps
Use of E-mail: Mandatory/optional?	Optional, but actively used	Optional	Mandatory: Staff-Staff Optional: Staff-Citizen	Optional	NA	Optional	Optional	Optional
Use of E-mail: Internal/external communication?	Mostly internal	Both	Both	Internal	NA	Internal	Internal	Internal
Availability of municipal 'focal point' in event of IT issues/problems?	Yes	Yes	No	No	No	No	No	No
Availability of Municipal webpage?	Yes	Yes	Yes	No	No	No	No	No
If Webpage exists, what info is displayed?	Municipal activity, Information on municipal procedures, etc.	Infrastructure works/events	Municipal activity, citizen feedback	NA	NA	NA	NA	
Local market support for municipal IT: Availability of h'w supplies, toners, cables?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Availability of IT-related manpower in city (skilled PC repair technicians, IT specialists. Etc.)	Yes	Yes	Yes	No	Yes	Yes	No	No
Rank of municipal personnel with access to a computer:								
Senior Officials	X	X	X	X	X	X	X	X
Mid-level personnel (accountants/engineers/urban planners)	X	X	X	X	X		X	X
Secretaries/Assistants	X	X					X	X
General IT Training (Use of Excel, Word docs, Powerpoint, E-mail correspondence, web-browsing) provided to staff?	Yes	Yes	No	No	No	No	Yes	Yes
General IT fluency level of municipal officials	Moderate - High	Moderate - High	Moderate	Low-Moderate	Low	Low-Moderate	Low-Moderate	Low
Awareness of National E-Gov policies?	Yes	No	No	No	No	No	No	No
Development of Municipal strategy/action-plan for ICT?	Yes	No	No	No	No	No	No	No
Overall Quality of Municipal IT infrastructure	Very High	High	Moderate	Low	Low	Low	Low-Moderate	Low

Table 3. Baseline Study Data on Municipal IT Infrastructure

***** As of Aug 2011, only 5 PCs were available in Manhiça. An additional 10 expected by Dec. 2011

- ***Municipal web page*:** As of 2011, only the big cities of Maputo, Matola, and Beira had municipal government web pages. Beira is notable for having a function allowing citizen feedback on its page.
- ***Local support:*** Needed hardware was available from the local market in every city. The situation regarding skilled technicians, however, was mixed: Most cities could find such skilled help when needed but Xai-Xai, Manhiça, and Chibuto lacked it.
- ***Staff skill level*:** General IT training was carried out for staff in half the cities. The overall IT fluency level among employees was nevertheless moderate-to-high only for the three largest cities (Maputo, Matola, Beira) and substantially lower in the smaller cities.
- ***Strategy and policy awareness*:** Only in the capital city Maputo was there awareness of the central government's e-government policies, and only in that city had a municipal strategy/roadmap for ICT implementation been devised.

Summary

Considering the above factors, this study finds that while overall municipal IT infrastructure remains weak in Mozambique, the quality improves noticeably with the increasing economic significance of a city. Table 4 provides a quick glance at this study result.

	Maputo	Matola	Beira	Xai-Xai	Pemba	Macia	Manhica	Chibuto
Overall Quality of Municipal IT infrastructure	Very High	High	Moderate	Low	Low	Low	Low-Moderate	Low

Table 4. Summary of Overall Municipal IT Infrastructure Quality

4.2. Geographic Information Systems (GIS)

Section 3 of the report described how GIS helps urban planners make more enlightened decisions, that is, decisions based on a more richly informed understanding of the social, physical, and economic environment that their planning affects. As an ICT tool for disaster prevention and recovery purposes, in the context of urban flood-risk reduction, GIS can play an invaluable role by providing municipal officials and relief agencies with in-depth clues on the population and location of citizens most susceptible to flooding as well as the extent/capacity of related disaster mitigation infrastructure. In Mozambique, a number of foreign agencies and technical experts have contributed significantly to the implementation of GIS in the local governments of major cities. To assess the usefulness and impact of the installed local

government GIS capability on the urban poor in the event of flooding, the approach adopted by this study is described below.

Methodology

Local governments worldwide often employ GIS to gain information related to topography of localities (to assess risk of flooding); socio-demographics of neighborhoods (to assess vulnerable population groups, who in most cases are slum/informal settlement dwellers); proximity to hydrological systems such as drainage, canals, and rivers (to assess means of water overflow/discharge); and proximity to road networks and emergency/medical centers (to assess ease of speedy evacuation and relief). The information so obtained is then used to devise effective evacuation strategies, demarcate needed new infrastructure, or better plan cities in a manner that makes neighborhoods and communities less susceptible to climate-related risks.

Step 1: In view of how local governments apply GIS for urban flood risk management, identification of the following features in GIS of municipality and INGC[e] of each city was performed:

- Depiction of vulnerable communities[f]
- Topography
- Drainage systems
- Road networks, and
- Hospitals/emergency centers.

Step 2: The level/quality of feature portrayal on the layers of GIS digital maps (for the overall city) was assigned a score from 0 to 10 (10 = highest) based on a cross-comparison of the depicted data for a sample of neighborhoods and regions, using available open-source maps

[e] Given the fact that in Mozambique a committee of representatives from the municipality and from the National Disaster Management Agency (INGC) coordinates response strategies in the event of imminent flooding, the GIS capacity of both these entities was evaluated to assess the coverage/quality of a GIS-enabled disaster response. (Note: an INGC field office is present in every city).

[f] To assess which communities are at most risk to flooding, cognizant of the fact that the urban poor living in slums/informal settlements bear the brunt of flooding disasters, any information from the GIS related to settlement type (formal/informal) was used as a proxy to identify where the poor are located. The corresponding information was overlaid on cities' topography maps to demarcate locations of the most vulnerable population groups.

Step 3: The level/quality of feature portrayal (relevant only to informal settlement areas) on the GIS digital maps was assigned a score from 0 to 10 (10 = highest) based on a cross-comparison of the depicted data for a sample of informal neighborhoods and regions, using available open-source maps.

Screenshots of relevant GIS mapping layers are illustrated in Annex A. Table 5 displays a baseline of GIS capability/capacity and corresponding impact on the urban poor.

	Maputo	Matola	Beira	Xai-Xai	Pemba	Macia	Manhica	Chibuto
Access to high resolution digital city maps	Y	Y	Y	Y	Y	N	N	N
GIS Capability in Municipality	Y	Y	Y	Y	N	N	N	N
GIS Capability in local INGC	Y	N	Y	N	N	N	N	N
Main purposes of installed GIS	Land Titling/Urban Planning/ Revenue Collection	Urban Planning/ Land use	Urban Planning/Land use	Urban Planning/ Land use	NA			
Total No. of mapping layers	18	2	21	18	NA			
Mapping layers associated with:								
Demarcation of informal settlements	Y	Y	Y	Y	Y			
Quality of Topographical information depiction	10	0	10	0	NA			
Topographical information extended to Informal Settlements?	Y	N	Y	N	NA			
Quality of Drainage system depiction	10	0	8	3	NA			
Drainage System information extended to informal settlements?	N	N	N	N	NA			
Quality of Road Network depiction	10	0	9	10	NA			
Road network information extended to Informal Settlements?	Y	N	Y	Y	NA			
Quality of Hospitals/Clinics information depiction	0	0	0	4	NA			
Hospitals/Clinics information extended to Informal Settlements?	NA	NA	NA	Y	NA			
GPS devices available in the municipality?	Y	N	N	N	Y			
Skill level of GIS Specialists (# Specialists/Yrs of relevant Experience)	4/3-5	2/3-4	1/2-3	1/2-3	NA			
Overall level of GIS impact on enhancing urban climate resilience	Moderate-High	NA *	Moderate	Low-Moderate	NA			
Overall level of GIS impact on enhancing climate resilience for the poor	Low-Moderate	NA*	Low-Moderate	Low-Moderate	NA			
Overall distribution of GIS impact on informal settlements/slums vis-à-vis formalized	Low	NA*	Low	Equal	NA			

Table 5. Baseline Study Data on GIS Capability/Capacity and Its Impact on the Urban Poor
* Not being considered in analysis due to weak GIS capacity

Assessment Findings

- ***Availability of GIS:*** Only the larger municipalities of Maputo, Matola, Baira, and Xai Xai had GIS capability. Pemba had access to high resolution digital maps of the city, but no GIS capability.
- ***Depiction of informal settlements*:** In the above five cities, classification of zones into either formal or informal categories was possible on the digital maps (based on information related to type of housing structure, average income level of communities, etc.). Where topographical data was available in the GIS (in Maputo and Beira), data extended to informal settlements as well.

- ***Depiction of (overall) city infrastructure*:** The quality of the depiction of drainage and road networks was found to be excellent in Maputo and very good in Beira. Beira scored lower than Maputo since base maps have not been updated since 1998. Note that although Beira's existing drainage and road networks have undergone renovation and upgradation since that time, no major expansion of this infrastructure has taken place. In smaller Xai Xai, the depiction of road networks was extensive but drainage depiction was weak (owing largely to the fact that not much drainage infrastructure exists); also, the city's GIS depicted hospitals or clinics to some extent. In Matola, depiction of city infrastructure was non-existent.
- ***Comparison of GIS coverage for informal settlements vis-à-vis formal settlements*:** While GIS depiction of drainage and sanitation networks is good in both Maputo and Beira, the non-existence of the infrastructure itself in informal settlements implies that GIS may be applied less effectively for planning disaster management strategies for these areas, compared to formalized settlements. In Xai Xai, the drainage infrastructure is weak in both the formal and the informal areas of the city; since road networks and hospitals/clinics are depicted for both types of settlements, overall coverage is regarded as equal.
- ***Overall impact on enhancing urban climate resilience*:** Given the above findings, the study concludes that the overall utility of GIS towards helping cities tackle flooding disasters may be regarded as moderate-to-high in Maputo, moderate in Beira, moderate-to-low in Xai-Xai, and irrelevant in Matola.
- ***Overall utility for strengthening climate resilience of the urban poor:*** In light of the GIS data coverage extended to informal settlements as described above, the study finds that the utility of local government GIS capacity towards enhancing the flood resiliency of the poor is low-to-moderate for Maputo, Beira, and Xai-Xai.

Summary

This research concludes that while municipal GIS capacity increased with level of city's economic prominence, the overall distribution of GIS impact (where available) on the poor vs. the well-off tended to increase in the reverse direction. Table 6 provides a quick glance on this result.

	Maputo	Matola	Beira	Xai-Xai	Pemba
Overall level of GIS impact on enhancing urban climate resilience	Moderate-High	NA	Moderate	Low-Moderate	NA
Overall distribution of GIS impact on informal settlements/slums vis-à-vis formalized	Low	NA	Low	Equal	NA

Table 6. Summary of Overall Impact of GIS Capacity

4.3. E-Governance Tools

Section 3 of this report described how mainstreaming e-governance systems into municipal government can provide officials with better management capabilities enabling them to deliver customized socio-economic services to their citizens. In the realm of land management, municipalities worldwide often apply e-governance solutions to ensure that construction licenses and land registration are not issued for plots deemed susceptible to flooding or violating coastal regulations. This practice can reduce the vulnerability of whole communities to flood damage. In Mozambique, a range of e-governance projects, both completed and ongoing, have been initiated at both the national and local levels. These include the Government Electronic Network (GovNet), the State Personnel Information System (SIP 2000), the Financial Administrative and Management System (e-SISTAFE), the Computerized Land Management Information System (LMIS), and the Civil Identification System, among others. For this study, each municipality was surveyed to assess the respective capabilities of its installed e-governance systems and to analyze whether any of them helped enhance urban climate resilience. A discussion of any thematically relevant installed systems is provided.

Assessment Findings

- ***Use of e-governance*:** Overall, cities in Mozambique have been slow to adopt e-governance systems into their functions, with inadequate technical and human capacities posing key hurdles. Only Maputo was found to be relatively advanced in its adoption of e-governance, while in a few other municipalities only ad-hoc instances exist. E-governance was used for the vehicle tax system in three of the cities and for land titling/management in two.
- ***Impact on climate resilience*:** While the cities of Maputo and Pemba are notable for extending e-governance capability to the domain of land management, the overall impact of these initiatives on enhancing climate resilience could only be considered moderate at best.
- ***Distribution of impact on the poor*:** Among all cities, Pemba has applied e-governance specifically to land-titling in informal settlements and, therefore, its e-governance has a higher impact on the poor.

The city-by-city results are displayed in Table 7. A brief overview of relevant e-government systems implemented in Maputo and Pemba follows.

	Maputo	Matola	Beira	Xai-Xai	Pemba	Macia	Manhica	Chibuto
Type of E-Governance systems in place	A] Vehicle Tax system B] SIGEM for E-Land Titling/Lease (DUAT), E-Construction license, E-Land management C] IFMIS (on hold)	Vehicle Tax system			Land Management Information System		Vehicle Tax system	
Overall level of E-Gov impact on enhancing urban climate resilience	Low-Moderate	Low	NA	NA	Low-Moderate	NA	NA	NA
Overall level of E-Gov impact on enhancing urban climate resilience for the poor	Low	Low	NA	NA	Low	NA	Low	NA
Overall distribution of E-Gov impact on informal settlements/slums vis-à-vis formal areas	Low	Low	NA	NA	High	NA	NA	NA

Table 7. Baseline Data on Municipal E-governance Tools and their Impact on the Urban poor

Overview of SIGEM and LIMS

In the realm of enhancing urban climate resilience, Maputo's *Sistema de Informação de Gestão Municipal* (SIGEM) [g] and Pemba's Land Information Management System (LIMS) both have some relevance.

- **SIGEM:** Maputo has implemented a GIS-based e-governance municipal management system that involves geo-referenced digital maps and a networked software platform capable of producing a variety of analyses and images. Data in the system has been populated by integrating and updating the existing datasets at different institutions. SIGEM currently pertains to the management of formalized areas only. For these neighborhoods, the system supports land use planning, land titling through issuance of the state-granted land right (known as Direito de Uso e Aproveitamento da Terra (DUAT)), and real property tax administration. It also improves the administration of a variety of municipal licensing systems, including construction, parking, and various business permits. Yet the system lacks any capability for measuring the susceptibility of land plots to natural disaster while reviewing and issuing land titles or construction licenses. In view of these factors, its potential impact

[g] Note that this tool is distinct from the regular GIS in place.

on enhancing city-wide climate resilience is regarded by this study as moderate at best but having low utility for the urban poor. (Refer Annex B for illustrations of SIGEM's capabilities)

- **Land Management Information System (LIMS):** LIMS is a type of cadastre system that commonly tracks land ownership, boundaries, and adjacent landmarks and often includes land-use information. This information can be crucial as a fundamental source of data on land disputes and lawsuits over land ownership. Other benefits of LIMS include: (i) improved quality of rural/urban planning, (ii) establishment of a transparent backlog of land management decisions, and (iii) improved revenue collection at provincial, district, and municipal levels. The city of Pemba, through support from the Millennium Challenge Account (MCA),[h] has implemented a LIMS by which, as depicted in Figure 10, each plot parcel in informal settlements is digitally mapped using GPS devices. Based on the geo-coordinates, corresponding land titles are issued to residents. Such provision of legal recognition to poor households helps protect them against land-sharking while enhancing the municipality's revenue stream, since property taxes may now be levied on newly formalized areas. While the system has the potential to provide the poor with greater social protection, its impact on enhancing climate resilience is regarded by this study as low in the short term and moderate in the longer term (by way of potentially impeding large-scale land grabbing of fragile coastal zones).

Figure 10: Pemba's LIMS – A screenshot depicting land parcels mapped for issuing land titles

[h] Millennium Challenge Account (MCA) is implementing similar LIMS in 4 Northern provinces: Zambezia, Nampula, Cabo Delgado and Niassa

Summary

While currently installed E-Governance tools in Mozambique do not contribute in any large extent towards enhancing urban climate resilience, overall distribution of the installed capacity's impact for poorer communities tends to be (slightly) inversely proportional with economic prominence of city.

	Maputo	Matola	Beira	Xai-Xai	Pemba
Overall level of E-Gov impact on enhancing urban climate resilience	Low-Moderate	Low	NA	NA	Low-Moderate
Overall distribution of E-Gov impact on informal settlements/slums vis-à-vis formal areas	Low	Low	NA	NA	High

Table 8. Summary of Overall Impact of E-Governance Capacity

4.4. Wireless Communications

Worldwide, both mobile telephony and radio communication systems have been harnessed to help cities tackle the effects of climate change. Local governments use these systems to broadcast warning messages on upcoming weather conditions and to disseminate information on evacuation routes and available relief services in the event of disaster. Using SMS--that is, text-messaging to thousands of subscribers at once--they can broadcast the same emergency messages traditionally received over the radio but with the added advantage that (for example) the listener/subscriber does not need to be "tuned in" the moment a message is sent.

As of 2011, at least 85 percent of all urban denizens in Mozambique had access to a mobile telephone, with mobile coverage extending to most urban regions and surrounding areas. [16] Mobile services are being provided by three operators--mCel, Vodacom, and Viettel—which provide service to the roughly 30 percent of the country's population that has mobile phones. Mozambique also has a number of radio stations, which together cover approximately 60 to 70 percent of the population, with Rádio Moçambique (RM) being by far the most advanced station and the one with the largest geographic coverage. Almost all cities host local community radio. In view of the scope to apply mobile solutions to flood-risk mitigation in Mozambique's cities, assessments were carried by this study to survey the extent to which these tools were so harnessed.

Methodology

Departments of public relations and communication in each city were assessed to identify any collaborative arrangements they had with mobile phone operators and radio channels and to assess the medium they used to collaborate with disaster-response agencies. Adoption of any relevant mobile-phone –based solution was also surveyed in municipalities.

Assessment Findings

- ***Coordination with climate disaster services*:** Personnel in all eight cities only used officially-provided landline phones to coordinate with remote agencies and services, such as the INGC, the national weather stations, and relief agencies. In emergency situations, personal mobile phones were sometimes used to deliver critical messages.
- ***Municipal arrangements with broadcast media*:** All eight cities had cooperative arrangements with the local radio and television broadcasters in order to relay emergency and other public information. Local media channels themselves get information from a range of sources, among which INGC is a major one as well as the ARAs and DNA. But according to the National Institute of Meteorology (INAM), accomplishing in-time dissemination of warnings using broadcast media is often challenging, since bad weather often arrives in the night – when most citizens and authorities are inaccessible.
- ***Municipal arrangements with mobile phone operators*:** None of the cities had cooperative arrangements with mobile phone operators for any form of emergency or other special communications.
- ***Availability of mobile applications for citizen engagement*:** In only one city is an application being tested. This application, being piloted by INAM in the Muinava informal settlement area in Beira, aims to give residents 48 hours' advance notice of floods. The system is still under development.
- ***Impact on climate resilience and the poor:*** Since the wireless medium is not being harnessed in an effective way for flood-risk mitigation, its overall impact on enhancing urban climate resilience is deemed by this study as too weak to be considered in the study's concluding analysis.

Table 9 provides detailed city-by-city results.

	Maputo	Matola	Beira	Xai-Xai	Pemba	Macia	Chibuto	Manhica
Coordination mechanism with other remote agencies (Eg.: INGC, weather agency, Relief	Landline phone-based							
Any municipal cooperation/coordination with media channels (local radio, television)?	Yes: Radio/TV channels used for dissemination of emergency-related information							
Any municipal cooperation/coordination with mobile-phone operators (Mcel/Vodacom)?	No							
Mobile apps for citizen engagement?	No		New SMS-based pilot in Muinava slum warns citizens of upcoming floods 48 hours in advance	No				

Table 9. Baseline Data on Municipal Wireless Telecom Capability/Capacity

4.5. Early Warning Systems

Early Warning Systems (EWS), as discussed in Section 3, are surveillance systems that provide timely information to enable early detection, forecasting, and warning about natural disasters such as floods and wildfires. Various forms of EWS--including telemetry systems and precipitation/weather simulation software--are applied to predict looming disasters, simulate a situation is likely to unfold, and furnish authorities with the information they need to respond effectively.

The monitoring and forecasting of hydrological and meteorological hazards in Mozambique is the within the mandate of the National Directorate for Water (DNA) in collaboration with the five Regional Water Authorities (ARAs), and the National Institute of Meteorology (INAM). Using a combination of ICT (such as various modeling capacities and softwares) and non-ICT tools, these agencies generate datasets to forecast upcoming conditions. The country's National Institute of Disaster Management (INGC) is the agency tasked with primary responsibility for carrying out relief measures in the event of disasters. In disaster contexts, meteorological information from INAM combined with hydrological information from DNA and the ARAs is relayed to the INGC's district centers.

Methodology

In view of the institutional coordination mechanisms just described, this study assessed any available ICT-based EWS capacity that INAM might have as well as the capacity wielded by the three regional ARA centers (ARA-Sul[i], ARA-Centro[j], and ARA-Norte[k]) under whose purview the surveyed

[i] Covers the cities of Maputo, Matola, Xai-Xai, Maçia, Manhiça, and Chibuto.

cities fell. In addition, the study surveyed each city's capabilities in the form of sensors or telemetry systems installed in or along its associated hydrological bodies, such as coastlines, rivers, and drainage.

Assessment Findings: INAM

INAM gathers its input data (including rainfall, air temperature, air humidity, wind speed and direction, and air pressure) for predicting weather conditions from a network of its own stations and from external sources, which include both global centers and regional centers such as South Africa Weather Service. While INAM's own network includes both manned and automated weather stations, most of its automated stations were found to be not functioning or to be delivering insufficient levels of information. Two doppler radars were installed in the mid-2000s, but neither is fully operational. As a result, many important types of observation--such as upper air, marine, and lightning detection--are not effectively performed. In sum, the agency lacked any meaningful ICT-based EWS capability related to the prediction of floods and tropical cyclones and their impact.

Assessment Findings: ARA

- ***ARA-Sul*:** Hydrological data pertaining to rainfall, river level, and river discharge are obtained from three sources: ARA-Sul's own rainfall and discharge monitoring stations; the water management agencies of upstream countries; and a GIS-based Famine Early Warning Systems Network or 'FEWSNET' (implemented in ARA-SUL) for simulating upcoming rainfall conditions. The agency also has the capacity to leverage a MIKE-11 software tool to simulate the flow and water levels in the Mbeluzi river basin, although this system is not fully operational due to dysfunctional telemetry equipment. See the next section for further discussion of FEWNSET and MIKE 11.
- ***ARA-Centro*:** ARA-Centro has little to no ICT-based EWS capability. However, the city of Beira, in cooperation with Gesellschaft für Internationale Zusammenarbeit (GIZ), is piloting a system of mechanical sensors in drainage canals that can warn residents of rising water levels (Figure 11). Since this mechanical system is not an ICT -based system, its impact is not analyzed in this study.
- ***ARA-Zambeze:*** ARA-Zambeze operates a MIKE 11 rainfall-runoff and routing model from the Cahora Bassa dam outflow to the mouth of the Zambezi River for flood forecasting and water infrastructure operations. Hydraulic routing is only performed on the main stem of the Zambezi, with tributaries modelled as hydrologic inflows. Flood forecasting performance is hampered by lack of real-time rainfall and runoff observations (telemetric networks) and precipitation forecasts. Despite

[j] Covers the city of Beira.
[k] Covers the city of Pemba.

operating MIKE 11, the agency is unable to produce flood inundation maps owing to the fact that it does not possess a digital elevation model (DEM) of the Zambezi Basin.

- ***ARA-Norte and ARA-Centro Norte:*** These agencies have little to no ICT-based EWS capability.
- ***Overall EWS-ICT impact on enhancing urban climate resilience:*** This study finds that in view of ARA-Sul's ICT simulation software, the agency's ability to predict heavy rainfall for its respective region is strong and can greatly enhance the climate resilience of its six southern cities. The other two regions (Norte and Centro), however, lack this predictive capacity.
- ***Distribution of EWS-ICT impact on the poor:*** ARA-Sul's simulation tools produce precipitation forecasts region wide, covering both the formal and informal areas of cities, so their positive impact on the vulnerable urban poor is distributed equally with their impact on the more well-off.

Table 10 provides detailed city-by-city results.

	Maputo	Matola	Macia	Manhica	Chibuto	Xai-Xai	Beira	Pemba
Regional ARA Agency	ARA-Sul						ARA-Centro	Ara-Norte
Type of hydrology monitored by EWS	River						Drainage	Rainfall
EWS Type:								
Manual	Gauge-readings on river, Standard rain gauge						Standard rain gauge	Standard rain gauge
Automated	FEWSNET + MIKE11						Mechanical Sensors (non-ICT)	
Overall level of EWS ICT impact on enhancing urban climate resilience	High	High	High	High	High	High	NA	NA
Overall level of EWS ICT impact on enhancing urban climate resilience for the poor	High	High	High	High	High	High	NA	NA
Overall distribution of EWS ICT impact on informal settlements/slums vis-à-vis formal areas	Equal	Equal	Equal	Equal	Equal	Equal	NA	NA

Table 10. Baseline Data on EWS Capability/Capacity

Figure 11: GIZ's Mechanical Sensor

Overview of FEWSNET and MIKE11

The FEWSNET and MIKE 11 software tools enhance resilience to natural disasters by virtue of their precipitation and flood prediction capabilities. These are briefly described below.

- **FEWSNET (GeoSFM):** A Geospatial Stream Flow Model (GeoSFM) that covers all of Mozambique has been made available by the U.S. Geological Survey and is provided free-of-charge to ARA-Sul through the FEWSNET software. GeoSFM utilises daily satellite-derived rainfall estimates produced by the U.S. National Oceanic and Atmospheric Administration along with daily potential evapotranspiration data. Together, these estimates produce precipitation forecasts with a high degree of accuracy, and when combined with GIS they allow for easy analyses and depiction of upcoming conditions (Fig. 12a).

- **MIKE11:** MIKE 11 is a software tool that simulates flow and water level, water quality, and sediment transport in rivers, flood plains, and other water bodies. Used in conjunction with GIS, it allows the depiction and analysis of flood depths and water levels as viewable layers of data (Fig. 12b), so it can serve as an effective tool for spatially based river and floodplain management. Telemetry systems installed on the embankments of water bodies can transmit their automated measurements of water flows and levels to MIKE 11 for real-time analyses. However, at present these telemetry systems are largely inoperative in Mozambique due to lack of resources for maintenance and upgrade.

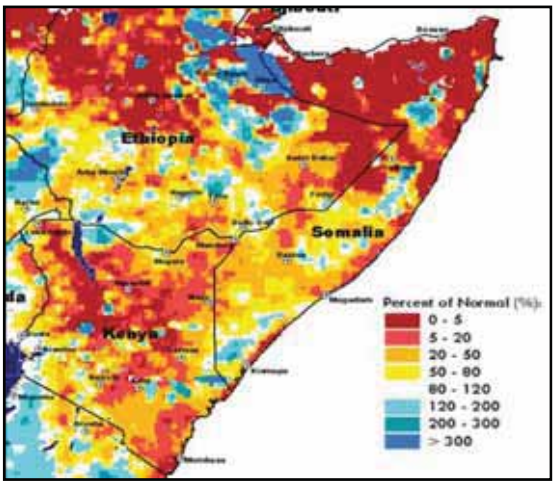


Figure 12 (a): FEWSNET
An illustration of FEWSNET showing rainfall levels using GIS

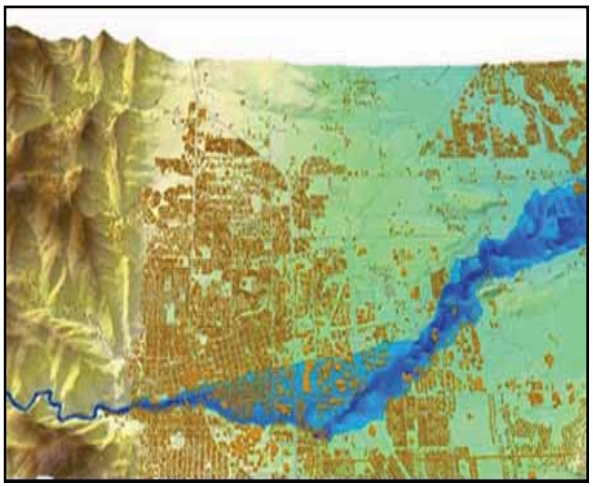


Figure 12 (b): MIKE 11
An illustration of MIKE11 GIS simulating potential flooding

Summary

By allowing forecasting of rainfall conditions, ARA-Sul's EWS-ICT capability enables the agency to significantly enhance the climate resilience of the country's southern cities, with an equal distribution of impact on formal and informal settlements. But while this can lead to more informed decision-making, the quality of inter-agency coordination is the factor that, eventually, most determines how great an impact the EWS-ICT capability can have.

	Maputo	Matola	Macia	Manhica	Chibuto	Xai-Xai	Beira	Pemba
Regional ARA Agency	ARA-Sul						ARA-Centro	ARA-Norte
Overall level of EWS ICT impact on enhancing urban climate resilience	High	High	High	High	High	High	NA	NA
Overall distribution of EWS ICT impact on informal settlements/slums vis-à-vis formal areas	Equal	Equal	Equal	Equal	Equal	Equal	NA	NA

Table 11. Summary of Overall Impact of EWS ICT Capacity

4.6. Results Analysis

At this point, we can pull together the summary findings on each of the four major ICT tools for which the study surveys found at least some impact on climate resilience, and examine their overall effectiveness city by city for the five largest cities under consideration. Looking at the general impact of these four ICT tools side by side reveals a general picture of the level of impact ICT currently has on disaster resilience in Maputo, Matola, Beira, Pemba, and Xai-Xai. Combining the summaries from Tables 5, 7, 9, and 11, the evaluations are presented in Table 12.

In order to synthesize the overall level of ICT impact on urban climate resilience for each city, this study quantifies the broad ratings of "low," "moderate," and "high" impact so that a mean rating can be calculated. This is also necessary to calculate an overall rating for impact on the urban poor. The method chosen was to assign a numerical scale running from 0 to 10 for climate resilience and from -2 to 4 for impact on the poor, as shown in Table 13. Table 14 depicts the overall scorecard for the cities.

	Maputo	Matola	Beira	Pemba	Xai-Xai
Population (est 2010)	1,430,000	758,000	620,000	156,000	128,000
% Population living in Informal settlements (est 2010)	70%	70%	75%	80%	85%
No. of people living in Informal settlements	1001000	530600	465000	124,800	108800
Susceptibility of City to flooding	High	High	High	High	Moderate
Overall Quality of Municipal IT infrastructure	Very High	High	Moderate	Low	Low
Overall level of GIS impact on enhancing urban climate resilience	Moderate-High	Low	Moderate	NA	Low-Moderate
Overall level of EWS ICT impact on enhancing urban climate resilience	High	High	NA	NA	High
Overall level of E-Gov impact on enhancing urban climate resilience	Low-Moderate	Low	NA	Low-Moderate	NA
Overall distribution of GIS impact on informal settlements/slums vis-à-vis formal areas	Low-Moderate	NA	Low-Moderate	NA	Equal
Overall distribution of EWS ICT impact on informal settlements/slums vis-à-vis formal areas	Equal	Equal	NA	NA	Equal
Overall distribution of E-gov impact on informal settlements/slums vis-à-vis formal areas	Low	Low	NA	High	NA

Table 12. Complete Summary Table

High	10
Moderate-High	8
Moderate	5
Low-Moderate	3
Low	2
NA	0

(a)

High	4
Equal	2
NA	0
Low	-2

(b)

Table 13. Point Systems for Quantifying the Impact of Municipal ICT on the Poor

Table (a): Point system for calculating overall level of ICT impact on enhancing urban climate resilience
Table (b): Point system for calculating distribution of ICT impact on the vulnerable urban poor

	Maputo	Matola	Beira	Pemba	Xai-Xai
Population (est 2010)	1,430,000	758,000	620,000	156,000	128,000
% Population living in Informal settlements (est 2010)	70%	70%	75%	80%	85%
No. of people living in Infirmal settlements	1001000	530600	465000	124,800	108800
Susceptibility of City to flooding	High	High	High	High	Moderate
Overall Quality of Municipal IT infrastructure	Very High	High	Moderate	Low	Low
Overall level of GIS impact on enhancing urban climate resilience	Moderate-High	Low	Moderate	NA	Low-Moderate
Overall level of EWS ICT impact on enhancing urban climate resilience	High	High	NA	NA	High
Overall level of E-Gov impact on enhancing urban climate resilience	Low-Moderate	Low	Low	Low-Moderate	NA
Total Points:	21	14	7	3	13
Overall distribution of GIS impact on informal settlements/slums vis-à-vis formal areas	Low	NA	Low	NA	Equal
Overall distribution of EWS ICT impact on informal settlements/slums vis-à-vis formal areas	Equal	Equal	NA	NA	Equal
Overall distribution of E-gov impact on informal settlements/slums vis-à-vis formal areas	Low	Low	Low	High	NA
Total Points:	-2	0	4	4	4

Table 14. City Scorecard: Municipal ICT and Its Impact on the Poor

The numerical summary ratings for each city immediately make clear that Maputo enjoys a far higher level of effectiveness in its ICT impact on climate resilience than any other city, and seven times higher than the effectiveness currently experienced in Pemba, which ranks at the bottom (21 versus 3) in this cluster of cities. Matola and Xai-Xai rank in the middle in this evaluation. This demonstrates that the local governments of the more economically advanced cities possess higher potential to harness ICT toward purposes of better urban development and planning.

The above result may not be completely unexpected, given that bigger municipalities have greater resources at hand to upgrade their capabilities. But what is surprising is that lower set of scores in Table 14 show an opposite city pattern with regard to relative impact on the poor. The distribution of ICT impact tends to be more equal or even higher for the poor in the smaller and *less* prosperous cities, such as Pemba and Xai-Xai, than in the economically most significant ones.

In essence, these results indicate that the introduction of ICT at the local government level in Mozambique is creating a *regional-level digital divide*, one in which the southern region is more advanced than the central and northern regions in terms of ICT capability. Factors involving political

economies may be at play, compelling institutions to leverage ICT to target different population segments based on a region's socio-economic condition. But significantly, the introduction of ICT is also creating a *community*-level digital divide, one in which the poor in smaller, less advanced cities tend to be more favorably impacted by the harnessing of any ICT at the local-government level, compared to for the poor in richer cities.

This second pattern might be attributable to the fact that smaller cities simply host a greater proportion of underprivileged communities, or perhaps to the fact that the economic gap between the relatively better-off and the poor is not as pronounced in these smaller cities vis-à-vis bigger metropolitan areas--implying that any ICT intervention will impact the poor more. Although determining which explanation is more accurate will require additional analysis and lies beyond the scope of this report, it is worth considering that similar patterns of ICT harnessing and impact might be found in other countries as well, especially in those with analogously low capacities and weak regulatory oversight.

In light of the observations in Mozambique, the existing situation necessitates suitable amendments to the country's ICT-PARPA framework such that ICT may more effectively be applied as an instrument that mitigates risks for all poor communities. To this end, Section 5 discusses needed policy reform measures along technical, institutional and social dimensions for bridging digital divides and enhancing institutional capabilities.

Section 5
Policy Recommendations

It is hoped that this report has raised awareness concerning the potential of municipal-level ICT to enhance transparency and productivity, transform services delivery, and reduce poverty in cities. In Mozambique, the harnessing of this potential began in the early 2000s with the government's introduction of its National ICT Policy and E-Government strategy. The ICT-PARPA framework, which links the country's ICT strategy with the objectives of poverty reduction, gave fresh impetus to the adoption of ICT in the public sector.

Against this backdrop and as observed in this report, over the last 10 years, a range of local government agencies in Mozambique have begun to adopt ICT systems for purposes of better urban planning, management and risk mitigation, and are today looking at further enhancing their capacities. In fact, indicators show that the readiness for eGovernment in Mozambique has been improving consistently over the last few years (rising in the United Nations' E-readiness Index from 0.173 in 2003 to 0.256 in 2008 [l]). The extensive prevalence of mobile telephony and the proliferation of mobile operators also stand as testimony to achievements in telecom-sector reform.

At the same time, however, this study's analysis of ICT's impact on climate resilience for the urban poor makes it clear that significant ground remains to be covered. That unfinished work will require not only enhancing municipal ICT capabilities but also ensuring that disparities in ICT-enabled service delivery are bridged so that all communities can enjoy an equal and favorable impact. It must also be mentioned that in order to effectively engage ICT as a risk mitigation tool for the poor, an overhaul of processes and culture is needed such that institutional ICT systems, at the very outset, function as planned and are indeed regarded as an integral 'go to' mechanism by intended population segments.

5.1. The Limitations of Supply-side ICT Interventions

The objective of the ICT-PARPA Framework adopted by the Government of Mozambique was to contour the application of ICT toward reducing dire poverty. Within this framework, in an effort to

[l] The United Nations Public Administration Network's (UNPAN's) E-readiness index shows the degree of a country's readiness for the knowledge economy. The E-readiness index is an aggregate index comprising an infrastructure index, a web measure index, a human capital index, and an e-participation index. For more information, go to http://www2.unpan.org/egovkb/profilecountry.aspx?ID=116.

enhance transparency and extend the reach and quality of public services, municipalities in Mozambique have indeed focused on adopting ICT for basic services to citizens, such as enabling online platforms for vehicular tax payment or for registration of public-sector staff and applying Geographic Information Systems tools to city planning.

However, this PSIA observes that local government agencies are leveraging ICT solutions largely to support "supply-side governance" (SSG), that is, the unidirectional government-to-citizen dimension of government activities. This approach alone might not be sufficient to achieve the objectives of poverty reduction and enhancement of institutional capabilities, for the following reasons:

1] Given the limited resources associated with public sector agencies in low-capacity regions, completely automating and sustaining the gamut of SSG activities across all regions may be unachievable in the short term.

2] Designing ICT-based SSG solutions tailored specifically for the poor will be a challenging endeavor, given the diverse needs and socioeconomic complexities associated with disadvantaged communities.

3] There is a risk of overcapitalizing low capacity organizations with costly and complex information technology systems. That is, investments in sophisticated and potentially efficient software and systems may prove wasteful as the necessary core skills and staffing are often missing.

5.2. Capturing the Citizens' Voice

Policy-level amendments such as Mozambique's 'E-Government Interoperability Framework' of 2009 (which, in a nutshell, recommends standards for data interchange between disparate ICT systems) are steps in the right direction towards implementing a technological framework allowing for better collaboration between government entities and improving government-citizen communication.[17] Yet based on this study's assessment of the extent to which the urban poor are being affected by the adoption of ICT, it appears that interventions on the supply side alone have led to a skewed impact in the context of cities and disadvantaged communities. To counter the effects of digital disparities induced by the generally top-down nature of SSG ICT interventions, mechanisms are needed for citizens themselves to connect with their public-sector institutions to co-design and co-participate in the functioning of government. Thanks to an increasing integration of ICT within public life in Africa, creation of new political economies in the region is being observed stemming from the emergence of ICT for "demand side governance" systems, termed as 'ICT4DSG'.

As demonstrated by the wide range of ICT4DSG initiatives, ranging from the Facebook and Twitter-fuelled Jasmine Revolution in North Africa to Kenya's community GIS-based Map Kibera project, this bottom-up approach comprises a powerful medium to facilitate large-scale citizen review, feedback, and dialogue on public-sector policies/services via up-to-the-second news, meeting notes, postings, data, images, and so forth. Such crowdsourcing [m] and geo-mapping ingenuities enable collaboration in real time and on a massive scale, rendering to citizens and businesses the ability to place adequate pressure points on governments for demanding reform, transparency, or action. An example of such citizen participation in urban design that was harnessed with an ICT4DSG methodology is discussed in Box 5.

Note that cities, long at the crux of the ICT era in Africa by virtue of their superior infrastructure and large concentrations of ICT users and innovators, can readily harvest ICT4DSG methodologies in presence of an enabling policy framework -discussed in the following pages. In collaboration with social intermediaries (such as NGOs, unions, social/traditional media, and activists) ICT4DSG can then be leveraged to compel public agencies plug service delivery gaps for the poor.

Box 5. Use of ICT4DSG in Dar es Salaam, Tanzania to Inform the Design, and Monitor Implementation of an Urban Development Project

In 2011, the World Bank, together with Twaweza, a regional ICT NGO, activated a network of practitioners, including 25 students from Ardhi University's School of Urban and Regional Planning (SURP) and 25 local residents, to capture citizens' voices through the creation of dynamic, online maps of a community within Dar es Salaam. The community was Tandale Ward, a neighborhood without access to public services and one of the target areas of the Dar es Salaam Metropolitan Development Project (DMDP). The initiative, which took place during the four weeks of August 2011, emerged from government interest in an active network of citizens who could identify local priorities and monitor implementation progress. The community mapping methodology from the Map Kibera experience in Kenya was applied to the Dar es Salaam context. Mapping practitioners provided training--involving the use of GPS and GIS--to local communities and ward officers, and in the process established a community mapping curriculum at Ardhi University. The resulting high-quality, open-source data set, as displayed in Figure 14 below, contains thousands of points that locate roads, schools, clinics, trash dumps, water points, and more. Since local capacity now also exists within the university and local government to replicate the work at low cost, this network will continue to collect and verify data. As a result, the evolving map will continue to improve citizen feedback around public services such as trash collection, pothole repair, and flood management.

[m] "Crowdsourcing", a term that combines the concepts of "crowd" and "outsourcing," can be defined as "the act of taking tasks traditionally performed by an employee or contractor, and outsourcing them to a group of people or community, through an 'open call' to a large group of people (a crowd) asking for contributions." It is thus a means for leveraging mass collaboration on a project – for instance, by inviting feedback via mobile phones.

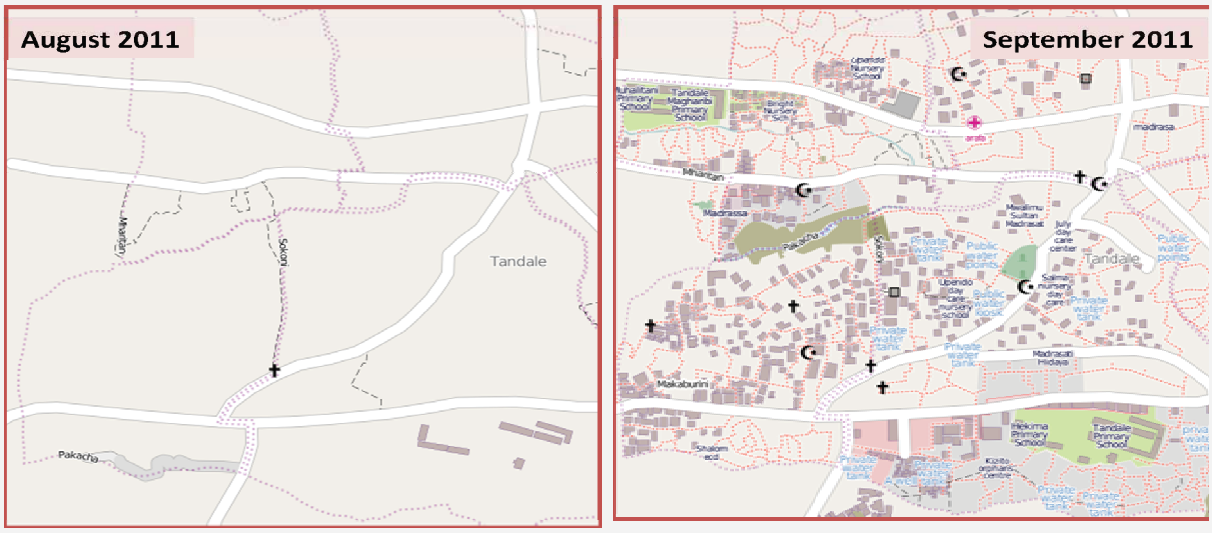


Figure 13: ICT4DSG in the Map Tandale Project

Source: Joshua Goldstein, *'Community Mapping & Open Development in Dar Es Salaam'* (2011) Available online at http://blogs.worldbank.org

5.3. Leveraging ICT for Community-Government Collaboration

To achieve the objective of reducing dire poverty through ICT as envisioned by the Government of Mozambique, this study recommends that the dimensions of the ICT-PARPA Framework be suitably enhanced to enable two-way government-citizen engagement involving both DSG and SSG methodologies. Through ICT4DSG, efforts can be placed on harnessing civil-society- and private-sector-led ICT solutions that would help communities monitor development results and facilitate citizen feedback on service delivery to government and service providers.

In the context of enhancing climate resilience for the urban poor, as an example, simple crowdsource-based geo-mapping mechanisms (such as the Map Tandale example described in Box 5) could assist in bringing infrastructure issues much more quickly to the attention of local governments and enable authorities to better devise zoning and planning regulations, while social accountability platforms (such as blogs) could be leveraged to gather information on the impact of extreme weather events and make improvements in disaster preparedness. As civil society –led DSG solutions can be flexibly designed, Table 15 shows that the intensity of these solutions can be suitably modulated to complement and compensate for the gaps created by current SSG interventions in Mozambique's cities, thereby

helping bridge digital disparities. Box 6 provides a flowchart to illustrate the general flow of ICT4DSG mechanism.

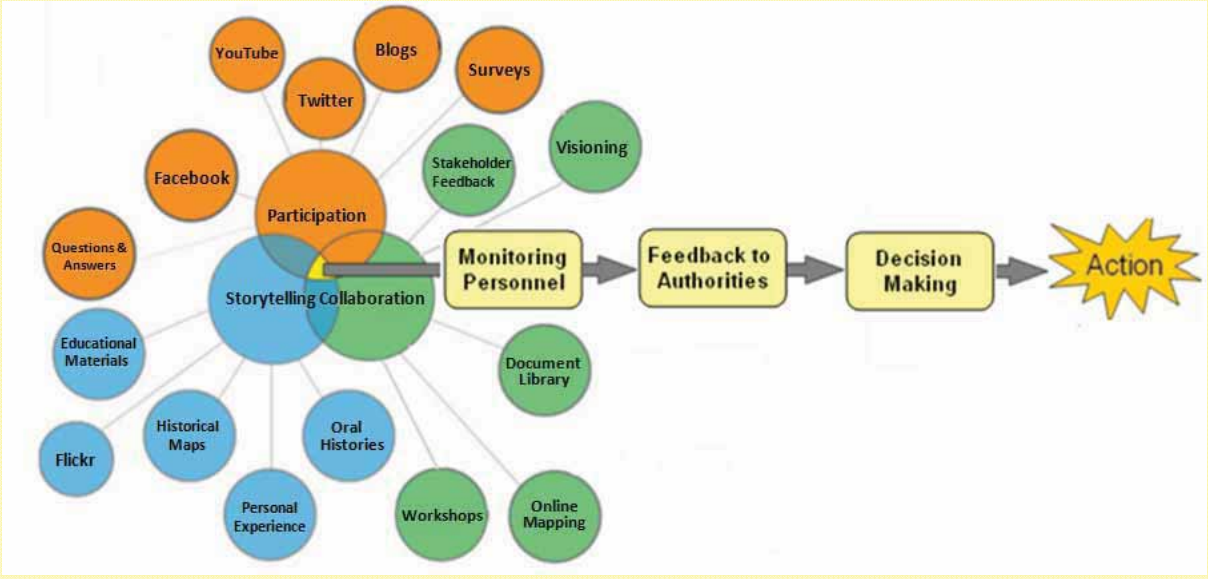
	Maputo	Matola	Beira	Pemba	Xai-Xai
SSG Points (Enhancing Urban Climate Resilience)	21	14	7	3	13
DSG Mechanisms					
SSG Points (Distribution of Impact on Informal Settlements vis-à-vis formal areas	-2	0	-4	4	4
DSG Mechanisms					

Table 15. ICT4DSG as a DSG Mechanism for Bridging Digital Divides:
Color Variation Reflects Intensity of ICT4DSG solution

Box 6. An Overview of ICT-based Social Accountability Mechanisms

Communities can harness the widespread prevalence of mobile phone and radio platforms to instantaneously monitor and communicate environmental issues and encourage environmental activism. These platforms help develop well-informed, aware citizens by fostering collaboration, participation, and idea-exchange and put them in real-time contact with elected officials or their offices.

The schematic below shows how such platforms constitute a mechanism towards inculcating more citizen-centric governments by providing residents the opportunity to conduct open dialogue, feedback, situation monitoring and idea-exchange with local governments and municipalities. This allows voters to have a direct impact and influence on their local governments, as officials are urged to take appropriate action based on prevailing views of constituencies. For instance, a mobile phone survey was conducted in urban areas of Southern Sudan via mobile phones that were provided to citizens, who were then asked a series of questions (over a period of time) to assess changes in their socioeconomic condition. Survey results were immediately conveyed to policymakers and local authorities, prompting them to action.



5.4. Needed Modifications to ICT-PARPA Framework

For public-sector institutions to effectively reduce poverty through ICT, policy frameworks must be sufficiently broadened so as to spur an enabling environment which could facilitate the rapid deployment of 'targeted' ICT interventions, that is, those that directly address poverty issues via tightly funneled ICT-PARPA initiatives. This can be achieved using a three-stage process which involves, firstly, ability of all stakeholders to partake in ICT interventions within the governance realm, ensuring that uptake of ICT interventions drives informed decision-making processes within government entities, and thirdly, ascertaining that ICT systems are compatible with local capabilities and work effectively to achieve intended objectives. In Mozambique, the most critical challenges to realizing the potential of ICT for this purpose are contextual: both technical and institutional. These challenges include:

- infrastructural and skilled manpower constraints
- weak enabling policies
- limited capacity of social intermediaries to scale up and secure sustainability
- weak partnerships among local stakeholders, and
- turf barriers among specialists concerned with ICT, governance, and social development.

To tackle these issues towards creation of an enabling environment, enhancements to the country's ICT-PARPA framework are needed. These can be grouped under three headings, and are discussed in the ensuing sub-sections.

1. Addressing Technical Constraints

- ***Promote Institutional Harnessing of the Mobile Platform:*** In view of the already extensive prevalence of mobile devices in cities, local governments in Mozambique are suitably placed to leverage ICT4DSG for e-government and social inclusion. Further, innovations in mobile appliances and solutions (for example, the SMS-based Ushahidi platform for geo-tagging or smartphone-based 'See-Click-Fix' application) are richly enhancing the scope of two-way government-citizen engagement. But as shown in Section 4 of this report, the mobile platform is currently not being harnessed in any major capacity in Mozambique for municipal services delivery. So to enhance citizen's participation in co-governance, leveraging the mobile telephony platform by local

governments can pave the way for greater government-citizen exchanges through ICT4DSG applications and also provide a means for remotely located communities to engage with government.

- ***Reduce Internet Access Tariffs for the Poor:*** Internet penetration is low in Mozambique at 2.8 percent, with most users concentrated in elite urban centers. Costly internet services due to high prices of national fixed fiber backbone connectivity (operated by state-owned Telecomunicações de Moçambique (TDM)) poses a major barrier towards greater ICT uptake amongst citizens, especially the poor.[n] While the arrival of two submarine cables at the coast of Mozambique in 2010 has lowered international connectivity prices by a factor of 10[o], the challenge remains to match those reductions with lowering the price of national backbone access for the poor to further enable these users to participate in ICT4DSG through the internet medium. Competition in the national fixed fiber sector and upgrading this network for greater bandwidth are needed interventions.

2. Cultivating Institutional Commitment and Culture for Harnessing ICT

- ***Ensure that public-sector institutions find value in ICT.*** For ICT systems to be effectively applied to the purposes of reducing poverty, local governments and other public sector institutions must be committed to embracing these systems and acting upon the information yielded through their use. In the arena of ICT4DSG, governments need to adapt and amend their own processes to become more responsive to these channels of citizen demand. To this end, it is necessary to ensure that local governments find adequate value--social, political, or financial--in using ICT systems. Research from various pilot programs worldwide has shown that initiatives such as media monitoring/reporting of ICT-based local government response to urban problems, or linking fiscal incentives to local governments based on their use of ICT systems, have proven successful in helping local governments find value in adopting ICT.

- ***Eliminate digital silos.*** One of the primary weaknesses of E-Government initiatives worldwide has been their silo-based approach, whereby each institution develops its own ICT capabilities without incorporating flexibility for integration with other systems. For instance, municipalities in Mozambique are currently unable to leverage electronic data-sharing with other agencies (such as INGC or ARA) in a coordination methodology that could address the issue of flooding, because each

[n] Note that despite high prices, availability of infrastructure has however improved considerably over the last few years and backbone services today reach all provinces in Mozambique.
[o] To illustrate: in 2008, a 2 Mbps dedicated line for 500 km was priced at US $ 7000 in Mozambique, nearly 40 – 60 times higher than United States or Europe.

institution has adopted a different data standard. To prevent the creation of digital silos, personnel from different agencies must closely collaborate when ICT projects are conceptualized and apply consistent standards or formats for data exchange to design inter-operable systems.

3. Empowering Social Intermediaries

- ***Equip intermediaries with needed tools, skills, and capacity.*** Inadequacy of resources, such as time, expertise, and information, often hinder individual citizens from exercising their client power over local governments to demand adherence to the 'social compact'. But social intermediaries, who often play the roles of organizers and citizen advocates, can help close the accountability loop on behalf of citizens. Recent advances in ICT (such as geo-mapping and crowd-sourcing applications, mobile apps, portals, and analytics) can vastly augment the role of social intermediary institutions. These institutions can use ICT4DSG tools on behalf of communities to amplify and aggregate citizens' voices, reduce access costs to information and media, help analyze information and detect patterns of poor service or corruption, and facilitate mobilization and collaboration with local governments.

- ***Render an enabling environment for intermediaries*.** Social intermediaries are essential actors in promoting good governance by demanding consultation, representation, transparency and accountability from authorities. But remaining largely dependent on international donors, association and involvement of intermediaries with Mozambican public sector institutions is limited and distant. [p] Yet, the success of applying ICT to social accountability depends on the extent to which civil society can enable communities to hold authorities and their representatives accountable. An enabling environment for intermediaries is therefore essential, and this in turn depends on favorable structural conditions. Factors typically favorable to an enabling environment include a legal and regulatory framework, political will, accessible government, freedom of information laws, open government, strong and independent media, independent judiciary, and independent accountability institutions.

5.5. Conclusion

The adoption of complex new products and services in public sector institutions of countries where subsistence lifestyles and widespread poverty are still common raises the question, whether rapid ICT adoption might be causing as much harm as good if it leaves the bulk of citizens untouched or isolated by a digital divide. Findings from this study suggest that within the framework of leveraging ICT

[p] Based on interviews with the NGO community in Mozambique.

for public-sector reform in Mozambique, differences in municipal resources and governance structures have led to a situation where ICT capabilities have been better developed in the cities that are of greatest economic significance, and least developed in cities where economic output is smallest. But significantly, the digital divide in ICT's impact appears to be widest in the better equipped, wealthiest cities, and narrowest in the lower capacity smaller ones.

So in view of the distance that Supply-Side ICT has yet to traverse in Mozambique, it is recommended that dimensions of ICT-PARPA framework be sufficiently broadened to increase citizen participation and social accountability. To this end, the report remains optimistic on three fronts regarding the possibility and potential of harnessing Demand-Side ICT for overcoming the digital divide in Mozambique and other low capacity countries. First, mobile-phone availability and Internet access are steadily improving in the country, rendering greater digital access to citizens. Second, innovations in ICT are themselves allowing for the rapid creation of ICT4DSG platforms and methodologies. And third, examples of ICT4DSG in regions worldwide illustrate the readiness of citizens and social intermediaries to engage with their governments through this platform, given the appropriate enabling environment. To better deliver on the social compact, especially towards the poor, local governments are thereby encouraged to participate in the uptake of cost-effective crowdsourcing methodologies, which can even render low human and economic resources a non-problem in certain areas of work, such as community mapping of drainage overflow points.

In other words, E-Government must be expanded to allow a flow of information and critique "upwards" from grassroots activists and residents as much as it allows the traditional flow "downwards." However, the flourishing of such a two-way government-citizen engagement model will necessitate facilitation of a suitable enabling environment which can be nurtured through calibrations along technical and socio-institutional dimensions. These changes will spearhead greater digital inclusion in governance of disadvantaged communities and their social representatives, while also bolstering absorption of ICT4DSG systems within institutions.

Achieving these measures will require a determined resolve amongst authorities towards reform. But policymakers and practitioners would be wise to discern the urgency factor concerning the growing tribulations afflicting the poor, such as climate change and its accompanying perils.

ANNEX A:

MUNICIPAL GIS SCREENSHOTS

Maputo Municipal GIS

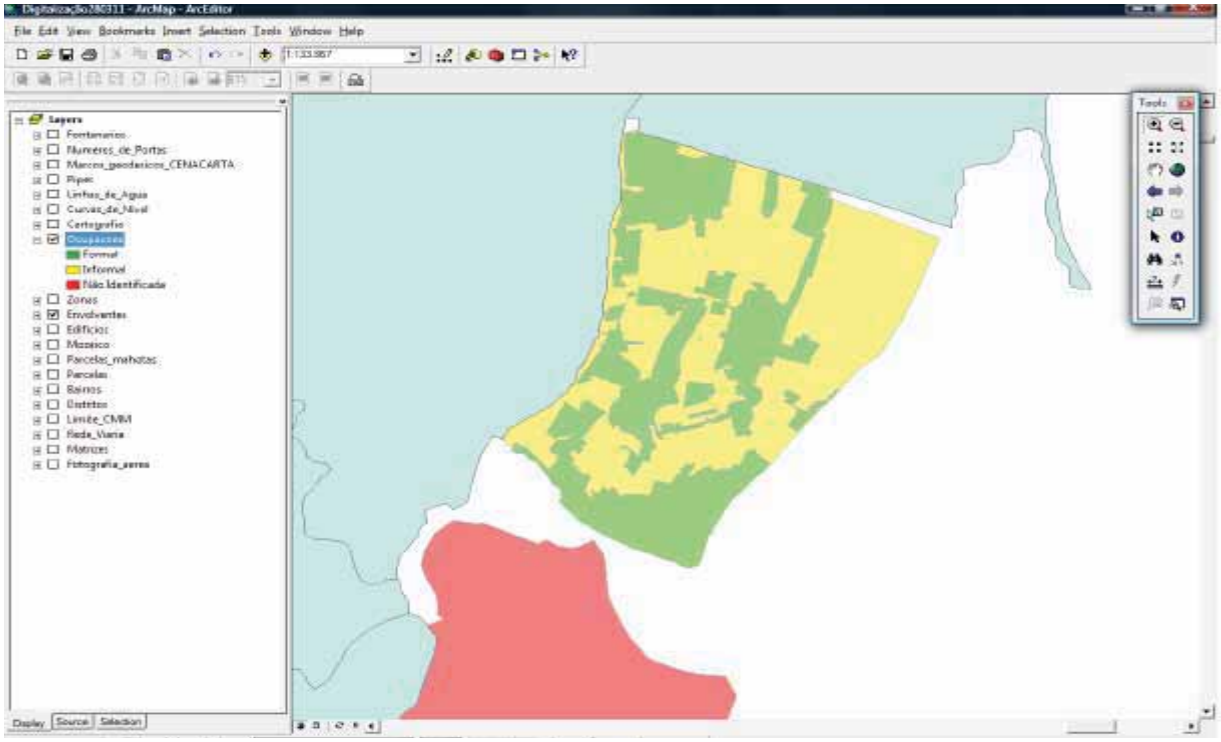


Figure A1. Depiction of Formal/Informal Settlements

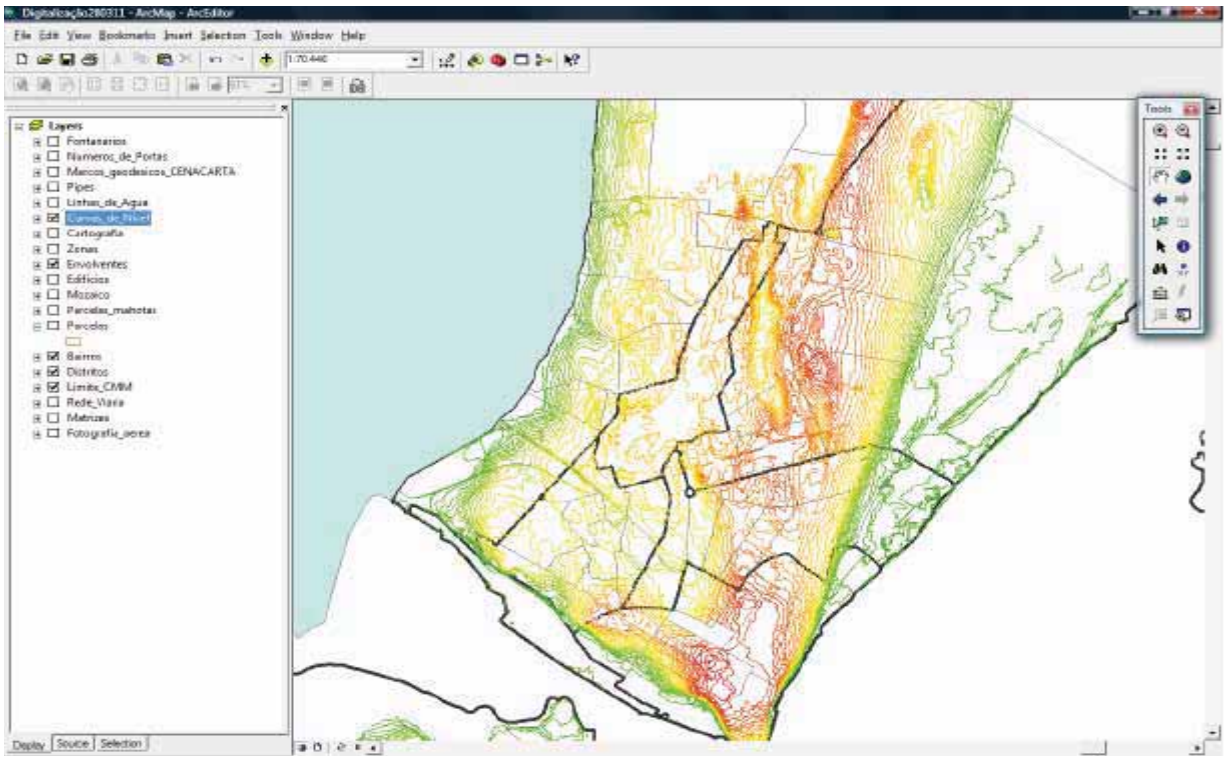


Figure A2. Depiction of Topography

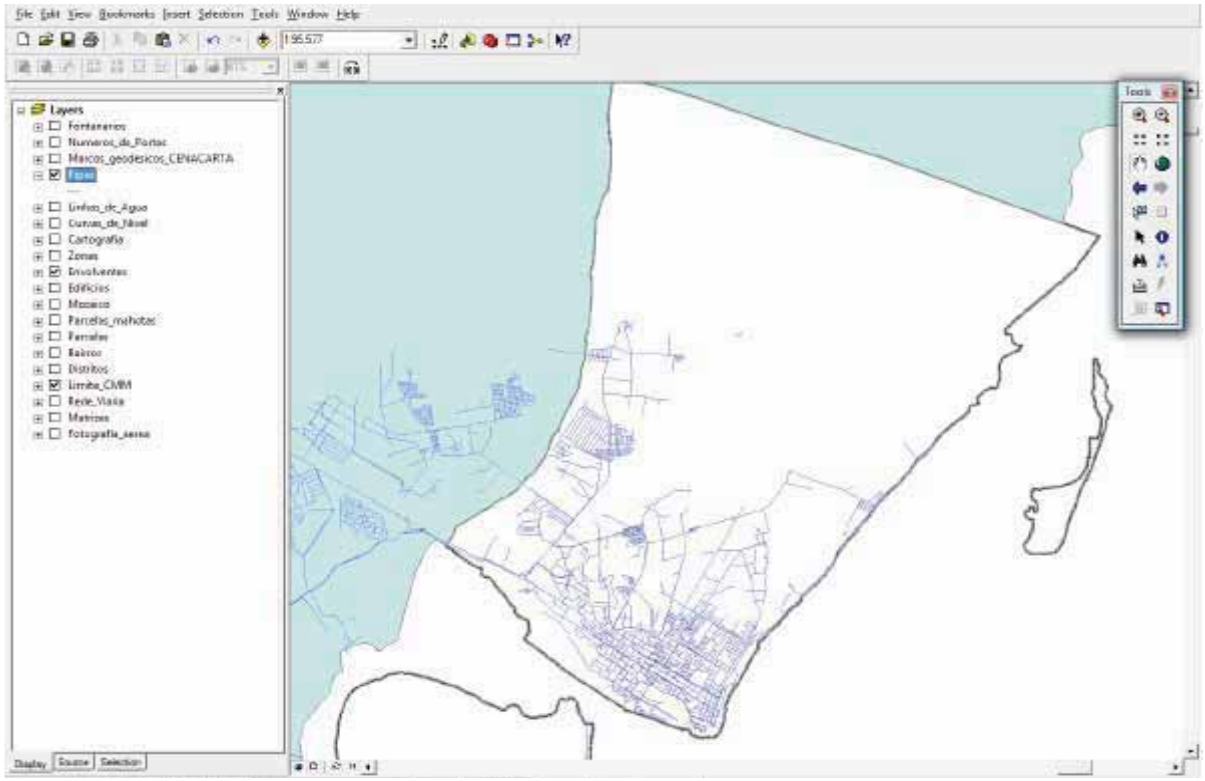


Figure A3. Depiction of Drainage network

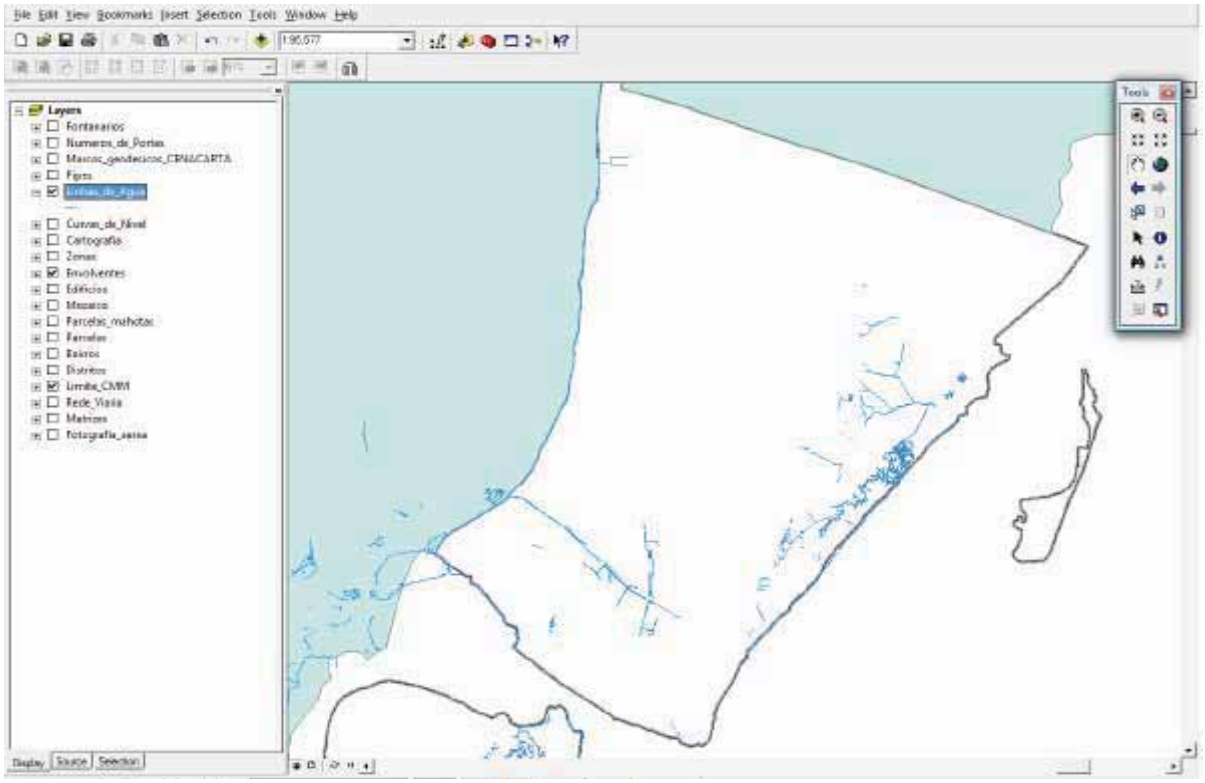


Figure A4. Depiction of natural watercourses

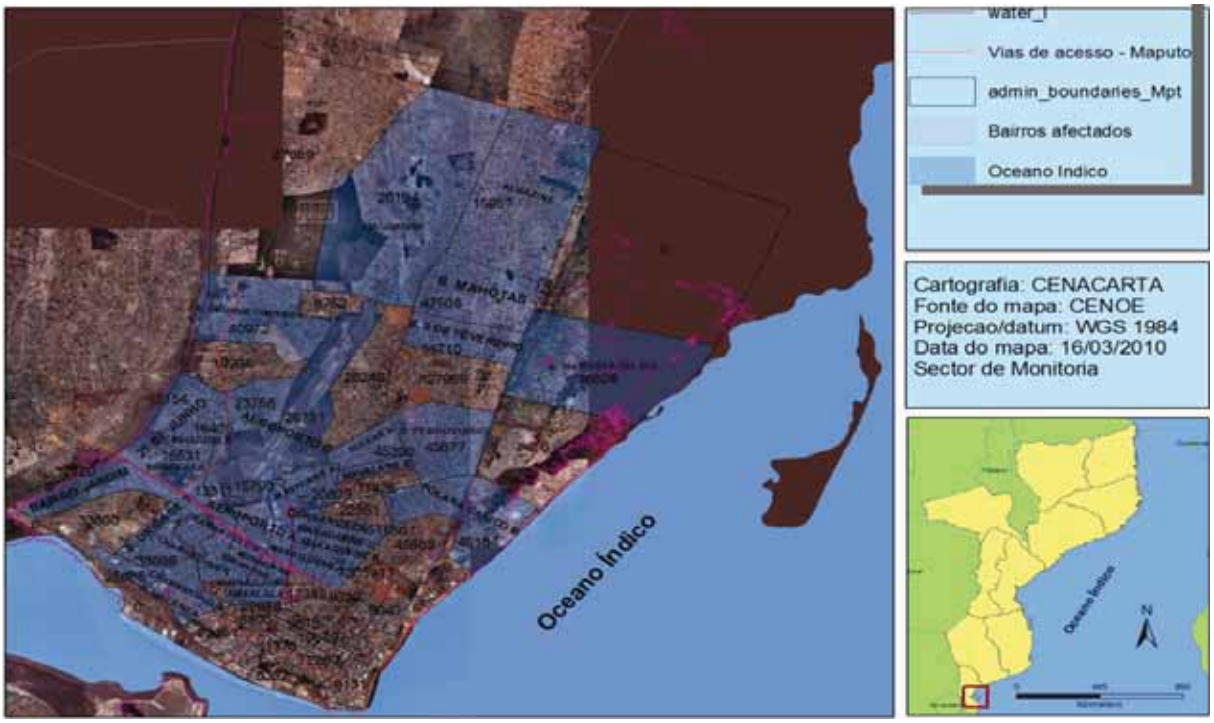


Figure A5. Depiction of Flood-prone localities in Maputo INGC GIS

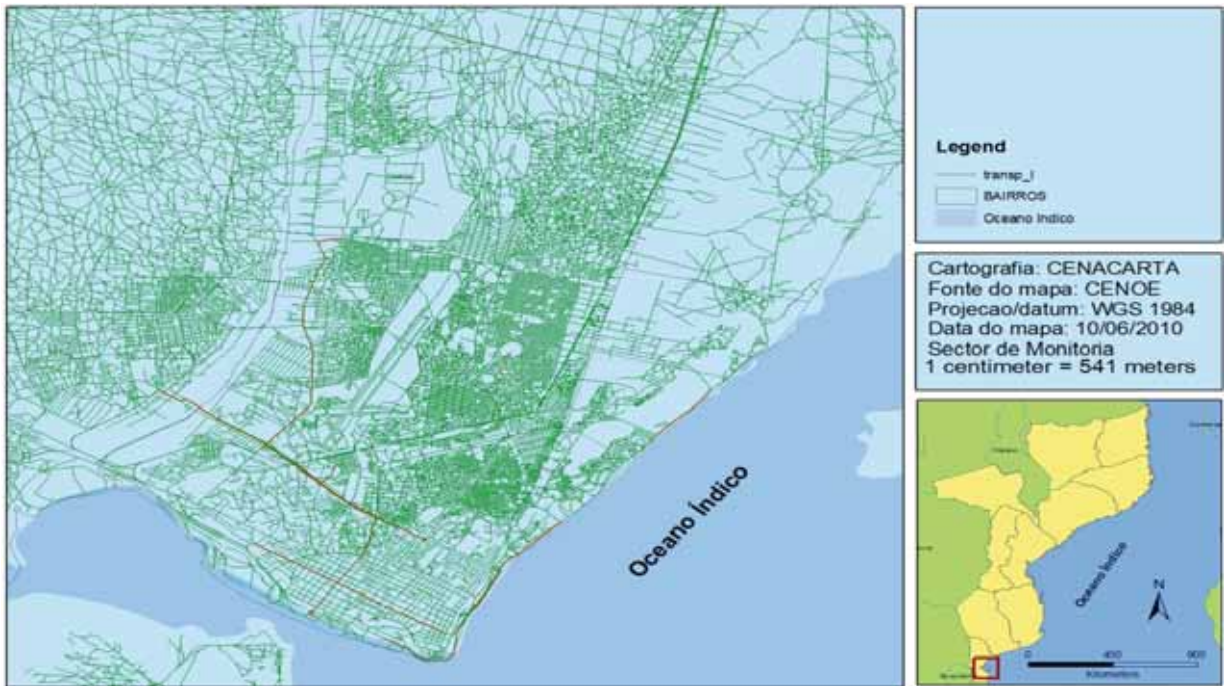


Figure A6. Depiction of road network in Maputo INGC GIS

Beira Municipal GIS

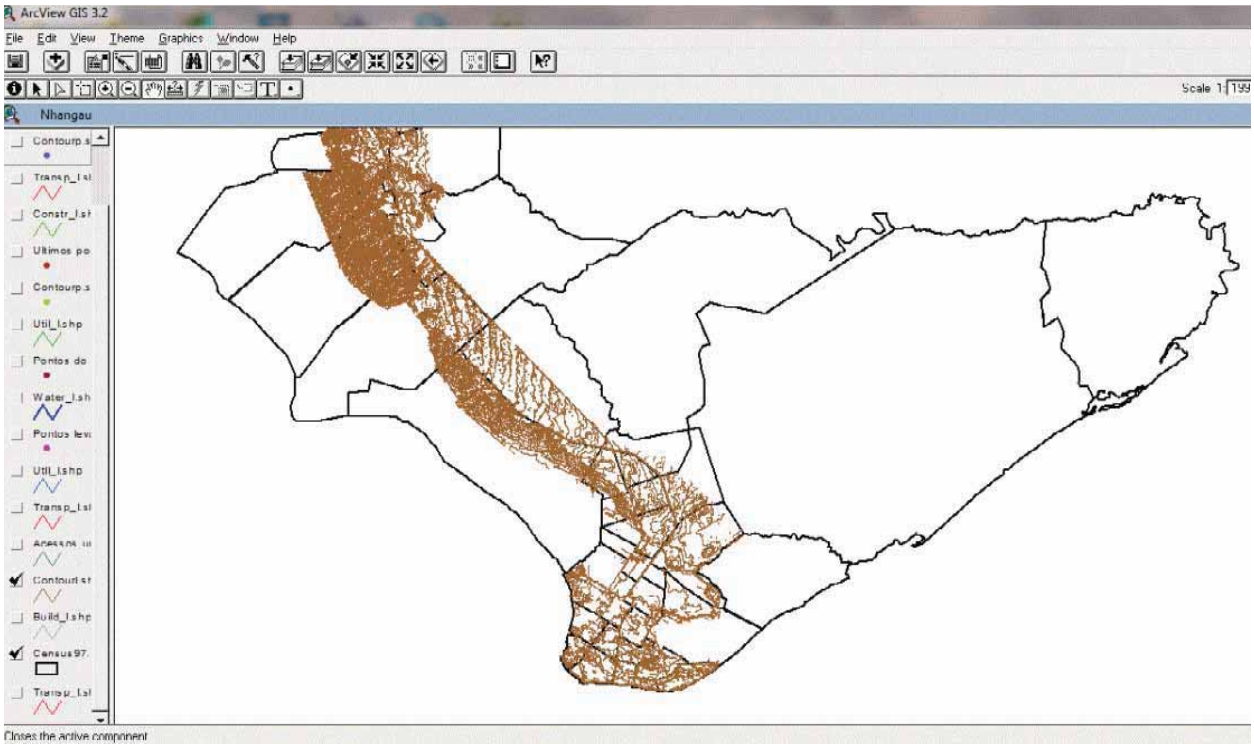


Figure A7. Depiction of Topography

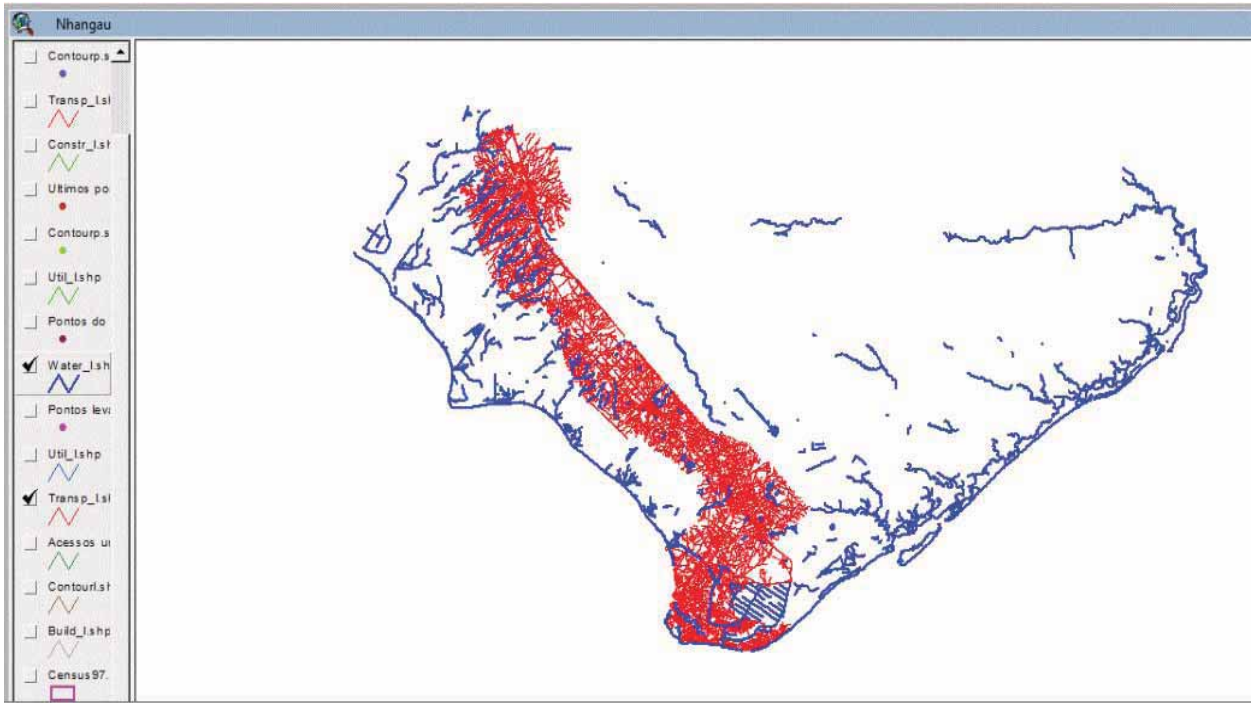


Figure A8. Depiction of Drainage+Canal system overlaid with Road network layer (in Red)

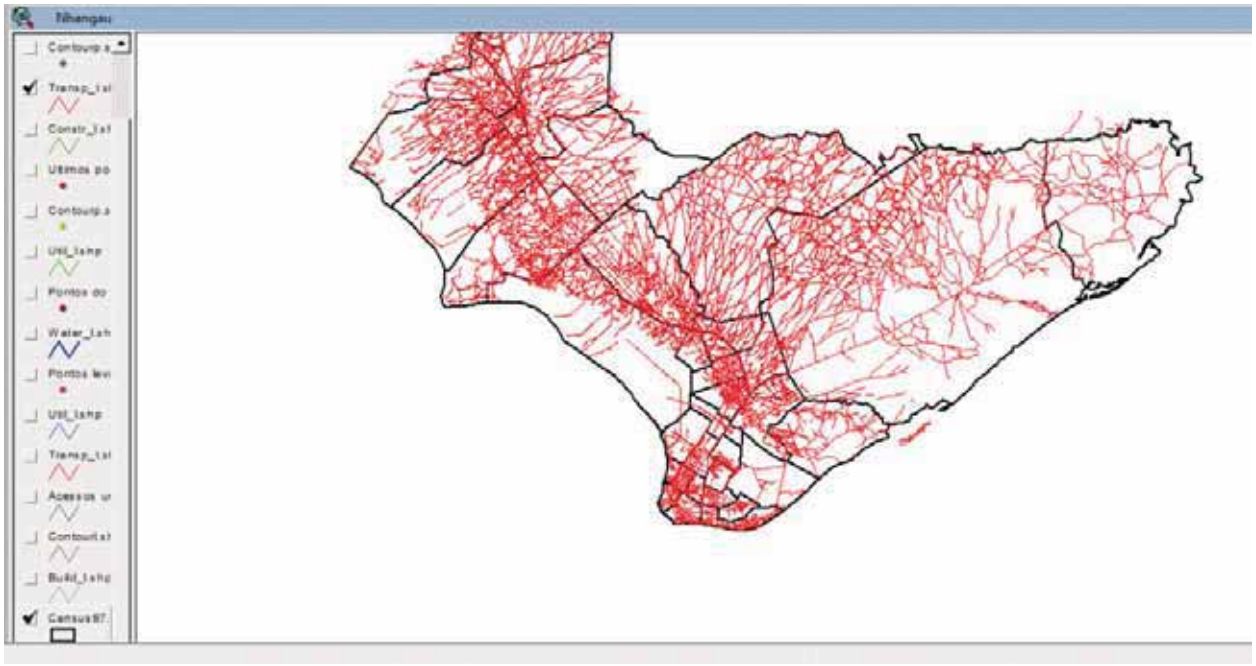


Figure A9. Depiction of District-level Road network

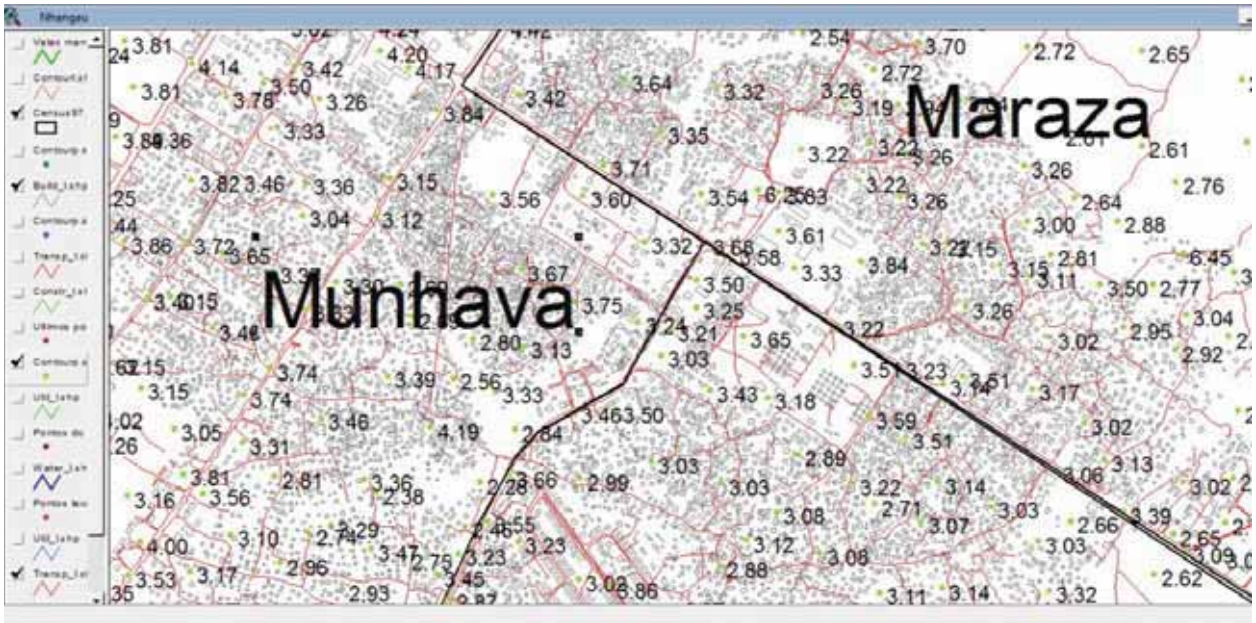


Figure A10. Depiction of Informal Settlements overlaid with Topography layer

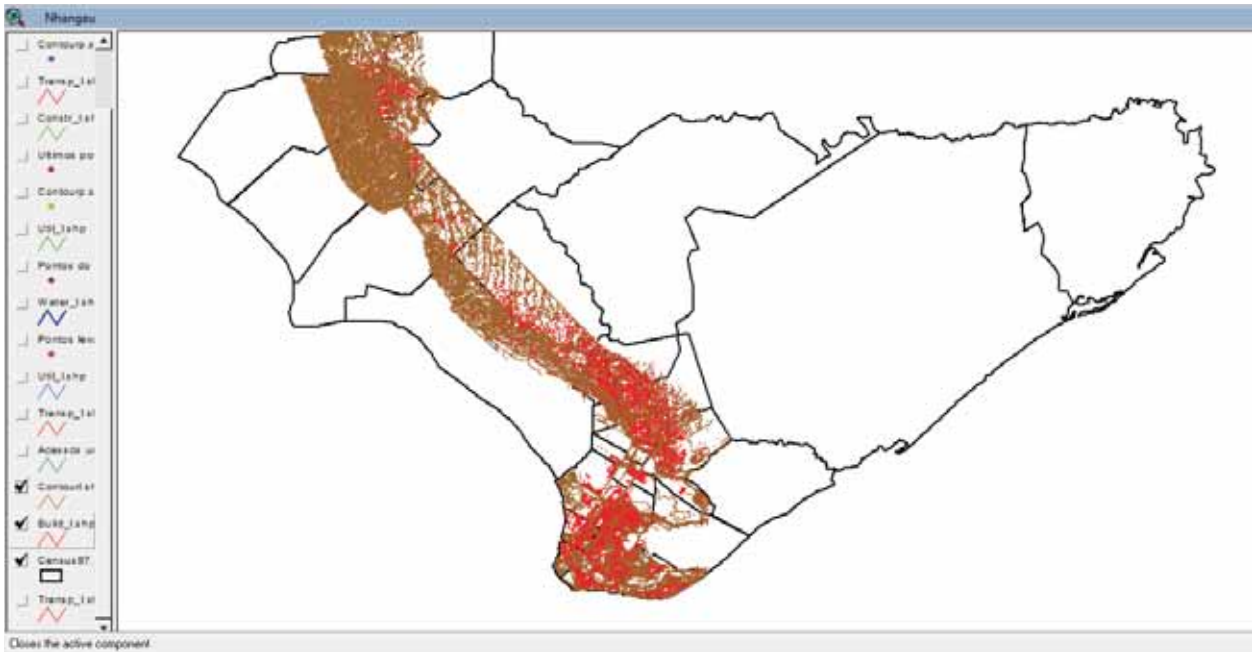


Figure A11. Depiction of Topography layer overlaid with Settlement areas

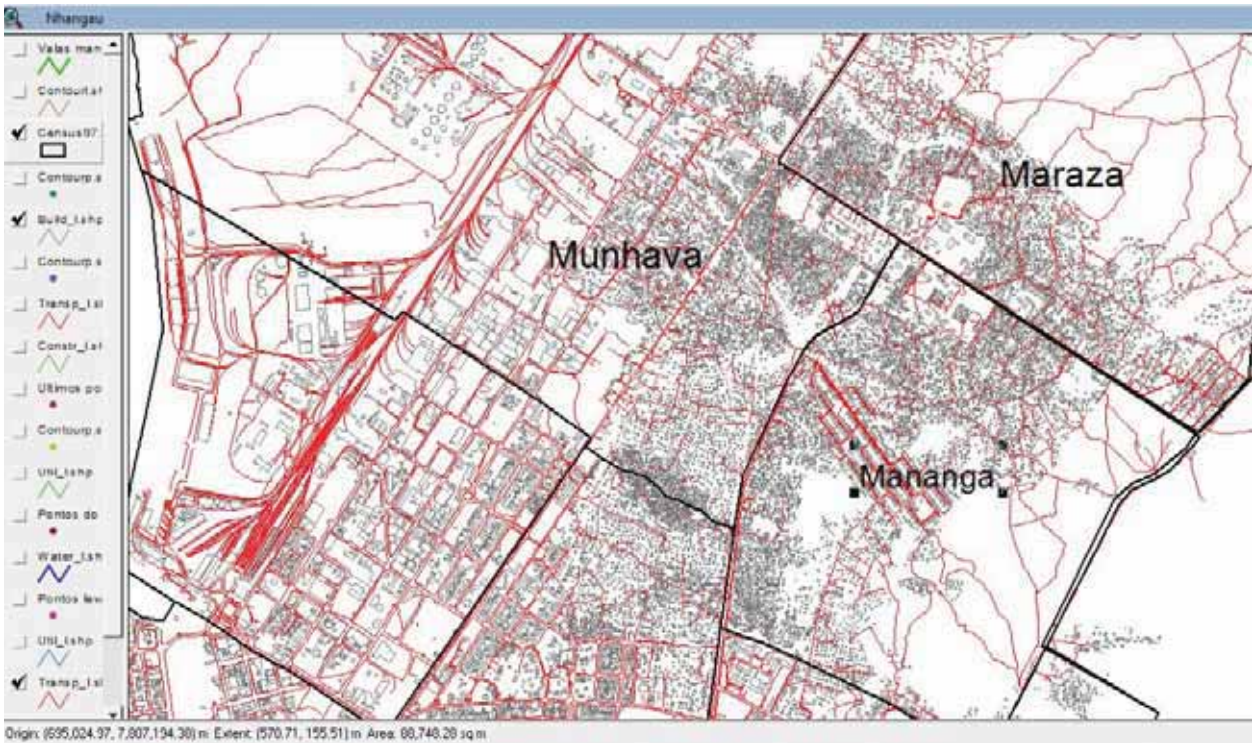


Figure A12. Depiction of Informal settlements overlaid with Road network layer

Xai-Xai Municipal GIS

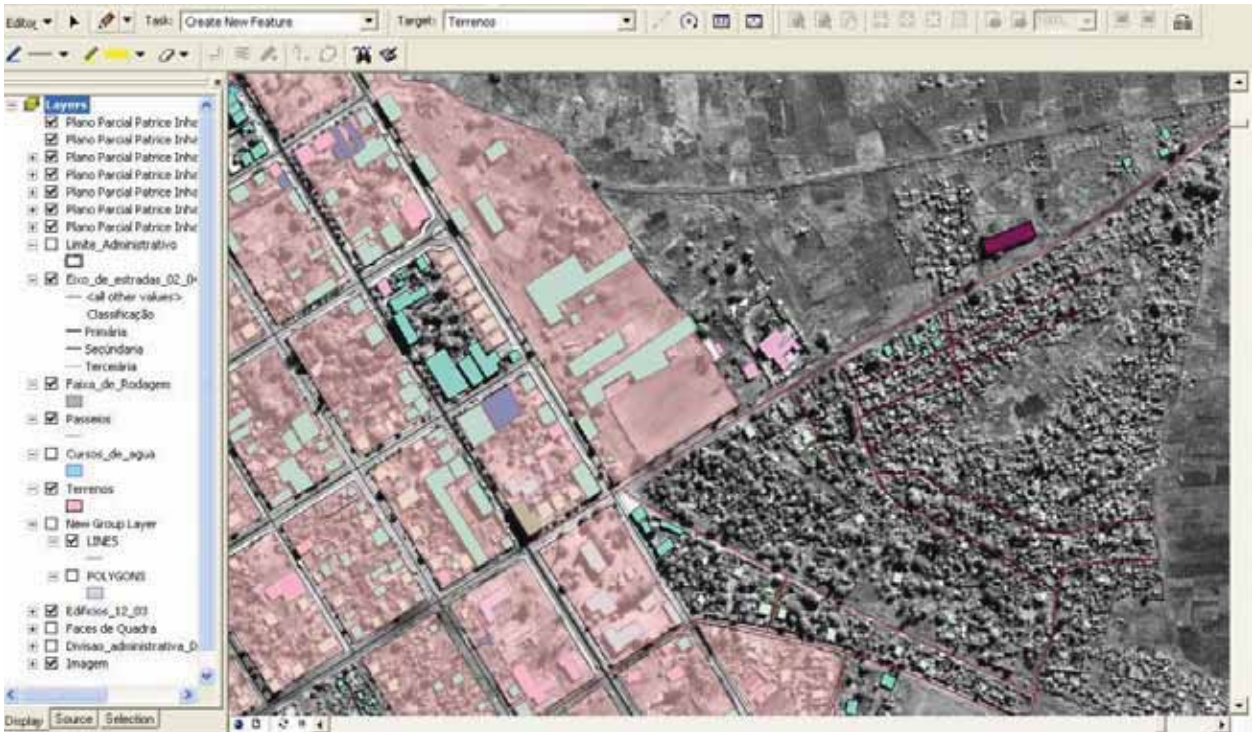


Figure A13. Depiction of Formal/Informal demarcations overlaid with Road network and Structure-type layers

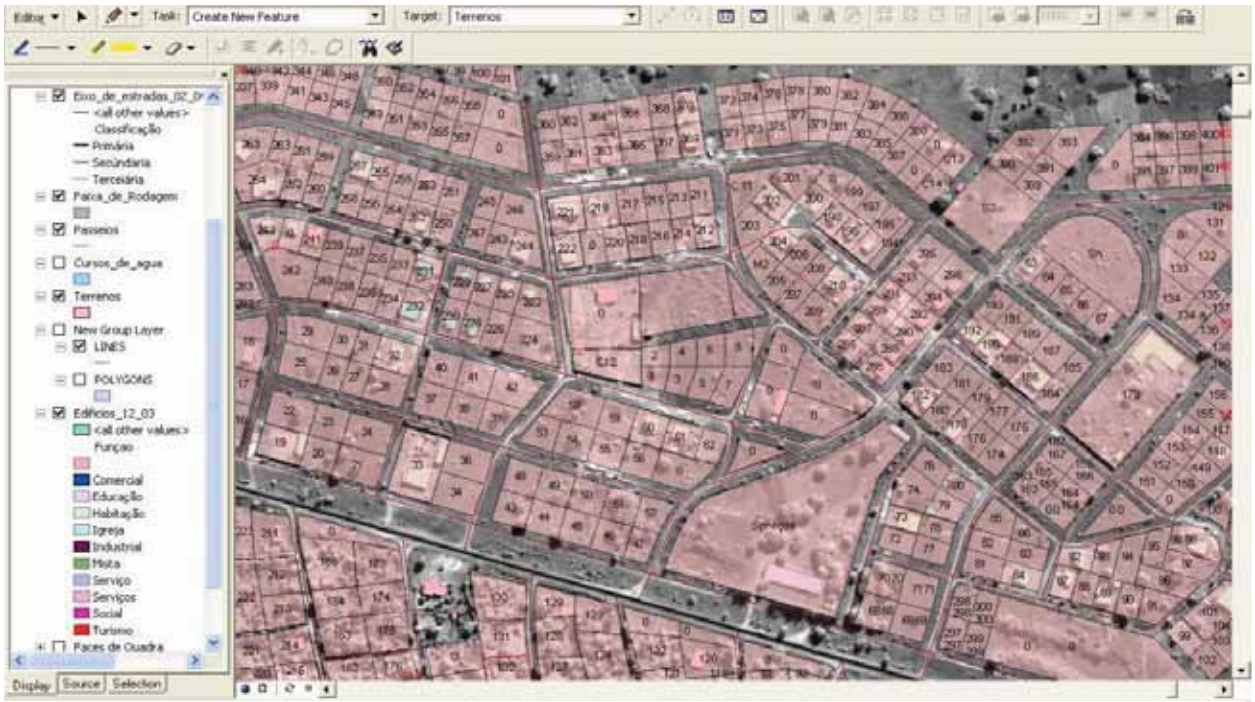


Figure A14. Depiction of Plots overlaid with Structure-type layer
(Note: Hospitals/clinics depicted under Social Category)

Matola Municipal GIS

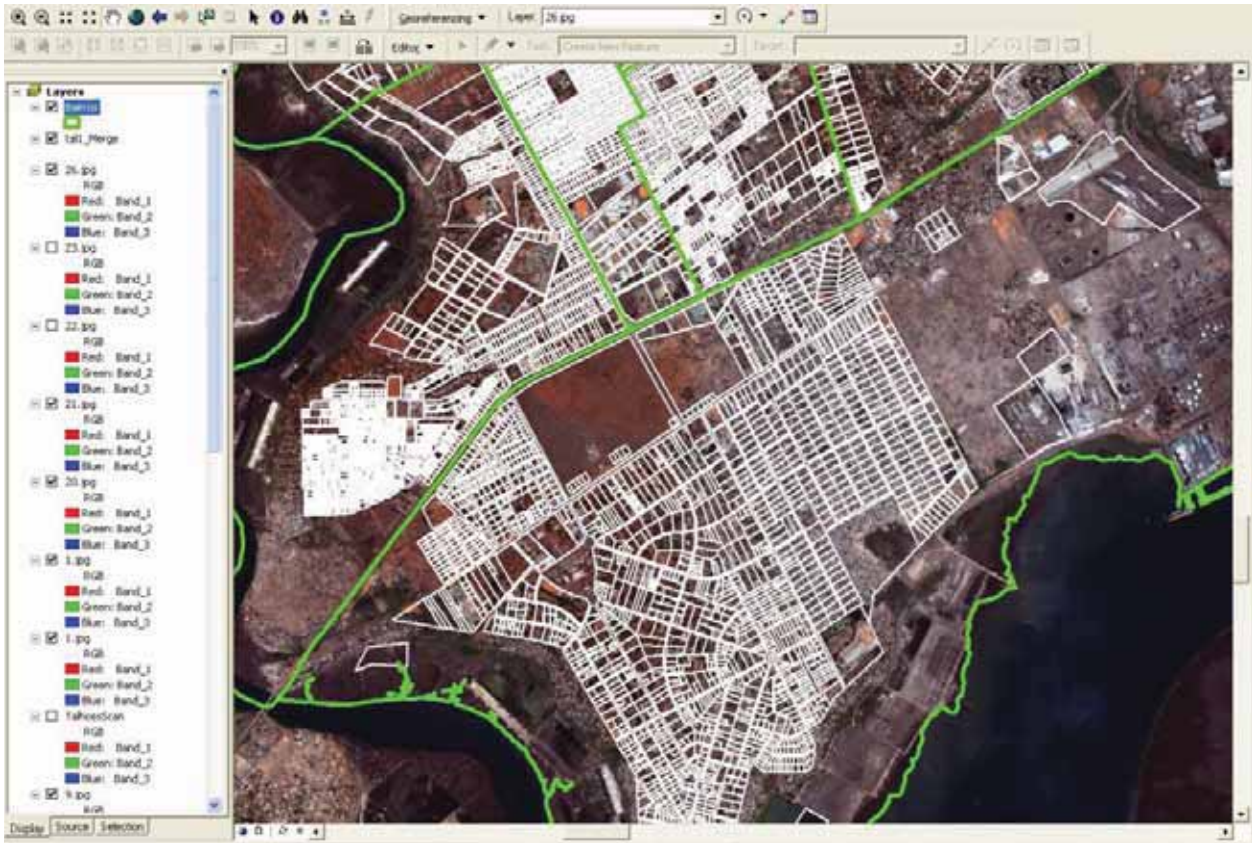


Figure A15. Depiction of Formal Settlements

ANNEX B:

OVERVIEW OF SIGEM (SCREENSHOTS)

Figure B1. The Capability of SIGEM to display cadastral information related to plots

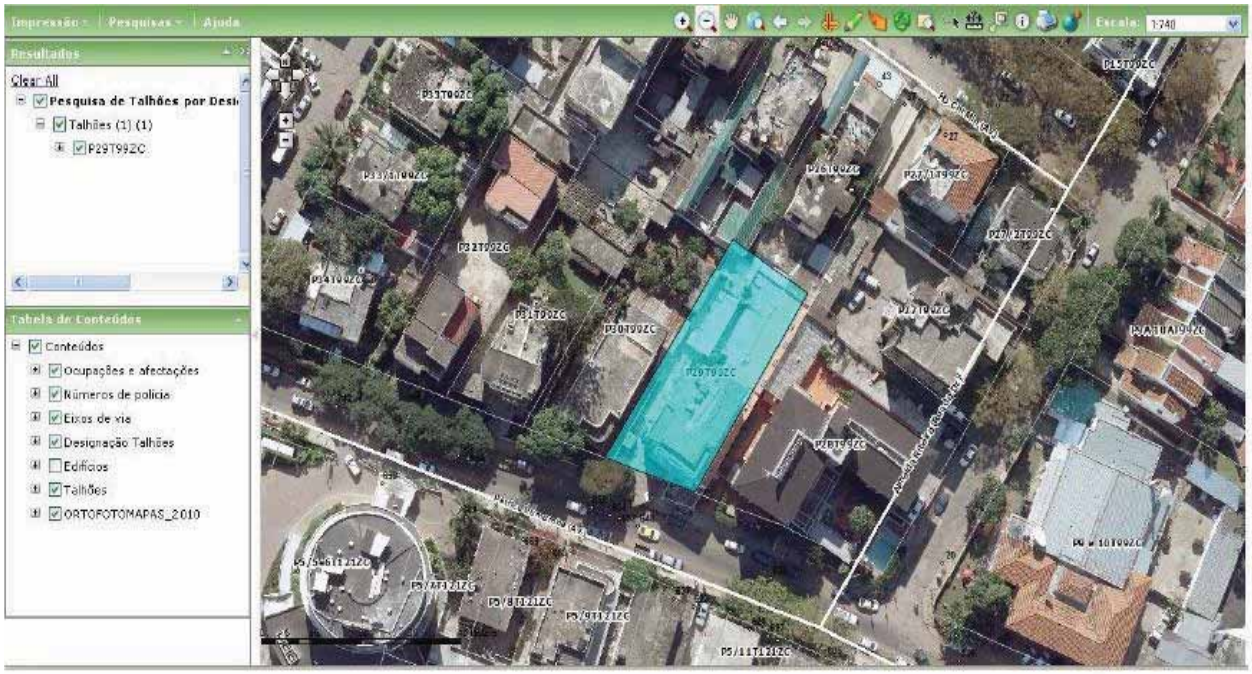


Figure B2. Capability of SIGEM to identify and display plots

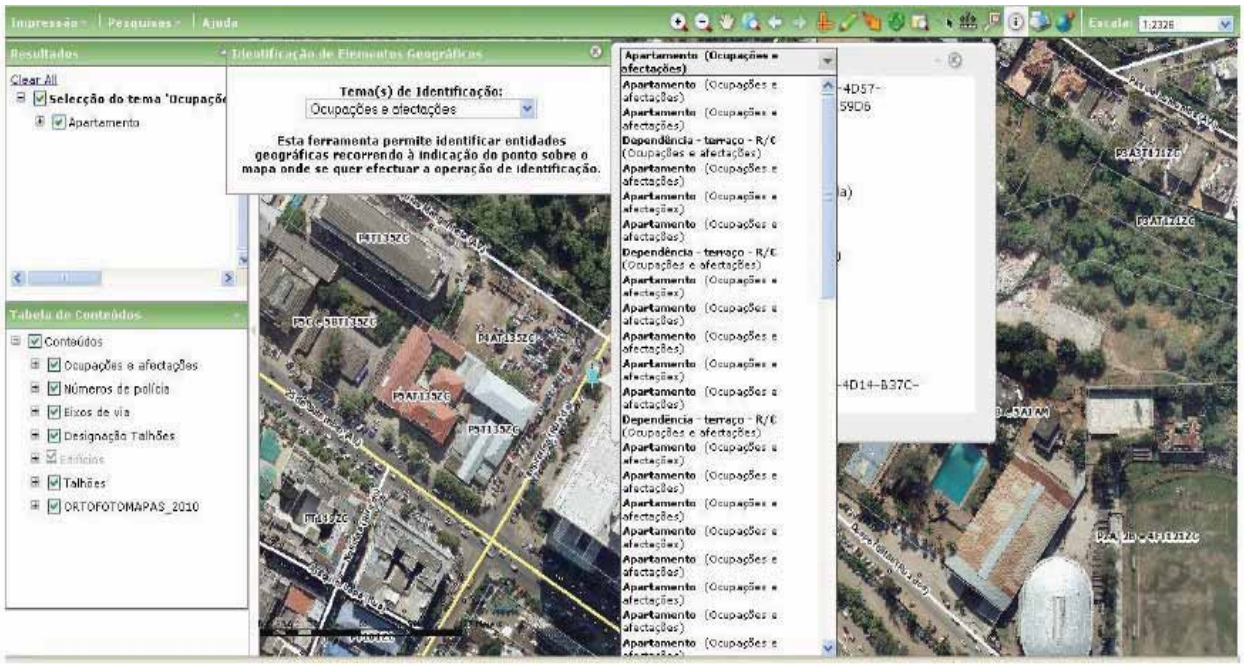


Figure B3. Using SIGEM to identify and display information on residents of buildings along with job occupations

Figure B4. Capability of SIGEM to identify and display roads

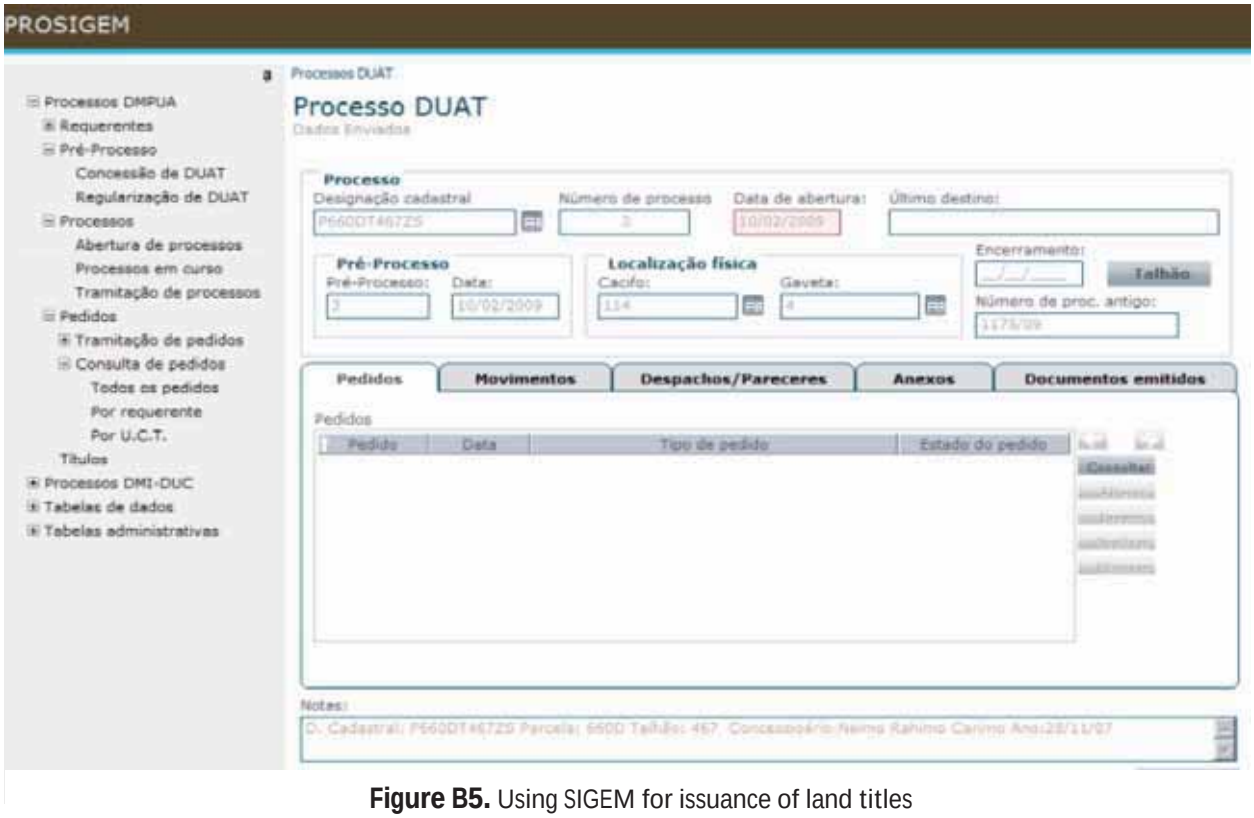


Figure B5. Using SIGEM for issuance of land titles

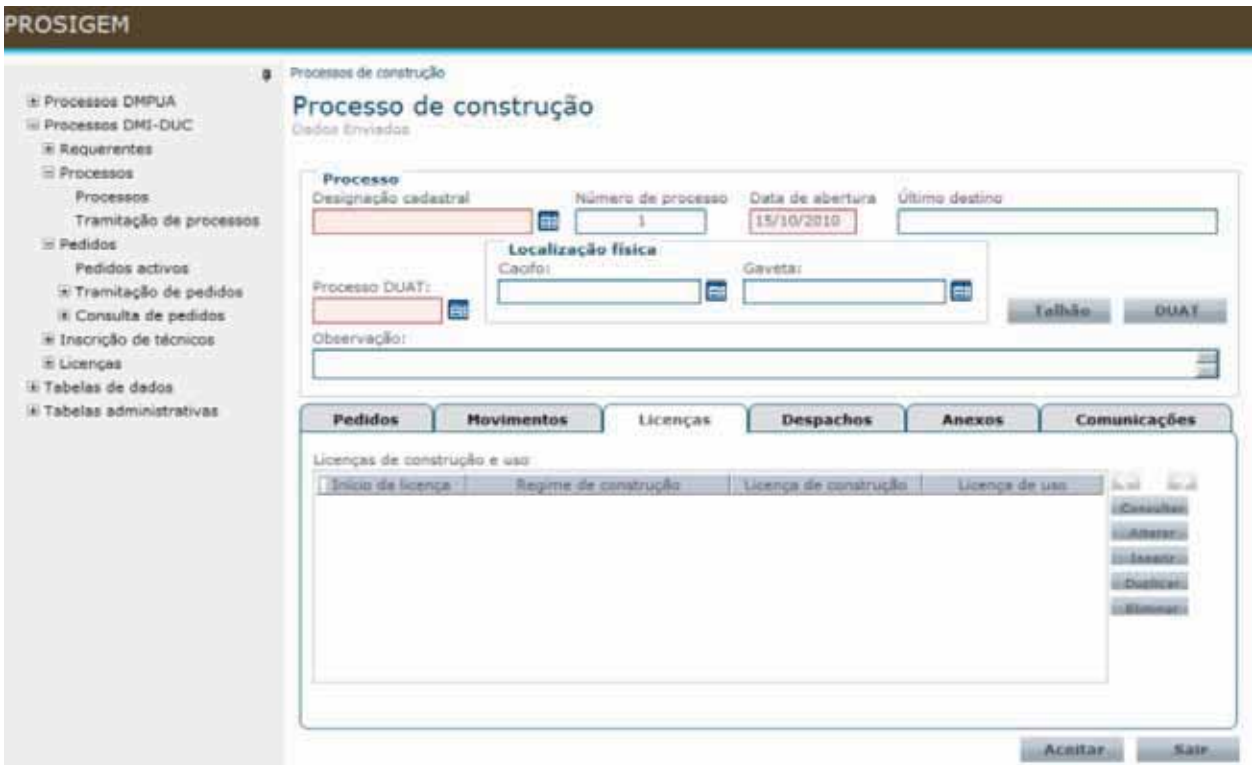


Figure B6. Using SIGEM for issuance of construction licenses

ENDNOTES

[1] UNEP and AMCEN, *Africa Environment Outlook.*
[2] The Maputo metropolitan area includes Matola, Beira, Nacala, Xai-Xai, Inhambane, Maxixe, Quelimane, Angoche, Ilha de Moçambique, Pemba. This list does not include coastal cities with less than 30,000 inhabitants.
[3] World Bank, *Urban and Local Government Strategy Report* (2009).
[4] World Bank, *Climate Change, Disaster Risk, and the Urban Poor: Cities Building Resilience for a Changing World* (Summary) (Washington, DC: 2011); available at http://wbi.worldbank.org/wbi/Data/wbi/wbicms/files/drupal-acquia/wbi/disaster_risk_urban_poor_final.pdf
[5] UNISDR, *2009 Global Assessment Report on Disaster Risk Reduction* (New York: 2009).
[6] World Bank, *Mozambique Country Water Resources Assistance Strategy: Making Water Work for Sustainable Growth and Poverty Reduction* (Washington, DC: 2007).
[7] IPCC, *Climate Change 2007: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the IPCC* (Cambridge: Cambridge University Press, 2007).
[8] World Resource Institute, World Greenhouse Gas Emissions Flow Chart, available at http://www.wri.org/chart/world-greenhouse-gas-emissions-flow-chart; David Satterthwaite, "Cities' Contribution to Global Warming: Notes on the Allocation of Greenhouse Gas Emissions," *Environment and Urbanization,* Vol. 20 (2008): 539-49.
[9] Nicholls, R.J., Hanson, S., Herweijer, C., Patmore, N., Hallegatte, S., Jan Corfee-Morlot Jean Chateau, and Muir-Wood, R., "Ranking of the World's Cities Most Exposed to Coastal Flooding Today and In the Future," OECD Environment Working Paper No. 1 (Paris: OECD, 2007).
[10] Based on author discussions with officials from the Ministry of Science and Technology.
[11] A. Bhavnani, R. Won-Wai Chiu, S. Janakiram, and P. Silarszky, *The Role of Mobile Phones in Sustainable Rural Poverty Reduction,* (Washington: World Bank, 2008).
[12] R. Crandall, W. Lehr, and R. Litan, "The Effects of Broadband Deployment on Output and Employment: A Cross-Sectional Analysis of U.S. Data", *Issues in Economic Policy* (Brookings Institution, July 2007).
[13] International Telecommunications Union (ITU) data, 2010. Available online at http://en.wikipedia.org/wiki/List_of_countries_by_number_of_Internet_users
[14] World Sites Atlas data, 2008. Available online at http://www.sitesatlas.com/Thematic-Maps/Internet-hosts-per-capita.html
[15] S. Dhar "Massive Digital Divide in the Land of IT", IPS News Report, Nov 2011. Available online at: http://ipsnews.net/news.asp?idnews=105725
[16] Source: http://www.vir.com.vn/news/business/corporate/viettel-launches-mobile-services-in-mozambique.html.
[17] E-Government Interoperability Framework https://www.portaldogoverno.gov.mz/docs_gov/outros/eGIF4M_v1_1web.pdf

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With over 35 million new urban residents each year, sub-Saharan Africa is undergoing the world's fastest urbanization—placing immense pressure on the region's resource-constrained local governments towards maintaining and improving livability standards of their cities. Simultaneously, the explosive growth of Information and Communications Technologies (ICT) across urban Africa, as evidenced by rapidly rising mobile and internet penetration rates within cities, is creating new opportunities for improving efficiency, transparency, and responsiveness of local governments, which are increasingly integrating ICT within their urban agenda.

By conducting a reconnaissance of the thematic interplays between ICT, Urbanization, and Climate Change, *Municipal ICT Capacity and its Impact on the Climate-Change Affected Urban Poor* investigates the impact of local government-level ICT adoption in Mozambique, a rapidly urbanizing country whose government is committed to leveraging ICT in an anti-poverty direction. Given the socio-economic importance of Mozambique's coastal cities and their susceptibility to regular climate hazards, this report evaluates Mozambique's ICT policy framework by analyzing the efficacy of municipal ICT tools along a dimension that disproportionately affects the poor more, namely vulnerability to flooding—a reality worsening each year due to the effects of climate change.

Against such backdrop, this case study on Mozambique stands to serve as a valuable resource guide to a wide range of practitioners, including policymakers, urban specialists, ICT and climate change enthusiasts, as well as social accountability activists.