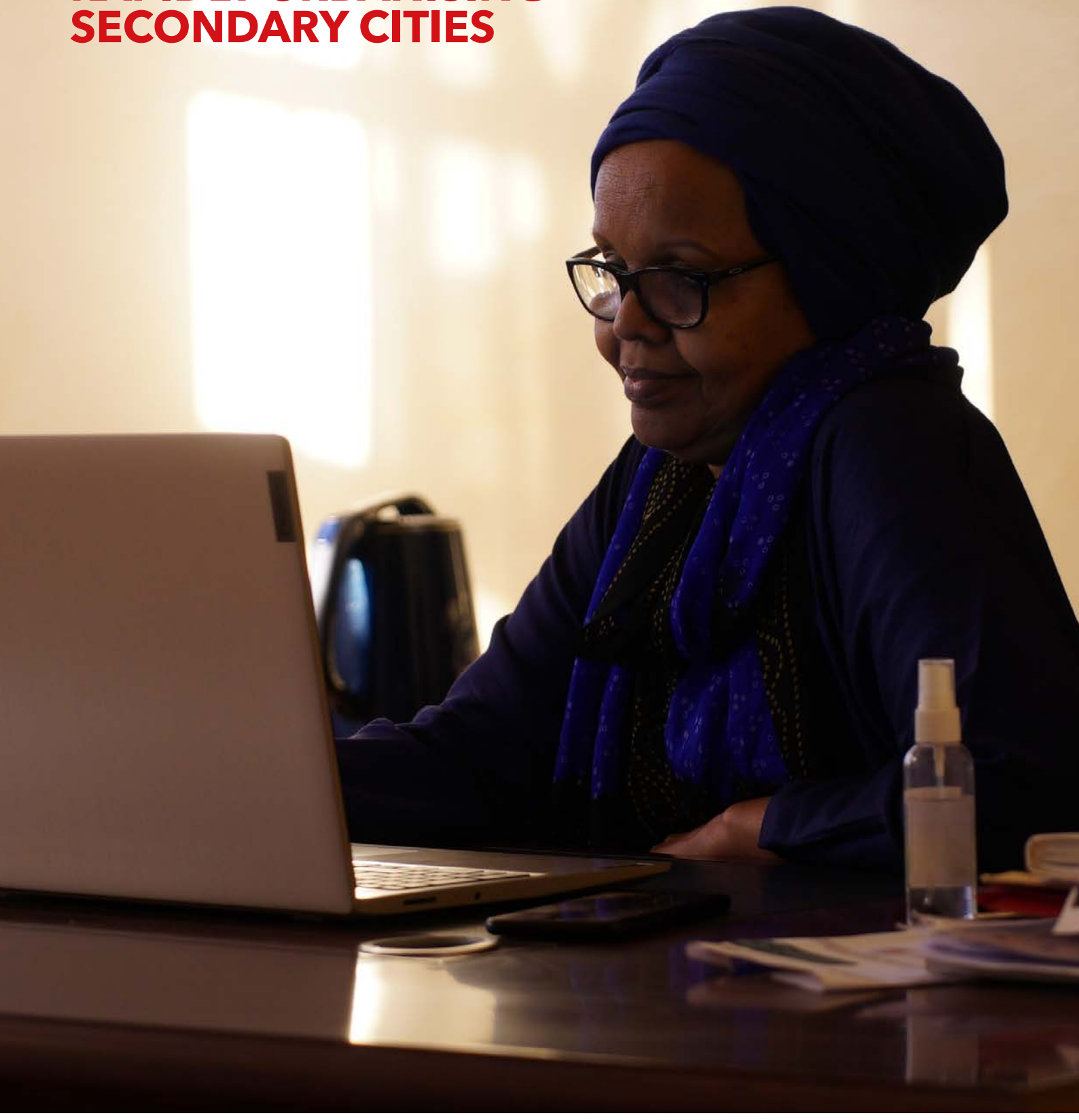
The Cities Alliance
Cities and Migration Programme

DIGITAL PRIORITIES FOR RAPIDLY URBANISING SECONDARY CITIES



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Disclaimer

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CONTENTS

EXECUTIVE SUMMARY

This knowledge product builds on Cities Alliance's previous work on the role of digital innovation in urban areas of low and middle-income countries (LMICs) around the world. It focuses on secondary cities, in which the majority of urban growth is occurring and where there are significant challenges resulting from unplanned and chaotic urban development, highly mobile populations, and low levels of economic productivity. These are further compounded by the gradually worsening impacts of climate change, such as cyclones, flooding, extreme heat, and landslides.

As explored in a recent study by Cities Alliance,[1] digital innovation is already having a significant impact in urban areas in LMICs, helping to create a productive and inclusive environment for rapidly urbanising cities using solutions enabled by digital technology and driven by the needs and agency of the urban poor and marginalised.

This study begins with a brief summary of the intersection of three key megatrends:

rapid urbanisation, digital transformation, and climate change.

It then sets out the key areas in which digital solutions are making an impact based on the pillars of the Cities Alliance Future Cities Africa (FCA) Programme:

economy, environment, governance and citizenship, and service delivery.

The second section provides a brief overview of the enabling environment for digital innovation, such as mobile and internet connectivity, data availability and quality, human resources and digital skills, data security and privacy, private sector innovation and new business models and the role of partnerships.

The main considerations and best-practice measures for digital inclusion are also introduced to maximise the number of people that are able to benefit from ICT-based solutions and to ensure inclusive uptake of efficient digital tools for sustainable and equitable economic development.

1 Cities Alliance. 2020. *Smart Technologies for More Equitable City Economies.* Cities Alliance/UNOPS: Brussels.

Digital solutions by themselves are not a panacea to complex urban challenges, and the link between digital innovation and urban inclusion is far from obvious. Digital inclusion is an essential component of the wider economic transformation roadmap for cities. Typical barriers to digital interventions include access and accessibility, skills and confidence, data privacy, and online security.[2] It is vital that solutions are designed to represent and serve all in society. While persons with disabilities, women and girls, the very poorest, ethnic groups, Indigenous peoples, rural-urban migrants, and forcibly displaced persons (refugees and internally displaced persons, or IDPs) are typically the most excluded from digital access, the need to proactively ensure digital literacy and inclusion is far wider.

2 Digital Inclusion Toolkit. 2022. "Barriers to Digital Inclusion." Webpage accessible at https://digitalinclusionkit.org/barriers-to-digital-inclusion/.

This section also introduces the concept of digital readiness and the gradual evolution of urban areas to become able to implement or encourage private sector development of more complex data ecosystems and solutions.

Building on these foundations, the main aim of this knowledge product is to showcase five particularly high impact areas of digital innovation and to provide practical recommendations to city managers on how to enable similar innovation in their jurisdictions. These five areas are:

Mobile big data (MBD) sources to understand highly mobile populations

In the absence of reliable and frequently updated data sources, mobile big data can be used to gain insights into population location and typical daily and longer-term movements, as well as many other socio-economic aspects. This can support more resilient urban development and early warning systems and contribute to infrastructure and transport planning.

Digital systems for land governance and tenure

Digital solutions can transform the ability to implement cost-effective land tenure registration. This must be done in a participatory way, helping to empower women and marginalised groups. ICT-based systems for effective land governance support urban planning and commercial land markets, unlocking investment in infrastructure and urban development.

Increasing tax revenue with digital systems

Digital innovation can be used to increase revenue from taxes. Digital tools such as analysis of satellite or drone imagery to categorise properties and apply a simple points-based system can make property tax calculation and revenue generation substantially more effective, providing much-needed revenue to cities.

Digital innovation for sanitation and waste management services

Digital solutions can support solid waste management and sanitation in many ways. For example, open-source mapping platforms, or analysis of satellite or drone imagery, using machine learning can support governments and private sector partners to identify plastic waste hotspots. Mobile apps and marketplace platforms can help connect people and businesses within the waste management value chain, making it more efficient and cost effective. Mobile app-driven, container-based sanitation (CBS) solutions can also make a vast difference to service delivery.

E-governance services to support livelihoods

Services such as business registration and license acquisition, property tax calculation and collection, and early warning system alerts are a few examples of what can be offered on e-governance. Offering public services on government-supported digital platforms enables an integrated approach to making cities liveable and supports the livelihoods of citizens.

For each area, an overview is provided of the potential to address urgent challenges. They include explanations of typical partnership models and case studies, along with learning points that can be applied. Each section ends with concise, actionable, and practical recommendations for city managers.

Overall, digital transformation offers much promise to secondary cities and other urban areas throughout LMICs. There are already many tried-and-tested examples of how digital solutions can support more inclusive and sustainable economic transformation in the context of rapid urbanisation, including across the five priority areas featured in this document. Each urban area and municipal government must aim to identify how they can best harness digital innovation and raise their state of digital readiness, working in partnership with the private sector, civil society, academic institutions, and development partners.

INTRODUCTION: RAPID URBANISATION AND DIGITAL TRANSFORMATION

THE DRIVERS AND CHALLENGES OF RAPID URBANISATION

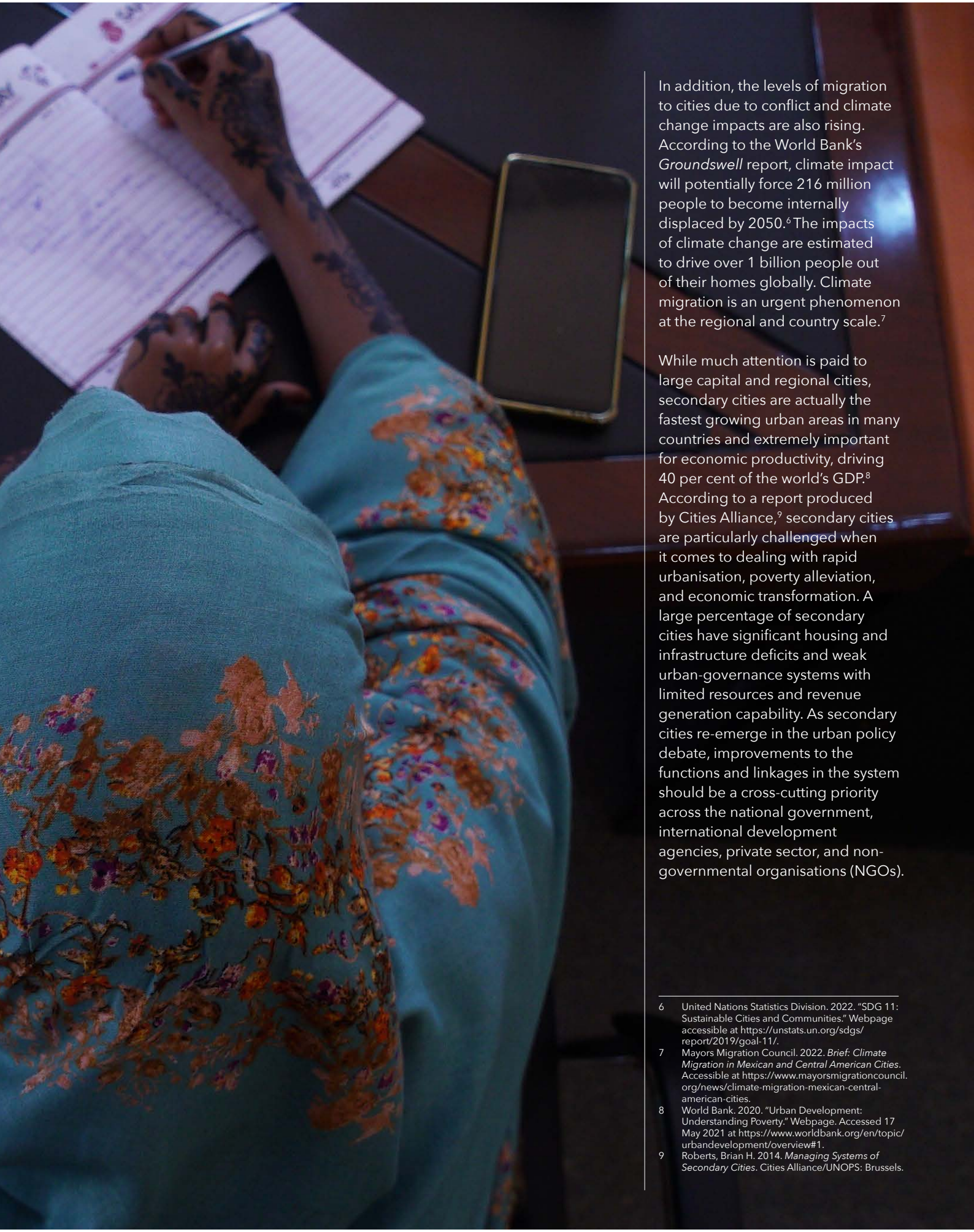
1.5 million people are added to the urban population of the world every week. African and Asian countries expect rapid urbanisation with a projection of 90 per cent urban population growth by 2050.[3] The phenomenon is both a challenge and an opportunity. In 2015, cities generated 85 per cent of GDP.[4] By harnessing the economies of scale, cities have the ability to be drivers of growth, centres of activity, and high production spaces.

On the other hand, poorly managed and unplanned urbanisation creates disparity, inequality, and environmentally unfriendly and sprawling development patterns.[5] An estimated 1 billion people currently live in informal settlements, 80 per cent of which are located in South and Southeast Asia and sub-Saharan Africa. By 2030, cities will need to integrate an estimated 3 billion people, which will place increasing strain on already stressed and insufficient urban systems.

3 United Nations Department of Economic and Social Affairs. 2015. *World Urbanization Prospects: The 2014 Revision.* (ST/ESA/SER.A/366).

4 World Bank. 2009. *World Development Report 2009: Reshaping Economic Geography*. World Bank: Washington, DC. https://openknowledge.worldbank.org/handle/10986/5991.

5 PwC. 2014. "A New Urban Agenda: Accommodating 2 billion New Urban Citizens." Webpage accessible at https://www.pwc.co.uk/issues/megatrends/rapid-urbanisation.html#2.



In addition, the levels of migration to cities due to conflict and climate change impacts are also rising. According to the World Bank's *Groundswell* report, climate impact will potentially force 216 million people to become internally displaced by 2050.[6] The impacts of climate change are estimated to drive over 1 billion people out of their homes globally. Climate migration is an urgent phenomenon at the regional and country scale.[7]

While much attention is paid to large capital and regional cities, secondary cities are actually the fastest growing urban areas in many countries and extremely important for economic productivity, driving 40 per cent of the world's GDP.[8] According to a report produced by Cities Alliance,[9] secondary cities are particularly challenged when it comes to dealing with rapid urbanisation, poverty alleviation, and economic transformation. A large percentage of secondary cities have significant housing and infrastructure deficits and weak urban-governance systems with limited resources and revenue generation capability. As secondary cities re-emerge in the urban policy debate, improvements to the functions and linkages in the system should be a cross-cutting priority across the national government, international development agencies, private sector, and non-governmental organisations (NGOs).

6 United Nations Statistics Division. 2022. "SDG 11: Sustainable Cities and Communities." Webpage accessible at https://unstats.un.org/sdgs/report/2019/goal-11/.

7 Mayors Migration Council. 2022. *Brief: Climate Migration in Mexican and Central American Cities*. Accessible at https://www.mayorsmigrationcouncil.org/news/climate-migration-mexican-central-american-cities.

8 World Bank. 2020. "Urban Development: Understanding Poverty." Webpage. Accessed 17 May 2021 at https://www.worldbank.org/en/topic/urbandevelopment/overview#1.

9 Roberts, Brian H. 2014. *Managing Systems of Secondary Cities*. Cities Alliance/UNOPS: Brussels.

UNDERSTANDING THE DIGITAL REVOLUTION IN LOW AND MIDDLE-INCOME COUNTRIES

In responding to urban challenges and enhancing economic transformation, digital solutions can play a key role in realising the opportunities to catalyse economic opportunities and improve liveability, sustainability, and productivity.[10] Over the past decade, LMICs around the world have experienced a dramatic transformation of access to mobile phone network coverage and penetration rates.

10 PwC, "A New Urban Agenda: Accommodating 2 billion New Urban Citizens."

This has opened up a vast array of new opportunities for digital solutions that can support access to information and services.

The United Nations Sustainable Development Agenda 2030 recognises ICTs and digital technologies as essential to accelerating human progress and transversal to all the Sustainable Development Goals (SDGs). The World Bank's World Development Report in 2016[11] focused on the digital dividends for sustainable development, which has become a watershed for the role of digital solutions to contribute to development, including sustainable urbanisation.

11 World Bank. 2016. *World Development Report 2016: Digital Dividends*. World Bank: Washington, DC.

Digital technologies are boosting economic growth by creating innovative solutions for job creation, creating efficient mechanisms, and improving urban governance and urban service delivery.[12]

It is important to note that mobile phones rather than broadband Wi-Fi are the key driver contributing to the explosion in the use of ICTs in developing countries.[13] By the end of 2018, there was a worldwide mobile penetration rate of 67 per cent, and this will continue to expand. By 2025, nearly 5.8 billion people will have a mobile phone (i.e., 71 per cent of the population), 50 to 80 billion objects and devices will be connected, and data traffic is likely to increase tenfold.[14] The number of internet users globally increased from 1 billion in 2005 to 4.3 billion in 2019, representing 57 per cent of the world's population.[15]

12 GSMA. 2019. *The State of Mobile internet Connectivity 2019*. Accessible at: https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/07/GSMA-State-of-Mobile-internet-Connectivity-Report-2019.pdf.
13 Walsham, Geoff. 2017. "ICT4D Research: Reflections on History and Future Agenda." *Information Technology for Development* 23(1).
14 Cities Alliance, *Smart Technologies for More Equitable City Economies*.
15 ITU (Telecommunication Development Sector). 2022. World Telecommunication/ICT Indicators Database 2021 (25th edition/December 2021).

Across Africa, there was a penetration rate of 45 per cent of the population based on unique mobile subscriptions, and this is forecast to grow to 50 per cent by 2025.[16] In certain countries such as Kenya and Nigeria, the mobile penetration rates are much higher at 80 per cent.[17] Forty-four per cent of total connections in Africa are associated with smartphones, which is likely to increase to 65 per cent by 2025. Mobile internet is also growing rapidly, from a penetration rate of 26 per cent in 2019 to a forecasted 39 per cent by 2025.

This rapid growth in mobile phone ownership has fuelled an equally rapid rise in mobile money services and financial technology (Fintech). Africa is actually the most active region globally in terms of live mobile money services; there are 157 mobile money-related services such as M-Pesa on the continent, out of 310 globally.[18]

Other digital innovation is accelerating in LMICs at the same time. Frontier technologies such as artificial intelligence, machine learning, and the internet of things (IoT) provide numerous possibilities in terms of digital tools and services that can help solve development challenges.

For example, IoT connected sensors can monitor water levels in rivers or movement on landslide-prone slopes, feeding valuable information into disaster early warning systems (EWS). A recent study by GSMA's Mobile for Development programme shows how artificial intelligence (AI)-based solutions are helping address a wide range of SDGs in LMICs.[19] For example, machine learning (ML)-based solutions can support the analysis of satellite or drone images to rapidly categorise property types and set appropriate property tax values. A financial services AI solution can enable more inclusive and transformational access to micro-loans. Crowdsourcing is an increasingly valuable source of data and insights that can support the creation of open-source mapping data to inform data-driven planning and decision-making. This includes mapping locally known exposure to hazards, which can inform disaster preparedness and resilience.

Such digital transformation is leading towards the ability for urban areas to become 'smart'. A smart city is defined by the International Telecommunication Union (ITU) as

"AN INNOVATIVE CITY THAT USES ICT AND OTHER MEANS TO IMPROVE QUALITY OF LIFE, EFFICIENCY OF URBAN OPERATION AND SERVICES, AND COMPETITIVENESS."[20]

However, it is important for city managers to extract the most relevant advantages that digital transformation can bring to their municipalities and not get too caught up in grand 'smart city visions' that often attract attention in sub-Saharan Africa. Cities Alliance is more interested in showing city managers how digital solutions can help manage and transform all urban areas, from older urban centres to rapidly expanding informal settlements and peri-urban fringes.

16 GSMA. 2020. *The Mobile Economy Sub-Saharan Africa 2020*. Accessible at: https://www.gsma.com/mobileeconomy/wp-content/uploads/2020/09/GSMA_MobileEconomy2020_SSA_Eng.pdf.

17 Statista. 2021. internet Penetration in Africa, by Country. Demographics and Use. Webpage accessed 17 May 2022 at https://www.statista.com/statistics/1124283/internet-penetration-in-africa-by-country/.

18 GSMA. 2021. *State of the Industry Report on Mobile Money*. Accessible at: https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2021/03/GSMA_State-of-the-Industry-Report-on-Mobile-Money-2021_Summary.pdf.

19 GSMA. 2020. *Artificial Intelligence and Start-ups in Low and Middle-Income Countries: Progress, Promises and Perils*. Accessible at: https://www.gsma.com/mobilefordevelopment/resources/artificial-intelligence-and-start-ups-in-low-and-middle-income-countries-progress-promises-and-perils/.

20 ITU, World Telecommunication/ICT Indicators Database 2021 (25th edition/December.

OVERVIEW OF DIGITAL SOLUTIONS TO SUPPORT INCLUSIVE ECONOMIC TRANSFORMATION OF CITIES

Cities Alliance's previous work on digital solutions to help address challenges in secondary cities has defined a framework of impact based on the pillars of the Future Cities Africa Programme:

economy, environment, governance and citizenship, and service delivery.[21]

These are briefly explained in the following pages with a handful of examples from LMICs to demonstrate how they can help to address inclusive economic transformation in rapidly growing urban areas.

21 Cities Alliance. 2017. *An Innovative Data Toolkit for City Management*. Cities Alliance/UNOPS: Brussels.

PILLAR 1: ECONOMY

Cities are a significant driver and magnet for innovation, talent, and business. Digital solutions can help to integrate the urban poor by supporting areas such as jobs, employment, and access to finance. It is important to note that much economic activity in LMICs is informal, and digital solutions can help support the transition to more formal employment, which is linked to tax revenues and improved government resources. The following examples show how digital solutions are supporting economic transformation in rapidly urbanising cities. Some of the most notable areas of impact are:

Enhancing value chain connections

There are many examples of digital solutions that allow more efficient market connections. For example, Twiga Foods in Kenya is a mobile-based supply platform for Africa's retail outlets, kiosks, and market stalls. The company is using a mobile-based, cashless, business-to-business (B2B) supply platform that lets grocers in cities order farm produce from smallholder farmers in rural areas across Kenya and have it delivered at competitive prices. This eliminates the inefficiencies of sourcing mostly perishable foods daily, while guaranteeing farmers consistent income and timely payments. It also creates reliable jobs while connecting rural producers with urban customers.[22]

22 Twiga Foods. Website accessible at: https://twiga.com/.

Employment matching, especially for digital economy jobs

The digital economy offers work and business opportunities, including via online web-based platforms, where tasks are performed online and remotely by workers with appropriate skills. For example, the International Labour Organization (ILO) recently showed how digital labour platforms such as Upwork, Freelancer, Fiverr, and Truelancer are enabling greater work opportunities in Kenya, Uganda and Egypt,[23] particularly for refugees, although vulnerabilities of workers in a gig economy is an important concern to address.

Digital solutions for skills training

There are a range of digital solutions that enable skills development and mentoring. In Lebanon, ReBootKamp aims to create a virtuous circle where graduates return as teachers and teach coding skills to refugees. Another example is Techfugees, an impact-driven global organisation that nurtures a sustainable ecosystem of tech solutions supporting the inclusion of displaced people.[24]

23 ILO (International Labour Organization). 2021. *Towards Decent Work for Young Refugees and Host Communities in the Digital Platform Economy in Africa*. Accessible at: https://www.ilo.org/wcmsp5/groups/public/---ed_emp/documents/publication/wcms_816539.pdf.

24 Christiaensen, Luc, and Nancy Lozano Gracia. 2021. *Migrants, Markets and Mayors: Rising Above the Employment Challenge in Africa's Secondary Cities – A Brief*. Cities Alliance/UNOPS: Brussels.

PILLAR 2: ENVIRONMENT

Digital solutions to monitor air quality

One of the greatest challenges in urban areas is the quality of the air, which suffers pollution from a range of sources including vehicles, industry, wood-burning fires for cooking, and the burning of rubbish. For example, in several Southeast Asian countries, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) is helping improve the ability of cities to understand and address air quality issues with its support for a programme to analyse satellite data from South Korea's GEMS satellite, in tandem with Pandora ground sensors to triangulate and ground truth the data.[25]

Mapping and monitoring environmental assets

GIS mapping has provided a revolutionary tool for municipal governments. It has helped map many different features of urban areas, including environmental assets such as watercourses and areas of special importance for biodiversity such as mangrove habitats. This can be paired with open-source community mapping and analysis of drone images to rapidly identify and map important features to better inform sustainable planning.

25 UN ESCAP and the Korean National Institute of Environmental Research. 2020. "Introduction to Geostationary Environmental Monitoring Spectrometer and Pandora Asia Network." Presentation at the 24th Session of ICC on RESAP,18-19 August 2020. Accessible at: https://www.unescap.org/sites/default/files/21.%20NIER_Introduction%20to%20Geostationary%20Environmental%20Monitoring%20Spectrometer%20and%20Pandora%20Asia%20Network.pdf

Circular economy solutions reduce resource wastage

Digital solutions can support circularity across a wide range of sectors, including food and agriculture, manufacturing, and construction, helping reduce resource usage and wastage and minimising waste. For example, in Cambodia, ATEC provides clean pay-as-you-go (PAYG) digitally connected cook stoves linked to biodigesters that convert organic waste from small-holder farming into clean cooking gas.[26] In theory, data from the e-stoves can support verification of impact in order to benefit from the voluntary carbon market.

26 ATEC. Website. Accessible at: https://www.atecbio.com/.

Resilience to climate change impacts

LMICs already have limited capacity to provide their citizens with essential services such as clean water and reliable electricity. The World Bank estimates that if urban areas do not become more resilient by 2030, natural disasters may cost cities around $300 billion globally.[27] Climate change alone could push 77 million people back into poverty. Digital solutions can play a vital role in improving resilience, which can be defined as solutions that can help cities and their populations adapt to multiple, long-term challenges brought about by climate change; anticipate climate hazards or events; or absorb (i.e., face, manage, and recover from) adverse conditions, emergencies, or disasters.[28] Cities Alliance has helped to deploy resilience.io in a range of African cities. Resilience.io is a computer-based platform that provides an integrated-systems view of a city-region and an analysis and decision-support tool for collaboration and resilience decision-making.[29]

27 IFC. 2018. *Climate Investment Opportunities in Cities: An IFC Analysis*. IFC: Washington, DC.
28 Aditya, B., et al. 2015. *The 3As: Tracking Resilience Across BRACED*. BRACED Working Paper. Accessible at: https://cdn.odi.org/media/documents/9812.pdf.
29 The Ecological Sequestration Trust. 2015. *Resilience.io: A Revolution in Planning*. DFID. Accessible at: https://www.preventionweb.net/publication/resilienceio-revolution-planning.

PILLAR 3: GOVERNANCE AND CITIZENSHIP

This category includes digital innovation to support participatory urban planning and e-governance services, which support economic opportunities in cities as well as access to services and information.

Participatory planning

Is critical to making sure infrastructure investments and city planning are designed to meet the needs of all citizens. Digital solutions can help by facilitating consultation and engagement. For example, D-Agree is an AI-based solution to support participatory urban planning in Kabul, Afghanistan, where the AI-based tool extracts the discussion structure based on issues, ideas, pros, and cons, helping decision-makers understand concerns and reach consensus. This has been particularly beneficial for amplifying the voice of women in planning processes.[30]

Transparency and accountability in local decision-making

Availability of information on governance practices and decision-making is vital to ensuring accountability of elected officials and the execution of government duties.

30 D-Agree. Facebook page. Accessible at: https://www.facebook.com/DAgreeAFG/.

e-Governance to support access to city services

Digital innovation has been transformed in many high and middle-income countries in terms of allowing easy access to city-related information and services, such as paying bills for public services, taxation, or applying for a license for small business. For example, the Irembo Digital Platform in Rwanda is a web portal which offers government services to Rwandan citizens via the internet. The platform was launched in 2015 and allows Rwandans to access 85 government services online including applying for a birth certificate, registering for a driver's license, and land title transfers.[31] In addition, the Digital Land Registry System has been in place since 2008 in Rwanda and maintains records of land-related occupation, updates on mortgages, and land tenure. Open data and digital technology in land and property management enables the security of long-term land ownership and creates stability among communities as well as supporting more straightforward land ownership for women.[32]

Cost-recovery data to support sustainable provision of services

Understanding the operating expenses for the functioning of the city is vital to preserving its fiscal health and providing critical services. While most city governments usually possess this information, its importance in determining the creditworthiness of the city and plans for future expenditure is vital. In the cities of many middle-income countries and virtually all developed countries, cost-recovery data is key to the city's ability to borrow to finance many long-term, fixed capital investments involved in city growth. In sub-Saharan Africa, where few cities (outside of those in South Africa) have access to finance, basic information is needed about the level and types of government expenditures, the share of local government expenditures allocated to salaries and administrative costs, and the share of the population with access to local government services.[33]

31 See https://www.nec.com/en/global/insights/article/2020022516/index.html.

32 Hansted, T. 2020. "Gender Equality: Women, Land, and Data." World Bank Blog. 25 November. Accessible at: https://blogs.worldbank.org/opendata/gender-equality-women-land-and-data.

Digital tools to help newcomers navigate local services

Mobile applications are at the forefront of digital innovations for newcomers to host countries. They provide quick access to city services and digital platforms for information exchange. Examples of targeted apps include Refugee.info (available in several European countries); Alfanus, Gherbtna, and the Services Advisor app in Turkey; and the Mojaher app for Afghans in Iran. Chatbots have also aimed to enhance the communication of information and support to refugees, such as DoNotPay, which gives legal advice, and Karim, which provides Arabic-language emotional and psychological support.

Open data improves data-driven urban planning and services

Open data, in which online portals and tools allow the co-creation and sharing of data on a range of aspects, also facilitates better urban planning and management. For example, the Open Data Roadmap in Mozambique is an open data source initiative to enhance transparency and accountability to improve the inclusion of the poor in good urban planning processes. OpenStreetMaps in Dar es Salaam, Tanzania, is an open-source platform with local volunteers to collect detailed terrain information to develop flood models that support resilience infrastructure and preventive flood measures in the city.

33 Cities Alliance. 2017. *An Innovative Data Toolkit for City Management*. Cities Alliance/UNOPS: Brussels.

PILLAR 4: SERVICE DELIVERY

As cities continue to go through rapid urbanisation, providing access to services such as transport and mobility, electricity, water, sanitation, and waste management is a significant challenge. The financing deficit for urban infrastructure and services is vast in LMICs. However, access to basic services is pivotal for sustainable, efficient, and productive cities.[34] Digital innovation is playing an increasingly significant role, particularly when linked to private sector delivery of services via innovative business models. Some of the most relevant aspects are:

Access to PAYG renewable energy

Mobile money allows PAYG options for a range of services including household solar energy, which allows clean access to electricity with a host of co-benefits from greater economic productivity to better education performance. There are many examples across sub-Saharan Africa.

34 FAO Land and Water Division (n.d). *Land Tenure Supports Sustainable Development*. Factsheet. Accessible at: https://www.un.org/esa/sustdev/csd/csd16/documents/fao_factsheet/landtenure.pdf.

Digital solutions for sanitation

Mobile-enabled tools can support container-based sanitation businesses. For example, in East Africa, Sanergy implements a franchise of digital app-enabled, container-based sanitation solutions across Nairobi's slum settlements. Well-designed toilets are installed in appropriate locations, and separated liquid and solid waste is regularly collected and then treated to safely convert waste into Sanergy Farm Star organic compost. Dignified sanitation options also have many co-benefits, such as higher school enrollment for girls.[35] In Kampala, the Kampala Capital City Authority (KCCA) provides pit latrine emptying services through a GIS-enabled app. Understanding the geography of emptying patterns also enables KCCA to improve logistics and forecast future treatment needs.[36]

Digital solutions for solid waste management

For solid waste materials that have a material value – particularly PET and HDPE plastics, glass, and metal – there are a range of private sector business models in place in LMICs to help connect value chains, from collection through to processing and uptake of recycled plastic by big manufactures. Banyan Nation in India is a leading example of digital innovation for more effective plastics recycling. It uses digital tools to address the 'last mile' of informal plastic waste aggregation.[37]

35 Sanergy. Website. Accessible at: https://www.sanergy.com/.
36 Njoroge, Brian. 2021. "Using Digital Tools to Improve the Commercial Sustainability of Container-Based Sanitation Models." GSMA blog. 10 November. Accessible at: https://www.gsma.com/mobilefordevelopment/blog/using-digital-tools-to-improve-the-commercial-sustainability-of-container-based-sanitation-models/
37 Wilson, M., et al. 2021. *Digital Dividends in Plastic Recycling*. GSMA. Accessible at: https://www.gsma.com/mobilefordevelopment/resources/digital-dividends-in-plastic-recycling/.

Digital solutions enable clean drinking water

Digital solutions have a significant role to play in more responsible management of precious water resources. For example, Digi Smart Solutions in Tunisia provides smart water management solutions using IoT and AI, offering an intelligent system for managing and controlling water consumption in real time.[38]

Sustainable transport and mobility via digital tools

Digital mobility is a rapidly evolving space. While ride-hailing for private vehicles is still prohibitively expensive for many in LMICs, ride-hailing for buses is becoming an exciting new phenomenon. For example, SWVL is an Egyptian digital mobility company based in Cairo with operations in more than five countries. It operates buses along fixed routes and allows customers to reserve and pay for them using an app.[39] Digital Matatus in Kenya is another example of data-driven innovation. An academic team used GPS tracking to map the network of informal *matatu* routes and stops in Nairobi and converted it into digital and paper-based maps, helping citizens navigate and feeding valuable data into the city's transport planning system.[40]

Overall, digital solutions can play a transformational role in the context of rapid urbanisation in LMICs. While there are a host of different possibilities, this report provides insights and recommendations for five areas of high potential for impact.

38 GSMA, *Artificial Intelligence and Start-ups in Low and Middle-Income Countries*.
39 SWVL. Website. Accessible at: https://www.swvl.com/.
40 Digital Matatus. "The Digital Matatus Project." Webpage accessible at: http://digitalmatatus.com/about.html.

THE ENABLING ENVIRONMENT FOR TRANSFORMATIVE DIGITAL SOLUTIONS

In 2017, Cities Alliance developed a comprehensive toolkit for improving the data ecosystem in secondary cities as part of its Future Cities Africa programme.[41] Drawing on the toolkit and other digital innovation experience in LMICs, this section summarises some of the key enabling environment factors, digital inclusion issues, best practices, and points relating to different stages of digital readiness for various digital solutions.

41 Cities Alliance, *An Innovative Data Toolkit for City Management*.

IMPROVING THE DIGITAL SOLUTIONS ENABLING ENVIRONMENT

There are important enabling environment factors that can be an enabler or a barrier to successful development and uptake of digital solutions. The most significant are summarised below.

Mobile and internet connectivity

It is important to develop a robust digital and telecommunications infrastructure as a prerequisite for enhancing EWS through digital and mobile technologies. Many remote areas still lack sufficient mobile network coverage. For mobile networks, this is generally the responsibility of mobile network operators (MNOs), but urban areas also generally invest in broadband Wi-Fi networks when it becomes financially viable. As discussed above, mobile connectivity and 'mobile first' solutions remain the norm in most LMICs. Widespread access to digital services will also improve the accuracy of insights from mobile big data or social media big data, as discussed later in this report.

Data availability and quality

The Cities Alliance Data Ecosystem Framework goes into detail on how cities can achieve data availability and quality in practice. Some of the key public sector enablers are a legislative mandate for data collection in certain areas, improved data management and storage, standardised data collection metrics, staff skills, and sufficient quality and coordination between government departments.

Data infrastructure

Data infrastructure – the hardware, software, and tools to store data and perform analytics upon it – are often missing in LMICs. However, this challenge is increasingly possible to overcome as the costs of computing equipment and power, even for intensive operations such as machine learning, are rapidly falling. Cloud computing is also able to play an important role. Recently, governments in some emerging economies have started pushing back against reliance on cloud services and calling instead for investment in data centres located in their own states. This is in part for national security of service and of data, but it also enables the capture of spillover benefits of data centres, such as local investment, skills development, capacity for small local businesses, ability to attract businesses, and develop technology clusters.[42]

Human resources and digital skills in government

Public sector capacity is often a barrier to improving the data infrastructure and implementing digital solutions in LMICs. Skills to manage data collection and data management are necessary for cities to harness digital systems for land governance, e-governance, tax collection, and so on. Governments can work with private sector suppliers who can provide strong expertise, but they should be aware of digital possibilities and solutions to implement robust and demand-led systems.

42 Giuliani, Dario, and Sam Ajadi. 2019. "618 Active Tech Hubs: The Backbone of Africa's Tech Ecosystem." GSMA blog. Accessible at: https://www.gsma.com/mobilefordevelopment/blog/618-active-tech-hubs-the-backbone-of-africas-tech-ecosystem/.

Digital skills and literacy among the public

Another similar barrier is low digital literacy among the public. While the youth may be highly tech savvy in many contexts, this is not the case across the broader population. There is also a lack of awareness about the usefulness of the internet in general and locally relevant content in many LMICs. For example, in the Philippines, even in the areas where mobile internet is available, 67 per cent of the population does not yet use it.[43] Digital inclusion is addressed more fully in the following section.

Data security and privacy regulations

Underdeveloped data privacy and security laws cause uncertainty for government and non-government digital innovators in LMICs. Many city governments are not yet able to handle data security and cyber security, and there are a lot of needs around capacity development in this area. In many LMICs, data is not protected and is often used for purposes other than for the original reason for which it was shared.

Private sector innovation and new business models

Supporting private sector innovation is one of the most important enabling factors for digital innovation. An innovation ecosystem based on strong local ICT skills and opportunities that connects, collaborates, and accesses external expertise, financing, and markets is important. In addition, job creation is linked to private sector-led solutions.

The role of partnerships

A recent report by GSMA[44] explores the role of partnerships between government and private sector innovators. As highlighted in the next section of this report, fostering partnerships between relevant organisations, including government and private sector innovators, can lead to high-impact, locally grown solutions.

Data sharing

There is often a lack of data on which public and private sector entities can build solutions and commercial models. Consistency and accuracy of data, system interoperability, absence of data use policy, and absence of a unifying framework are other gaps related to data-driven and digital solutions.

43 UNDP. 2021. *Mapping and Analysis of Vulnerable Groups for Climate Change Adaptation and Disaster Risk Reduction (CCA-DRR) in Support of the Digital Readiness Strategy in the Philippines*. UNDP Bangkok Regional Hub: Bangkok.

44 GSMA 2021. *Innovative Data for Urban Planning: The Opportunities and Challenges of Public-Private Data Partnerships*. Accessible at: https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2021/07/Innovative-Data-for-Urban-Planning-Opportunities-and-Challenges-Associated-with-Public-Private-Data-Partnerships-SPREADS.pdf.

RECOGNISING AND ADDRESSING THE BARRIERS TO DIGITAL INCLUSION

Digital solutions by themselves are not a panacea to complex urban challenges, and the link between digital innovation and urban inclusion is far from obvious. Digital inclusion is an essential component of the wider economic transformation roadmap for cities. Typical barriers to digital interventions include access and accessibility, skills and confidence, and data privacy and online security.[45] It is vital that solutions are designed to represent and serve all in society.

Persons with disabilities, women and girls, the very poorest, ethnic groups, Indigenous peoples, rural-urban migrants, and forcibly displaced persons (refugees and/or IDPs) are typically the most excluded from digital access.

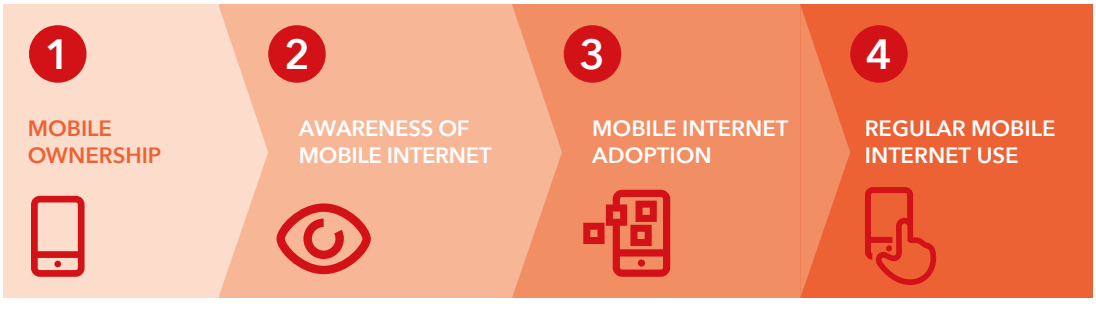
However, the need to proactively ensure digital literacy and inclusion is far wider.

When looking specifically at gender dynamics, GSMA's report *The Mobile Gender Gap 2020* shows that across LMICs, 82 per cent of women now own a mobile phone. Despite a perception that mobile ownership is near universal, over 390 million women in LMICs remain unconnected, which translates to a gender gap of eight per cent.[46] Typically, the gender gap widens along each stage of the user journey; it is smallest for mobile ownership and increases for mobile internet adoption and regular use, as illustrated in Figure 1.

45 Digital Inclusion Toolkit, "Barriers to Digital Inclusion."

46 GSMA. 2020. *The Mobile Gender Gap 2020*.

FIGURE 1
Mobile internet user journey (GSMA 2020).



The gender gap for mobile ownership is 13 per cent in sub-Saharan Africa and 23 per cent in South Asia. The corresponding mobile internet access gaps are greater than these figures. There are a wide range of barriers that impede greater access by women and girls to regular mobile internet use. According to GSMA,[47] women are less likely to acquire their own devices and 20 per cent less likely to use the internet on a mobile phone than men. Literacy and digital skills are the main barriers for women, caused by lack of knowledge on how to access the internet and lack of time to learn. The second prominent barrier is affordability of smartphones. Particularly in sub-Saharan Africa, affordability is the primary barrier to mobile internet adoption.[48] In the context of Covid-19, women's financial precarities have increased, and there is a growing need to be connected and access information and services remotely. Online services can greatly help in aspects such as digital access to markets and access to healthcare advice, so closing the mobile internet gender gap has become even more critical.

In December 2020, GSMA released a Digital Inclusion Framework and set of principles[49] that link closely to overcoming the five barriers to digital inclusion:

Access to networks and enablers (quality network coverage, handsets, electricity, agents, and formal IDs) and usability of handsets, content, and services.

- **Affordability** of handsets, tariffs, data, and service fees.
- **Relevance** of locally relevant content, products, and services.
- **Knowledge and skills**, namely the ability to navigate devices and content based on digital skills and literacy.
- **Security** involves addressing mobile-related harassment, theft, fraud, security, and building consumer trust.

UNESCO also sets out guidelines to enhance digital inclusion following well-defined steps, such as offering meaningful services that support the development of digital skills and literacy, understanding and designing solutions for people with low literacy that take their unique needs and ambitions into account, creating engaging content and usable interface, ensuring implementation environments, supporting inclusive usage, and monitoring, measuring, and iteratively improving solutions on a regular basis.[50]

47 GSMA, *The Mobile Gender Gap Report 2020*.
48 GSMA, *The Mobile Gender Gap Report 2020*.
49 GSMA. 2020. "Principles for Driving the Inclusion of Persons with Disabilities." Webpage. Accessible at: https://www.gsma.com/mobilefordevelopment/principles-for-driving-the-digital-inclusion-of-people-with-disabilities/.

50 UNESCO-Pearson Initiative for Literacy. 2018. *Guidelines: Designing Inclusive Digital Solutions and Developing Digital Skills*. UNESCO: Paris.

RECOGNISING DIFFERENT STAGES OF DIGITAL READINESS

It is vital to remember that urban areas across LMICs are vastly different in terms of their unique contexts and state of digital development. For example, Bengaluru in India is very advanced compared to secondary cities in Central Africa. Therefore, gaining a sense of 'digital readiness' is a useful concept for city managers as they implement enabling environment factors or digital solutions themselves.

Figure 2 below shows some of the building blocks of digital innovation from the more basis applications at the bottom, to more advanced systems at the top, which rely on robust ICT infrastructure, data privacy policy and active private sector activity and innovation in tech.

FIGURE 2
The building blocks for different stages of digital readiness in cities (Author's analysis).

DIGITAL SOLUTIONS BUILDING BLOCKS	BASIC FOUNDATIONS	MEDIUM READINESS	ADVANCED READINESS
Robust data security and privacy policy			
Advanced 4G mobile internet coverage			
Medium to high broadband coverage in cities			
Active private sector activity in digital tech			
Proactive public sector initiatives in progress			
Low to medium broadband coverage in cities			
Medium to advanced 3G or 4G mobile internet coverage			
Lack of any broadband internet			
Limited public sector capacity in data management and digital infrastructure			

Figure 3 provides some examples of digital innovation in the context of rapid urbanisation that align with the different stages of digital readiness. The use of basic digital tools such as GIS mapping for planning can be done at very basic levels of digital readiness, while solutions such as IoT sensors rely on much more advanced internet connectivity infrastructure and robust data security regulations.

FIGURE 3

Examples of different applications aligned with the stages of digital readiness (Author's analysis).

EXAMPLES OF TYPICAL SMART CITY / DIGITAL SOLUTIONS	BASIC FOUNDATIONS	MEDIUM READINESS	ADVANCED READINESS
AI and IoT for smart grids and demand response mechanisms			
Network of IoT sensors linked to digital twin model of city			
Traffic management and intelligent transport systems			
Smart transport solutions for public transit and ride hailing, etc.			
More advanced e-governance services (healthcare, etc.)			
Digital land registry and revenue collection process			
IoT for monitoring and warning on flood risk			
Mobile-enabled solutions for utilities such as collection of waste			
Mobile-enabled PAYG for energy and water supply			
Simple e-governance services (digital information on services)			
GIS and basic data to inform urban planning			
COUNTRY EXAMPLES	**DRC, NIGER, NEPAL**	**GHANA, KENYA, RWANDA, PHILIPPINES**	**INDIA, INDONESIA, SOUTH AFRICA**

FIVE DIGITAL INNOVATION PRIORITIES FOR RAPIDLY URBANISING SECONDARY CITIES

This section focuses on five specific use cases to provide practical insights and guidance:

Mobile big data sources to understand highly mobile populations

Digital systems for land governance and tenure

Increasing municipal tax revenue with digital systems

Digital innovation for sanitation and waste management services

E-governance services to support livelihoods

These five themes were selected to provide inspiration for digital innovation to address rapid urbanisation, with coverage across the two main thematic areas outlined previously (digital solutions for economic transformation and digital solutions for sustainable, productive, and efficient cities). They represent possible solutions to challenges that are urgent in the majority of secondary cities and urban areas in LMICs, including addressing chaotic urban development and poor resilience to disasters, improving land tenure systems and rights, helping empower vulnerable groups, helping raise own-source revenues which can be invested in much needed infrastructure and services, encouraging private sector innovation in service delivery for waste management and sanitation services, and enabling access to livelihoods, jobs and information via e-governance solutions. Figure 4 shows how the selected themes are relevant to the FCA pillars.

Each of the five themes is structured to i) outline how the solution can address specific challenges; ii) discuss the partner organisation types typically involved in implementing such solutions; iii) provide case studies and learning points; and iv) provide recommendations for municipal governments.

FIGURE 4
How the five priority areas meet the FCA pillars.

FIVE PRIORITY THEMES FOR DIGITAL INNOVATION	ECONOMY	ENVIRONMENT	GOVERNANCE AND CITIZENSHIP	SERVICE DELIVERY
Mobile big data analysis to understand highly mobile populations	■	■	■	
Digital solutions for land tenure and governance	■		■	■
Increasing municipal tax revenue with digital systems	■		■	■
Delivery of basic sanitation and waste management services		■		■
E-governance services to support livelihoods	■		■	■

MOBILE BIG DATA ANALYSIS TO UNDERSTAND MOBILE POPULATIONS

Highlights

Mobile big data

Can be analysed to provide insights into population location, typical daily movements, and migration patterns over time or following disaster events, among others.

Resilient urban planning and management

Such insights can support more sustainable and resilient urban planning and management, helping governments meet the needs of vulnerable groups and better manage development control.

Highly dynamic populations

Insights into highly dynamic populations can inform hazard vulnerability and impact forecasting for more effective early warning systems.

Outlining how the solution can address specific challenges

Rapid urbanisation is occurring in most LMICs. Typically, national and sub-national governments are not able to keep track of how urban populations are changing in terms of dwelling location and other socio-economic factors. Census data is only collected every ten years, and in some LMICs not collected at all or at questionable level of robustness. It soon becomes outdated and insufficient for urban planning and service delivery purposes. For example, Indonesia is rapidly urbanising at a rate averaging 4.4 per cent annually – the highest rate of urbanisation in Asia – and 68 per cent of its population is expected to be living in cities by 2050.[51] Poorly planned and constructed informal settlements are a typical result of rapid growth in cities. In sub-Saharan Africa, more than 80 per cent of the urban population lives in informal settlements.[52]

Cities in LMICs are also increasingly hotspots for climate change impacts, including inland and coastal flooding and damage wrought by cyclones, landslides, and drought. This is adding to the vulnerability of populations and likelihood of internal displacement during times of disaster. At the same time, global conflicts have resulted in over 82 million people forcibly displaced by the end of 2020, 86 per cent of which are hosted in developing countries, often in urban areas.[53]

As such, in the absence of data generated by government surveys or other sources such as tax records, there is a significant need for better data insights into urban populations.[54] As shown in countries such as the Philippines, where the mobile subscription rate is equivalent to 138 per cent of the population due to some users having more than one subscription,[55] even the very poorest in a society tend to invest in a mobile phone.

Analysing data from MNOs is an innovative and effective method that has been tried in many countries around the world.

Big data can be defined as

"HIGH-VOLUME, HIGH-VELOCITY AND HIGH-VARIETY DATASETS THAT CAN BE ANALYSED TO IDENTIFY AND UNDERSTAND PREVIOUSLY UNKNOWN PATTERNS, TRENDS AND ASSOCIATIONS."[56]

The role of 'passive' data created by everyday usage of mobile services, such as call detail records (CDR) and mobile positioning data, can be extremely useful to provide detailed insights into population movements and other factors.

51 World Bank. 2016. *Indonesia's Urban Story*. World Bank: Washington, DC.
52 Angel, S. 2012. *Planet of Cities*. Lincoln Institute of Land Policy.
53 UNHCR. 2022. "Figures at a Glance." Webpage accessible at: https://www.unhcr.org/figures-at-a-glance.html.
54 Ospina, A.V. 2018. *Big Data for Resilience Storybook: Experiences Integrating Big Data into Resilience Programming*. International Institute for Sustainable Development: Winnipeg.
55 World Bank. 2020. *Philippines Digital Economy Report 2020: A Better Normal Under COVID-19 - Digitalizing the Philippine Economy Now*. World Bank, Washington, DC.
56 Monroe, Trevor. 2017. *Big Data and Thriving Cities: Innovations in Analytics to Build Sustainable, Resilient, Equitable and Livable Urban Spaces*. World Bank: Washington, DC.

Mobile big data can provide data insights to inform the following use cases, as well as many others:

Understanding land use

Insights on the intensity of urban population activities can be used for land use classification, while insights on activities in locations that are at-risk from climate-related hazards can be used to make changes in the way space is used.

Identifying climate vulnerable communities

Mobile big data can help identify which population groups are susceptible to climate hazards, when they are most at risk, and where they are located within specific disaster risk-prone areas. This can also inform disaster early warning systems.

Long-term migration patterns

Data on population movement and density across time can provide insights on the shifting population density, which can be used for medium and long-term planning for public services and infrastructure.

Migration/displacement triggered by disasters

Insights into the migration patterns of people when they are affected by disasters can support better operational planning and allocation of resources.

It is often necessary to combine mobile big data with other data sets, such as more localised household surveys, to ground truth the findings or gain insights into more complex aspects such as why certain people movements are occurring at certain times. AI analysis of satellite or drone images can also provide insights that could be correlated with mobile big data to help assess population movement and their exposure to hazards.

The value proposition of mobile big data for certain applications is still underdeveloped. The costs incurred on the supply side of data infrastructure – the cost of obtaining consent and investment in skills – are much more visible to MNOs. However, mobile big data is likely to provide unique insights that will greatly contribute to reducing the loss of life and damage to property if applied in the context of urban resilience and early warning systems. For example, The World Bank reports that natural hazards may cost cities worldwide $314 billion each year by 2030. Investing in climate-resilient infrastructure and solutions can provide a net benefit in low and middle-income countries of $4.2 trillion, with $4 in benefit for each $1 invested in resilience.[57] Mobile big data is also likely to offset the high costs of conventional surveys, which can improve its value proposition.

57 Hallegatte, Stephane, Jun Rentschler, and Julie Rozenberg. 2019. *Lifelines: The Resilient Infrastructure Opportunity*. Sustainable Infrastructure. World Bank: Washington, DC.

Research from a forthcoming study by GSMA's Mobile for Development programme[58] shows that there are currently a range of barriers to the greater use of mobile big data analysis for urban areas in LMICs:

- **Limited awareness** within government of the use cases that mobile big data could contribute to and low capacity of national and local government to apply mobile big data in practice.
- **Immature methods** for assessing how representative mobile big data sets are, and therefore how well suited they are for a given use case and how representative they are of socio-demographics/ gender and geography.
- **Unclear partnership agreements**, data governance processes, and accountability cause issues with coordination, collaboration, and trust.
- **The scale of investment** in data processing/analysis required by the supply side is not matched by a clear understanding of potential impact and value of this data insight on the demand side.
- **If used for disaster response**, the speed of response is hampered by lack of preparedness, such as not having set up agreements to perform data analytics and share privacy compliant data insights prior to the disaster.
- **Underdeveloped** data privacy and security laws in some countries.
- **Lack of evidence** of impact and value (social, economic, and environmental), few quantified benefits of the application of data, and limited evidence captured of improved decision-making and outcomes.

The potential of mobile big data remains strong to help provide innovative and valuable data insights, as shown by the case studies below. Data privacy is a key aspect to consider, and all examples identified make use of anonymised data so that individual identifiers are removed from mobile data records.

58 GSMA. 2022. *Mobile Big Data for Urban Climate Resilience*. Forthcoming.

Partner types typically involved

Making progress in this area relies on some very specific partnerships, most importantly with a suitable MNO.

National and or municipal government

It is important for a national or sub-national government department to take ownership of the initiative and be able to apply the insights from data to practical application in plans or policies.

Mobile network operator

Cooperation of an MNO is vital, and partnerships may take several forms, including a purely commercial transaction for a data set, a longer-term agreement to analyse data and co-create solutions, or a philanthropic arrangement.

Data analytics experts

Ideally, the government project owner would be able to take on the data analytics. However, if capacity is low, there are several examples of third-party expert organisations playing a role, such as the UN Pulse Lab Jakarta. This can also lend confidence in terms of data security and the robustness of the analytics methodology.

Civil society organisations (CSOs)

It is important to combine the insights generated from mobile big data with insights from other more qualitative sources, which are often gained from engagement with CSOs.

Access to mobile big data

The opportunities to harness MBD can be unleashed with appropriate commercial and partnership models. Key to this is the ability to be able to estimate or quantify the value of acquiring and applying MBD in certain contexts. Some likely arrangements include: i) straightforward commercial models, which is also often necessary to cover MNO costs in processing mobile big data; ii) reciprocal arrangements, where the MNO is driven by some form of incentive, such as a tax credit or other government benefit; and iii) philanthropic, where the MNO provides data for free, which could be tied to corporate social responsibility objectives.

Case studies and learning points

The following case studies show how mobile big data has been applied in practice.

BOX 1
MOBILITY INSIGHTS TO SUPPORT PLANNING IN COLOMBO, SRI LANKA

In 2015, the Sri Lanka-based research agency LIRNE Asia initiated a partnership between the municipal government of Colombo and a Sri Lankan MNO (undisclosed by LIRNEAsia for privacy reasons). The idea was to explore how mobile big data could inform integrated transport planning and urban planning in the absence of comprehensive data from other sources on the transport patterns around the city and to and from other urban centres.

LIRNE Asia was given access to pseudonymised call detail records (calls, SMS, internet access), airtime recharge records, and visitor location records. The analysis showed clear mobility patterns and hotspots in typical weekday and weekend 24-hour periods. This provided a series of recommendations for the city authority, including adjusting administrative boundaries and accommodating transport demand.

The analysis also found different mobility patterns around and during the festival period of Avarudu, providing insights into population movement across the whole country. Machine learning techniques were used via principial component analysis to shed light on population numbers and distribution in the city, complementing census data.[59]

59 MESC Public Lecture. 2015. "Using Mobile-Network Big Data for Urban and Transportation Planning in Colombo." Video. View at: https://www.youtube.com/watch?v=Yw5Zc1fFGw4.

These insights would have been very challenging and expensive to obtain through conventional transport demand and origin-destination surveys. The insights have provided a strong basis for providing transport services along certain routes and at certain times of the day and week, helping improve the efficiency and productivity of Colombo. However, the extent to which the government has acted on this information is unclear.

LEARNING POINTS:

- **Data privacy is a top concern when making use of mobile big data and can be observed with simple measures to anonymise or pseudonymise data, as well as strict agreements on how the data can be accessed and shared.**
- **Mobile big data insights can provide a cost-effective alternative to expensive surveys.**

BOX 2
MOBILE BIG DATA TO MEASURE POPULATION DISPLACEMENT IN COLOMBIA

A partnership between the United Nations Food and Agriculture Organization (FAO) and Telefónica Colombia leveraged mobile big data to measure the internal displacement of citizens from the region of La Guajira following a severe drought in 2018. Colombia has Latin America's highest occurrence of major natural hazard events, and 84 per cent of the country's population is vulnerable to experiencing two or more extreme climate events per year.[60] The World Bank estimated that, in 2018, 3.7 million people in Colombia were vulnerable to climate-related impacts such as cyclones, landslides, and floods.[61]

Telefónica aggregated and anonymised call detail records of its 11+ million customers in Colombia and combined this with government and open datasets to produce previously unattainable insights on population movements in response to climate extremes. Looking at historical mobile data from 2017, Telefónica was able to model where populations in La Guajira impacted by climatic variability-related natural disasters were located and where they moved when forced to abandon their homes.[62] Telefónica's LUCA division used its SmartSteps platform to analyse mobile network data from La Guajira mapping population movements, many of which were from rural to urban areas.[63] SmartSteps scans mobile user activity records and builds an anonymised mobility profile for each mobile phone number. Insights derived from the analysis of these profiles made it possible to quantify migratory flows by groups of people in La Guajira.

This innovative approach enabled the government to have better data with which to plan and implement social protection measures, reduce climate-related displacements, and build more resilient communities. The cost of purchasing and analysing the data is not publicly available, but it is expected to generate considerable cost-savings by giving the government the information to rapidly respond to the needs of IDPs. Mobile big data filled a critical gap; data on IDPs is inherently difficult to collect, and IDPs in low and middle-income countries can be almost invisible to state and international organisations, with their needs unaccounted and unprepared for. Telefónica is also working with LUCA and UNICEF on displacement due to floods and landslides.[64]

LEARNING POINTS:

- **Mobile big data analysis can provide unique insights into the movements of displaced populations, enabling governments to better plan for displacement and respond to the needs of IDPs when it occurs, improving disaster resilience.**
- **The MNO partner provided sophisticated data analytics capability, supporting the government and UN partners to access and understand the data insights.**

60 GFDRR (Global Facility for Disaster Reduction and Recovery). Colombia country overview. Webpage. Accessible at: https://www.gfdrr.org/en/region/colombia.
61 World Bank. Colombia Dashboard Overview. Webpage. Accessible at: http://sdwebx.worldbank.org/climateportalb/home.cfm?page=country_%20profile&CCode=COL&ThisTab=RiskOverview%20.
62 GSMA. 2019. "Big Data for Social Good: Case Study on Building Communities Resilient to Climatic Extremes." Accessible at: https://aiforimpacttoolkit.gsma.com/resources/Big-Data-for-Social-Good_TEF_FAO_Case_Study.pdf.
63 GSMA, "Big Data for Social Good."
64 LUCA and UNICEF. "Big Data for Social Good in Colombia." Video. View at: https://www.youtube.com/watch?v=xhlolKPbQRU.

Recommendations for municipal governments

Identify gaps in data and evidence that could be addressed by insights from MBD

The use of MBD should be demand-led and relevant to specific challenges in a city of country context.

Build staff capacity in the potential role of MBD

A significant barrier to progress in the use of MBD for sustainable urban development uses is a lack of awareness in public sector institutions of how it can be accessed and applied.

Actively approach MNOs to explore potential partnerships

Often, the right ingredients are already in place in LMICs for public sector use of MBD.

Develop the value proposition for using mobile data in a particular context

Assess how costs of mobile big data insights can leverage much greater savings and economic development if applied to urban planning and disaster resilience.

Actively assemble suitable partnerships with other entities

The case studies have shown the important role of third-party organisations in data analytics, where government capacity is low, as well as the role of international donor organisations, academic institutions, and civil society organisations. However, the ultimate objective should be to develop analytics capability within government.

Optimise the data infrastructure and enabling environment for mobile big data sharing

A significant barrier to MNOs being able to share or sell MBD is a lack of appropriate data privacy regulations. Optimising the data regulatory environment will have many other benefits for digital innovation across a country context.

Consider incentives to encourage MNOs to share MBD on a free-of-charge basis

Incentives could include tax-related discounts or access to other commercial partnerships.

DIGITAL SOLUTIONS FOR LAND GOVERNANCE AND TENURE

Highlights

- Digital tools can identify plot boundaries and facilitate community discussion on land ownership and rights.
- ICT-based systems facilitate cadastre management, linking to GIS and data for tax systems, urban planning, and service delivery.
- The digitalisation of land governance enables an equitable transition to more formal land markets that can unleash investment in infrastructure and planned urban development.

Outlining how the solution can address specific challenges

Land tenure is an important area where digital tools can address urgent challenges in rapidly urbanising contexts. Land constitutes a main asset for people around the world in rural and urban areas alike. Secure access to land or property can provide a source of livelihood, ensure access to adequate housing and services, and create a pathway out of poverty for future generations. Land tenure security is a precondition to benefit from civil, cultural, economic, political, and social rights.[65]

However, a significant proportion of urban dwellers, particularly the urban poor, in LMICs do not have access to sufficient land tenure rights due to poorly developed land governance systems and unequal tenure rights.[66]

Another extremely important area for improvement in many LMICs is women's land tenure rights; women often have less access, control, and ownership of land. This often limits women's economic opportunities and leaves them more vulnerable to poverty, hunger, gender-based violence, and displacement.[67]

In rapidly evolving urban and peri-urban areas, land governance is coming under increasing pressure in many LMICs. Rapidly expanding populations and municipal boundaries make land tenure a critical element in transitioning from chaotic urban sprawl to more planned and sustainable growth. Land tenure and governance has a direct impact on the ability of local governments to plan and develop urban areas in a coordinated way. Strategic urban planning, commercial land markets, and development of infrastructure are usually reliant on clear and effective land governance.[68] Therefore, there is an urgency for governments to create simple and less costly measures for the security of land tenure in rapidly urbanising areas.[69]

65 Mercurio, G. 2021. "Challenges and Perspectives for Tenure Security in African Cities: Lessons Learned from the Secure Tenure in African Cities Projects." A Cities Alliance roundtable discussion on 8 April 2021. Accessible at: https://www.citiesalliance.org/sites/default/files/2021-04/CN_W%20TenureSecurity_01042021_0.pdf.

66 Hendricks, B., et al. 2019. *Designing and Implementing a Pro-Poor Land Recordation System*. UN-Habitat, University of Twente, Global Land Tool Network. Accessible at: https://ris.utwente.nl/ws/portalfiles/portal/142749548/PRO_POOR_LAND_RECORDATION_Web_version.pdf.

67 USAID. 2016. "Land Tenure and Women's Empowerment." LandLinks factsheet. Accessible at: https://www.land-links.org/issue-brief/fact-sheet-land-tenure-womens-empowerment/.

68 Bird, J., and A. Venables. 2020. "Land Tenure and Land-Use in a Developing City: A Quantitative Spatial Model Applied to Kampala, Uganda." *Journal of Urban Economics* 119. Accessible at: https://www.sciencedirect.com/science/article/abs/pii/S0094119020300395.

69 Lengoiboni, M., C. Richter, and J. Zavenbergen. 2019. "Cross-cutting Challenges to Innovation in Land Tenure Documentation." *Land Use Policy* 85, 21–32. Accessible at: https://www.sciencedirect.com/science/article/pii/S0264837718309943.

Digital tools can support a participatory and collaborative approach to recording land tenure within communities where there may be no formal or paper-based system. This is demonstrated by the example of UN Habitat's Social Tenure Domain Model (STDM) in Box 3. Customary and informal land tenure is very challenging to incorporate into more formal land tenure systems. A number of internationally accepted models have emerged to help address these challenges, including the ISO-accredited Land Administration Domain Model. The STDM takes this model further by basing its implementation on ICT-based solutions, including digital mapping.

There are many other digital innovations that can be applied to improving land tenure and governance. Aerial photography from planes, drones or satellite images can be used as a basis to work through land plot boundaries in a participatory way with community groups, transferring the resulting cadastral information into GIS format, which can then be stored and managed by local governments. It also provides a necessary layer for urban planning. A strong example of this innovation is a project supported by Cities Alliance that used Unmanned Aerial Vehicles (UAVs) or drone, photography, and ICT solutions to improve land tenure and women's empowerment in the peri-urban community of Kasangulu in the Democratic Republic of Congo (Box 4). Digital tools are also vital for managing land cadastres in an organised, transparent, and sustainable way, linking into urban planning and management.

However, there are a number of barriers to the uptake of digital solutions for land tenure, including digital inclusion, as mentioned in the previous section. It is important to recognise that digital technologies for mapping and registering land tenure do not by themselves ensure more equitable situations for marginalised groups.[70] Key questions to address are:

who gets access to and control over the technologies associated with digitalisation, and is access and control over the data generated by digitalisation fair and transparent?

Successfully implementing digital tools in land tenure security requires a balance between inclusion of diverse land tenures and necessary adjustments to existing institutional norms and regulations in land governance. Moreover, flexibility in practice, legitimacy of digitally collected data, and balance between transparency and openness and data protection must be evaluated in rapidly urbanising contexts.[71]

70 SEWOH Lab. 2019. *Women's Tenure Security and Digitalization*. Accessible at: https://assets.ctfassets.net/rrirl83ijfda/2z6uTqq4OlW2CD5WOuME9q/44f2918e5883d5bdce54bdfb0c0d2fae/SEWOH_Lab_GLR_Concept_Note_final.pdf.

71 Lengoiboni, M., et al., "Cross-cutting Challenges to Innovation in Land Tenure Documentation."

Partner types typically involved

The following partners are typically involved in digital solutions for improved land governance processes:

Government decision-makers

Local governments play a key role in the allocation of funds to strengthen capacity, technological infrastructure, and tools. Stakeholders and decision-makers at local, regional, and central administrative levels can promote digital participation such as e-consultations and e-petitioning systems. They can provide opportunities for democratic governance systems and open channels for social interactions to improve the public policy development process.[72]

Private partners

Tech innovators and ICT developers' providers play a major role in the sustainable implementation of digital tools in land governance. For example, a local company could provide the drone mapping and digitisation of data into GIS.

Academic partners

Research-practice partnerships can help recognise contextual challenges and address theoretical and practical setbacks in the implementation of digital tools in land tenure and land governance in the local context. The usual focus of academic partners is on place-based problems, local policies and practices, or the development of local capacity.[73]

Community-based organisations

Local community leaders and civil society organisations play a significant role in gaining access to expertise in a local context and understanding social development challenges, such as the exclusion of women or other groups in land tenure.[74]

Individuals and communities

Creating shared 'working' environments for collaborative work on identifying plot boundaries and ownership rights, with the use of digital tools such as drone imagery and GIS mapping, can be used to communicate information and promote ideation for solutions.[75] The role of citizen engagement, potentially via digital channels, would also allow target or vulnerable groups to submit proposals for improvements or development of ideas related to land governance. This could include participatory budgeting for land governance systems.[76]

Case studies and learning points

The following case studies show how digital tools have been applied in practice for improved and equitable land governance and tenure.

72 Luna-Reyes, Luis Felipe. 2017. "Opportunities and Challenges for Digital Governance in a World of Digital Participation." *Information Polity* (22)2–3, 197–205.

73 Fjørtoft, H., and L.V. Sandvik. 2021. "Leveraging Situated Strategies in Research-Practice Partnerships: Participatory Dialogue in a Norwegian School." *Studies in Educational Evaluation* 70. Accessible at: https://www.sciencedirect.com/science/article/pii/S0191491X21000894.

74 Tuhkanen, Heidi. 2021. "How to Leverage the Power of Digital Participatory Tools in Urban Planning." Stockholm Environment Institute blog. Accessible at: https://www.sei.org/perspectives/digital-participatory-tools-for-urban-planning/.

75 Luna-Reyes, Luis Felipe, "Opportunities and Challenges for Digital Governance in a World of Digital Participation."

76 Cantador, I., and M.E. Cortés-Cediel. 2018. *Towards Increasing Citizen Engagement in Participatory Budgeting Digital Tools*. Accessible at: http://arantxa.ii.uam.es/~cantador/doc/2018/dgo18ebudgeting.pdf.

BOX 3
UN HABITAT'S SOCIAL TENURE DOMAIN MODEL

UN Habitat's Social Tenure Domain Model is a pro-poor land information tool that aims to mitigate the gap in conventional land administration systems. It provides a standard for representing people to land relationships. The STDM is a specialisation of an ISO-approved Land Administration Domain Model. The relationship established between people and land is independent of the level of formality, legality, and technical accuracy. The front-end interface to test and apply the STDM concept and model is supported using ICT as an information tool to provide efficient land rights recordation tools. The STDM prototype adheres to the pro-poor, equity, affordability, good governance, subsidiarity, gender-sensitive, systematic large-scale approach. In partnership with Global Land Tool Network, the tool is continuously developed for application in areas such as informal settlement upgrading and natural resource management.[77]

Cities Alliance, in partnership with the World Bank and other organisations, has been supporting the implementation of STDM in Uganda since 2011 through the Transforming Settlements of the Urban Poor in Uganda (TSUPU) project, in which 14 municipalities were supported to address infrastructural challenges.

This began with a year-long pilot in the municipality of Mbale, where satellite imagery was used to produce a settlement map on which structures, houses, roads, water points, etc., were digitised.

Data from completed questionnaires is entered into Excel for further processing. The imported data can be checked via a data management window, which also enables editing, updating, and managing non-spatial data. With the STDM plug-in, almost any type of document, scanned image or text, photos, and videos can be uploaded into the tool. These supporting documents can link tenure status to a specific spatial unit, such as a structure (as used in the pilot), land and other properties, making it flexible and practical in informal settlement contexts.[78]

There are many benefits, including the ability for citizens to obtain land right documentation for free, and the fact that the STDM software is free and open source for a government to use and modify if they want to. It provides a cost-effective means for cities to enable registration of land rights in a much more rapid way than conventional surveying, which is vital in the context of rapidly growing urban areas. The information provided by STDM can also provide the basis for city managers to better plan and provide services to settlements, including slum areas.[79]

LEARNING POINTS:

- **Pilot projects to innovate land tenure are being implemented in various countries to mitigate the gaps in land registration and the formal procedures associated with it. In most cases, the general technological approach is through community-based digital data capture via mobile applications.**
- **Mobile technology and the internet can be used to enhance access to land tenure for urban poor communities in rapidly urbanising environments.**
- **Partnerships such as those between international organisations, national institutions, local authorities, and community stakeholders were key to the successful execution of STDM in Mbale.**
- **STDM's success depends to a great extent on the readiness of the government and relevant authorities to embrace the tool and adopt it as part of the urban governance system.**
- **An understanding of the benefits and subsequent support and ownership of the process by the community is also critical for success.**

77 Social Tenure Domain Model. 2021. Website. Accessible at: https://stdm.gltn.net/.

78 Cities Alliance. 2014. *STDM Pilot in Uganda – Addressing the Information Requirements of the Urban Poor*. Project output report. Accessible at: https://documents1.worldbank.org/curated/pt/655271468185045558/pdf/99245-WP-P126966-Box393191B-PUBLIC-tenure-domain.pdf.

79 Cities Alliance. 2019. "STDM in Uganda – Social Tenure Domain Model." Video. Accessible at: https://www.citiesalliance.org/resources/multimedia/videos/stdm-uganda-social-tenure-domain-model.

BOX 4

USING DRONES TO IMPROVE LAND TENURE AND EMPOWER WOMEN IN DRC

In Kasangulu, a small city of about 28,000 people in the outskirts of Kinshasa, the Cities Alliance Innovation Programme[80] supported IRDAC SARL, a local cartography group, to implement a pilot project using digital tools and participatory processes to help vulnerable communities formalise and protect their land and property rights, while reducing potential conflicts and modernising land governance systems. The project was implemented in partnership with members of RADEKAS, a network of community-based development associations in Kasangulu.[81]

Kasangulu is an agricultural community made up of mostly poor farmers. Land pressure in Kasangulu and other rural communities has been intensifying as Kinshasa, the fast-growing capital of DRC, expands. Most residents of Kasangulu lack official property titles for their customary lands, a common situation in areas where less formal recordkeeping practices were used in the past. Many people are also unaware of the tenure insecurity risks they face without official title deeds.

The pilot project helped the DRC land administration modernise its land management tools and establish a digital, automated cadastral database for Kasangulu. It created a complete land registry plan covering 622,000 ha in four Kasangulu districts, and nearly 5,000 land plots were extracted from the drone's aerial digital images.

The project also implemented a customised IRDAC smart filter app that extracts individual land data from the land registry database to be used for producing official land titles. The pilot cost $49,570 over a period of 10 months and was funded by Cities Alliance under its Secure Tenure in African Cities Initiative: Micro Funds for Community Innovation.[82]

THE PILOT DEMONSTRATED A NUMBER OF BENEFITS, INCLUDING:

- Innovative digital technologies can be combined with tools for participatory dialogue between land tenure stakeholders, enabling exchange of views between key stakeholders during the process of securing informal land rights.
- Integrating geographic information technologies including GIS, civilian drones, and web-mapping tools into DRC's land management system is a cost-effective way to modernise the land management system and formalise land and property rights.
- Job creation by offering technical training to young people from RADEKAS member households to help the land administration digitise the land registry.
- Enhanced financial inclusion by sharing knowledge on the benefits of land titles with women, who received guidance and support to use land titles for microcredit to support income-generative activities, tackling poverty as a sustainable strategy to improve family income generating activities.

80 Cities Alliance. 2019. "Innovation Programme to Fund Five Activities Promoting Tenure Security in African Cities." Cities Alliance news. Accessible at: https://www.citiesalliance.org/newsroom/news/business-opportunities/innovation-programme-fund-five-activities-promoting-tenure#:~:text=The%20Cities%20Alliance%20Innovation%20Programme%20aims%20to%20incubate,that%20helps%20grantees%20transform%20their%20cities%20and%20communities.

81 Africa Goes Digital. 2020. "DRC: Using Drones to Improve Land Tenure and Empower Women." Blog. Accessible at: http://www.afgoesdigital.com/drc-using-drones-to-improve-land-tenure-and-empower-women/.

82 Cities Alliance. 2020. Drones for Land Clarification and the Empowerment of Women. Project overview document. Accessible at: https://www.citiesalliance.org/sites/default/files/2020-09/Rapport_final_IRDAC_2020_EN_0.pdf.

While the pilot was not able to generate land titles for residents, the cadastre is in place and a subsequent phase of the initiative is expected to scale up the process and convert the land tenure information into official titles. The next stage is likely to be a public-private partnership involving a large foreign entity that can bring in the necessary skills and the original implementers of the pilot. The costs of this, although not yet defined, are expected to be offset by additional revenue that the government will be able to generate from property tax, made possible via more formalised land titles.[83]

83 Information from interview with the project implementers, April 2022.

LEARNING POINTS:[84]

- The project demonstrates that combining the tools of participatory dialogue between land tenure stakeholders with the use of innovative digital technologies can facilitate the process of securing informal land rights.
- The digitisation of the land registry is a first step towards helping residents secure their property and informal land rights, and for preventing possible conflicts.
- Building capacity in land administration and modernising services are crucial to helping people secure property rights.
- The pilot ran parallel with a wider UN Habitat initiative to review the DRC's land policy at the national level, which is important for synergies and compatibility between innovative local processes to digitise land management systems and overarching policy requirements.
- To capitalise on the experience, an advocacy, monitoring, and evaluation strategy was seen as the next step in effectively integrating the project's achievements into national land management instruments.

84 Cities Alliance, DRC: Using Drones to Improve Land Tenure and Empower Women.

Recommendations for municipal governments

Allocate resources or seek external funding

Use cost-effective digital solutions to improve land tenure registration. Digital tools make the process of land administration efficient and accurate, as opposed to traditional methods. A project implemented over the course of 10 months would take several years if traditional land survey tools were used. Digital tools can also improve the accuracy of data collection and management.

Assemble an appropriate partnership

This is necessary to guide the implementation process. It is likely to include a tech innovator with the ability to carry out drone photography and a supplier who could advise on ICT/GIS-based systems for land governance.

Inform the general public and all key stakeholder groups

All should be apprised of the intention to use digital tools to improve land tenure and implement a participatory process from start to finish. This may involve raising awareness via local media channels, workshops to explain the process, and sessions to work with community members to identify and register land tenure based on an accredited system such as STDM.

Maximise the gender and inclusion benefits of digital processes in land tenure registration

Work with stakeholder groups to co-design the process to register ownership rights as well as the land governance and cadastre system governance.

Link the resulting land governance database

The database should be linked to an open data or e-governance portal to ensure transparency and easy access to records.

Contribute to the evidence base of what works well or what failed during the implementation

This can be done by measuring certain metrics and sharing information with other sub-national and national government stakeholders.

INCREASING MUNICIPAL TAX REVENUE WITH DIGITAL SYSTEMS

Highlights

- Generating property tax revenue ties into securing land tenure systems as the next step from technological interventions in land tenure.
- Learning from initiatives such as the African Property Tax Initiative and the subsequent Local Government Revenue Initiative (LoGRI)85 can be adapted by rapidly urbanising regions to build support for the digitalisation of property tax with contextual adaptation.
- GIS, Unmanned Aerial Vehicles, e-filing systems, and open-source databases have been successfully used to aid property tax systems in LMICs.

Outlining how the solution can address specific challenges

In all countries, urban areas are the main contributors to GDP and government tax revenues.[86] However, to generate property tax in many LMICs, the strengthening of land administration is crucial. The complexity of land tenure is one of the most sensitive political and technical issues and often a key barrier to revenue collection.[87] Challenges in land registration and records systems in rapidly urbanising contexts are compounded by existing conditions, marginalisation of vulnerable groups, and influxes of migrants. Many people do not have legal rights, and in the cases where they do have them, there is no formal documentation as evidence, leading to significant gaps in property taxation and revenue generation.

In the context of property tax, research by the African Property Tax Initiative shows that if properly harnessed, property tax has the potential to constitute a mainstay revenue stream for African countries.[88] This coincides with findings for rapidly urbanising countries in Asia.

In the context of developing countries where the tax revenue system is underdeveloped, introducing digital technology as a tool can reduce the dependency on governments' non-foreign aid and natural resource revenues. A recent Better than Cash Alliance report on tax in LMICs found that developing and emerging economies can potentially raise an additional $300 billion in government revenue every year by digitising tax payments.[89] Digitalisation makes it easier for tax authorities to levy and collect taxes and for businesses and individuals to pay them, among many other benefits. Some of the key benefits are higher revenue from increased taxpayer compliance in an easy-to-follow digital system, lower administrative costs through automation, and more transparency and accountability leading to reduced leakages and corruption.

In Tanzania, for example, digitising tax payments has the potential to increase annual revenue by almost $500 million per year and increase the tax-to-GDP ratio. A study conducted by the World Bank[90] found that Africa is home to the largest amount of buyable land, and that securing access to land is essential for millions. An effective property tax revenue system using digital technology presents an opportunity to governments, investors, and those who seek land rights.

85 Local Government Revenue Initiative (LoGRI) website. Accessible at: https://www.ictd.ac/programme/logri/.
86 Payne, G. et al. 2014. "Land Tenure in Urban Environments." USAID LandLinks Issue Brief. 23 March. Accessible at: https://land-links.org/issue-brief/land-tenure-in-urban-environments/.
87 Ibid.
88 Haas, Astrid R.N., Justine Knebelmann, and Colette Nyirakamana. 2021. "Five Tenets for Consideration When Undertaking Property Tax Reform in Africa." ICTD blog. Accessible at: https://www.ictd.ac/publication/five-tenets-consideration-undertaking-property-tax-reform-africa/
89 Rosengard, J. 2020. *Success Factors in Tax Digitalization*. Better Than Cash Alliance. Accessible at: https://www.betterthancash.org/explore-resources/success-factors-in-tax-digitalization
90 Bird. R.M., and E. Slack. 2002. *Land and Property Taxation: A Review*. World Bank. Accessible at: http://www1.worldbank.org/publicsector/decentralization/June2003Seminar/LandPropertyTaxation.pdf.

Digitalising property market and land systems in particular can help the tax administration regime expand tax bases, improve efficiency in enforcement and compliance, reduce tax evasion and the cost of tax collection, and enhance revenue collection, as well as improve tracking, reporting, forecasting and decision-making.[91]

Municipal governments can use digital solutions in a range of ways to support tax collection. The lack of digitised city maps acts as a barrier to property tax revenue, as the uncertainty of land boundaries makes taxation unclear. Digital tools such as GIS can be used to integrate data sources and AI-based analysis of UAV aerial photography to classify property types. Open-source software can be used to capture the location, ownership, and GPS location of properties, and to collect photographs. Trained groups can use devices such as tablets to create an electronic database for properties. A comprehensive property database supports governments to identify taxable properties and expand the tax registry.

Another digital solution is an e-filing system that helps regulate and increase efficiency in tax filing and **mitigate corruption** as well as compliance costs.[92]

Digital solutions have many advantages. They are convenient and efficient for citizens, with no need to queue at a public office. Tax departments can reach everyone in a society via app or Unstructured Supplementary Service Data (SMS). They offer greater compliance and real-time visibility of tax income and related economic performance, as well as **greater public sector accountability and transparency**. There is often increased revenue and lower administrative costs for government, providing strong value for money, as well as increased **transparency**, more evidence for data-led policy making, and greater efficiency for businesses, which leads to greater compliance.

Secure tax payment platforms that link directly to citizens' digital accounts allow for real-time monitoring of revenue collection and provide system checks and audit trails. They can facilitate both business-to-government (B2G) payments and person-to-government (P2G) payments.

Challenges typically include implementation difficulties in technology and staff capacity, slow initial uptake, risk of excluding those without digital access, private sector cost of learning, and data security and privacy risks.

For a sustainable city growth model, a continuum of digital and inclusive land administration approaches needs to be applied. Cities Alliance can play a key role in building strategic partnerships, inviting stakeholders, and strengthening existing capacities to upscale digital infrastructure, drawing on conventional land administration professionals, civil society, researchers, and expert insights for innovative pro-poor land administration.[93] As a result, a digitalisation of land administration should reduce cost, generate security at faster rates, enhance livelihoods, and create revenue for low-income countries.

91 Mburu, P. 2021. "Kenya: African Countries Urged to Digitise Land Records to Boost Revenue." All Africa, Daily Nation. Posted 7 September 2021. Accessible at: https://allafrica.com/stories/202109070831.html.

92 World Bank. 2022. "Filling the Gap by Filling Taxes: How Technology Can Aid Governments in Tax Collection." Feature Story. Accessible at: https://www.worldbank.org/en/news/feature/2022/01/06/filling-the-gap-by-filing-taxes-how-technology-can-aid-governments-in-tax-collection.

93 Zevenbergen, J., et al. 2013. "Pro-poor Land Administration: Principles for Recording the Land Rights of the Underrepresented." *Land Use Policy* 31, 595–604. Accessible at: https://www.sciencedirect.com/science/article/abs/pii/S0264837712001743.

Partner types typically involved

A wide range of stakeholders are required to develop digital solutions for tax revenue and collection systems in urban areas.

Stakeholders and decision-makers for local, regional, or central administration

Ensuring a successful digitalisation process requires government approval to implement or access sufficient funding and to strengthen the government and public capacity for the digitalisation process.

Tax revenue professionals

Provide expert input on land issues and the areas of tax systems that can be digitalised, as well as defining priority areas and linking to land tenure systems in the case of property tax.

Landowner groups (general target group, majority, or minority vulnerable groups)

Engage with other stakeholders to input information as required, collaborate actively with land policy actors to highlight needs, and participate in assessments. Ideally, an elected leader may liaise for the target citizen group between the community and land policy actors.

Donors and private partners

These can provide funding, innovative resources, and – most importantly – the technology to develop infrastructure and strengthen a city's capacity to carry out the digitalisation process for tax systems. They can also promote investments to improve inclusive economic growth, raise awareness, provide training, and build capacity on the ground.[94]

94 Myers, G. 2014. "Grading Donors on Land Rights: Where We Are, and Where We're Going." USAID website. Accessible at: https://blog.usaid.gov/2014/03/grading-donors-on-land-rights-where-we-are-and-where-were-going/.

Researchers

They may develop qualitative and quantitative material to design a participatory digitalisation of tax revenue systems. They can aid in recognising challenges and generate insights for countries and/or cities to digitise tax systems and effectively tackle challenges.

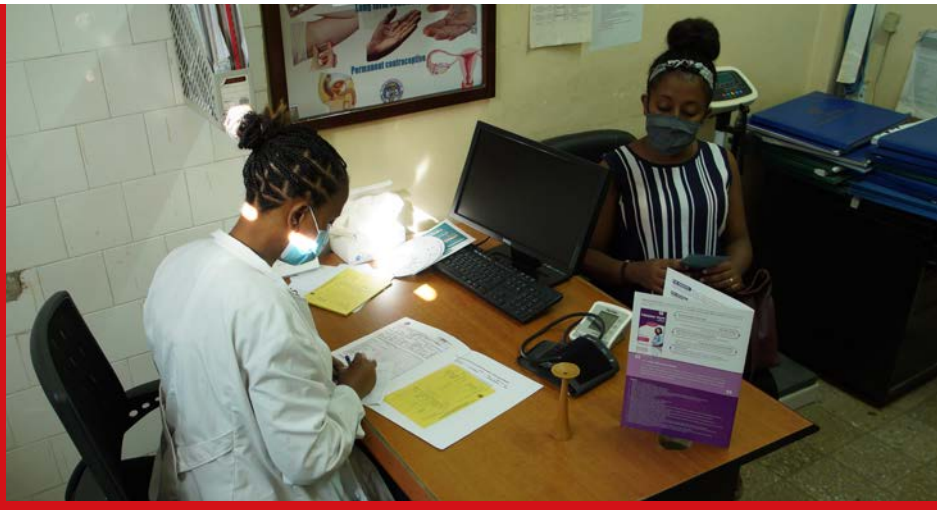
Civil society organisations and NGOs

These organisations can recognise and acknowledge the needs of people in accessing and using digital systems related to tax collection. They can conduct digital literacy workshops to enable citizens to use the digital system, which is likely to be important. They can also produce and disseminate new knowledge, provide support to civil society actors, and implement awareness and training sessions for communities.

Case studies and learning points

The following case studies are highlighted to understand the complexity of digitalising land tenure to generate revenue.

BOX 5
SIERRA LEONE: FREETOWN PROPERTY TAX COLLECTION



Freetown's population increased by 37 per cent between 2004 and 2015.[95] This rapid population growth resulted in greater demand to supply citizens with basic services. As part of a reform initiative, the city deployed digital ICT solutions to subject every property in the city to an identical valuation process and generate tax according to approximate market values. This generated sustainable income source for city-level initiatives, which in turn decreased dependency on international aid to provide citizens with public services. The IT system managed data collection for valuation, billing, payments, appeals and enforcement.[96]

In 2019, the International Growth Centre (IGC), in partnership with the International Centre for Tax and Development (ICTD), implemented a proof-of-concept pilot project to introduce and refine a simplified points-based property tax system in Freetown. Satellite imagery was used to identify and measure every property in Freetown, and an IT-based model was developed based on patterns in the quality of roofs, windows, etc. using ground team observations. These proxy indicators helped to quickly measure the property tax bracket that each property should pay.

At the same time, the city council developed a new IT system to cover data collection, valuation, billing, payments, appeals and enforcement.[97] The initiative resulted in a number of strong benefits. As 95 per cent of properties were mapped and valued, the number of registered properties doubled from about 57,000 to over 120,000.[98] As a result, in the first two months of 2019 more than $537,000 was collected, which was more promising than the annual generation of $800,000 under the old system.[99] Allocating a percentage of revenue from property tax collection to participatory budgeting each year creates an incentive for citizens to engage with the reform of property tax system. The tax revenue is creating a greater revenue stream which can be invested in basic service delivery such as sustainable waste management systems to the city's road infrastructure.[100]

LEARNING POINTS:

- **There have been many advantages. The new system is forecast to generate five times as much property tax revenue, which can be invested elsewhere in municipal needs.**
- **It is far easier and more cost-effective to administer compared to the former 'surface area'- based system, which was hard to measure and often inaccurate, charging residents inappropriately high taxes, leading to a lower compliance rate.**
- **The simple new digital system is more sustainable than a complex modelling approach and more equitable than systems based on calculating the surface area of buildings.**
- **Every aspect is transparent, readily available, and verifiable, helping reduce abuse of the system and further safeguard revenue for public expenditure.**

95 Kamara, A. 2021. "Property Tax Reform – Lessons from Freetown." International Growth Centre. Accessible at: https://www.ataftax.org/property-tax-reform-lessons-from-freetown.

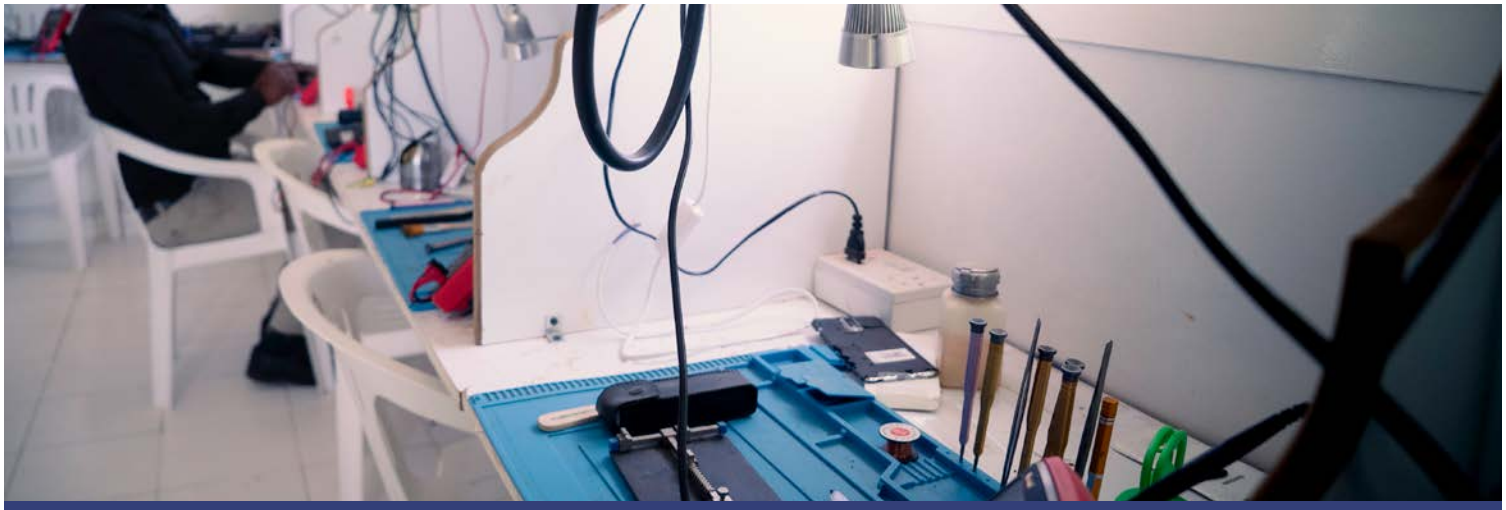
96 Kamara, A., N. Meriggi, and W. Prichard. 2020. "Freetown Just Implemented a New Property Tax System that Could Quintuple Revenue." ICTD website 20 May. Accessible at https://www.ictd.ac/blog/freetown-new-property-tax-system-quintuple-revenue/.

97 Grieco, K., J. Michel, and D. Holliday. 2020. "Reforming Property Tax Valuation in Sierra Leone." International Growth Centre blog, 21 February. Accessible at: https://www.theigc.org/blog/reforming-property-tax-valuation-in-sierra-leone/.

98 Kamara, A., "Property Tax Reform – Lessons from Freetown."

99 Institute of Development Studies. 2021. "Collaborating to Reform Freetown's Property Tax System." Impact story. 14 June. Accessible at: https://www.ids.ac.uk/opinions/collaborating-to-reform-freetowns-property-tax-system/.

100 Freetown City Council. 2018. "All Freetonians Have a Role to Play in the Transformation of Our City." Website. Accessible at: https://fcc.gov.sl/property-tax/.



BOX 6
M-DECLARATION, RWANDA

In rapidly urbanising contexts, small to medium-sized businesses form a large part of the informal economy. Governments will benefit a great deal by creating inclusive strategies for tax administration. In Rwanda, earlier online platforms for tax administration favoured large organisations with computer-literate users. Platforms such as M-declaration address the issues of lack of computer knowledge and complicated online systems, allowing all citizens to declare taxes on time by leveraging the emerging use of mobile phones in Rwanda.

The Rwanda Revenue Authority (RRA) implemented the M-declaration system in 2013 in collaboration with the International Finance Corporation. The World Bank Group provided $100,000 to develop the M-declaration platform and campaign to promote awareness of the new system.[101] It has enabled SMEs to file their tax returns and pay taxes using their mobile phone. It has also improved compliance by eliminating the need for taxpayers to wait in a queue at the RRA offices. Taxpayers simply dial an access number and follow basic steps to declare their taxes. They can report the previous year's turnover, calculate the profit tax for the current year, and submit payment using a traditional bank account or mobile money. M-declaration also offers taxpayers the option of making payments in quarterly installments. All of this reduces tax evasion by making it easy to comply through a handheld device, saving money and time taxpayers otherwise spent on transport and paperwork. It has also improved the formalisation of informal businesses by providing a convenient platform to register.[102] The service is employing citizens for call centres, technical support, and dissemination of information on social media after formal training, which enhances economic and upskilling opportunities for citizens.

During the Covid-19 pandemic, the M-declaration system encouraged taxpayers to take health checks to have tax penalties and interest waived as an incentive, tying it into the wider objectives for holistic citizen well-being.[103] The RRA has also used social media platforms such as Twitter to encourage citizen use of the system by tweeting to thank them for paying their taxes on time and to remind them of accumulation of interest on late payments. Learnings from the M-declaration process are now being used for wider initiatives across African countries.[104]

LEARNING POINTS:

- **Public sector support and private sector partnership are key to implementing digital solutions.**
- **Enabling and progressive regulation drives innovation and growth of the digital financial sector.**
- **Authorities can leverage Unstructured Supplementary Service Data to service the last mile, while developing more robust app-based solutions for advanced segments with smart phones.**

101 World Bank. 2013. "Small Businesses in Rwanda Dial in to Pay Taxes." Website article. Accessible at: https://www.worldbank.org/en/news/feature/2013/12/31/small-businesses-in-rwanda-dial-in-to-pay-taxes.
102 World Bank, "Small Businesses in Rwanda Dial in to Pay Taxes."
103 Author's findings from the official Rwanda Revenue Authority Twitter page in 2022. Accessible at: https://twitter.com/rrainfo/status/1507269360733278209.
104 The New Times. 2013. "Tax Declaration, Payment Go Mobile." 8 October. Accessible at: https://www.newtimes.co.rw/section/read/69782.

BOX 7

THE LAND GOVERNMENT REVENUE COLLECTION AND INFORMATION SYSTEM IN TANZANIA

As a result of rapid urbanisation and pressure on governments to provide adequate public services and infrastructure, local governments in Tanzania face significant challenges in tax revenue collection, budgeting, audits, accountability, and transparency in the tax administration cycle.[105]

The Land Government Revenue Collection and Information System (LGRCIS) was established to address these issues. LGRCIS is an ICT system that centrally manages revenue from all municipal sources. Using GIS, the system collects taxes from properties, billboard tax, business licenses, service, and hotel levies. The government of Tanzania established LGRCIS with support from the Danish International Development Agency (DANIDA) and the World Bank. In 2014, the World Bank approved a $213 million credit from the International Development Association to the Tanzania Strategic Cities Project that focused on eight urban centres. DANIDA provided $6 million to support complementary projects.[106]

The LGRCIS supported revenue collection with taxpayer identification information; generation of invoices, receipts, and demand notes; defaulter identification; and facilitated electronic payment through a single payment portal. The system uses mobile phones to connect to money transfer networks such as M-Pesa, Tigo-pesa, Max Malip and Airtel Money,[107] enabling easy connection to the integrated system. LGRCIS also used GIS to identify and digitise buildings to create a record of taxable properties, information that was used to create a comprehensive database that increased coverage of main revenue sources.

There are many benefits to this digital tax system. Public awareness and compliance have dramatically increased. Prior to the initiative, 70 per cent of citizens in the city of Arusha were not aware of the need to pay taxes, and many small businesses did not have any records for tax accounts, compared to 94 per cent now.[108] Citizen trust has grown as taxpayers believe receipts from the LGRCIS system are genuine and that their payments are reaching legitimate beneficiaries. Transparency and accountability increased as well, as LGRCIS authenticated the accuracy of bills for taxpayers and boosted budgeting for city management.

paperwork and inconsistencies caused by manual information collection in city records. The LGRCIS system makes it difficult for forgery to take place and does not provide scope for negotiation between taxpayers and staff. This allows for a transparent payment process with little space for corruption. Enforcement measures benefit from the system by helping revenue collection staff know the exact location of compliant taxpayers and information about defaulters.[109]

Finally, the increased revenue stemming from an effective collection system made it possible to construct the first-ever sanitary landfill and storm drains, as well as streetlights and bus terminals. This visible sign of tax expenditure creates further incentives for citizens to pay their taxes.

LEARNING POINTS:

- **Designing an effective property tax revenue policy encourages partnerships with the private sector, which sees an opportunity to provide ICT solutions. It also mitigates funding and technology gaps.**
- **Designing LGRCIS to integrate with mobile money platforms makes it simple for citizens to pay taxes, enhancing compliance and revenue generation.**
- **Digital solutions such as LGRCIS can greatly enhance transparency, which further increases tax revenues.**

105 McCluskey, W., and R. Franzsen. 2005. "An Evaluation of the Property Tax in Tanzania: An Untapped Fiscal Resource or Administrative Headache." Property Management 23(1), 43–69.

106 World Bank. 2014. "Building Arusha: One City's Journey to Better Urban Services, Access and Quality of Life." Accessible at: https://www.worldbank.org/en/news/feature/2014/08/12/building-arusha-one-citys-journey-to-better-urban-services-access-and-quality-of-life.

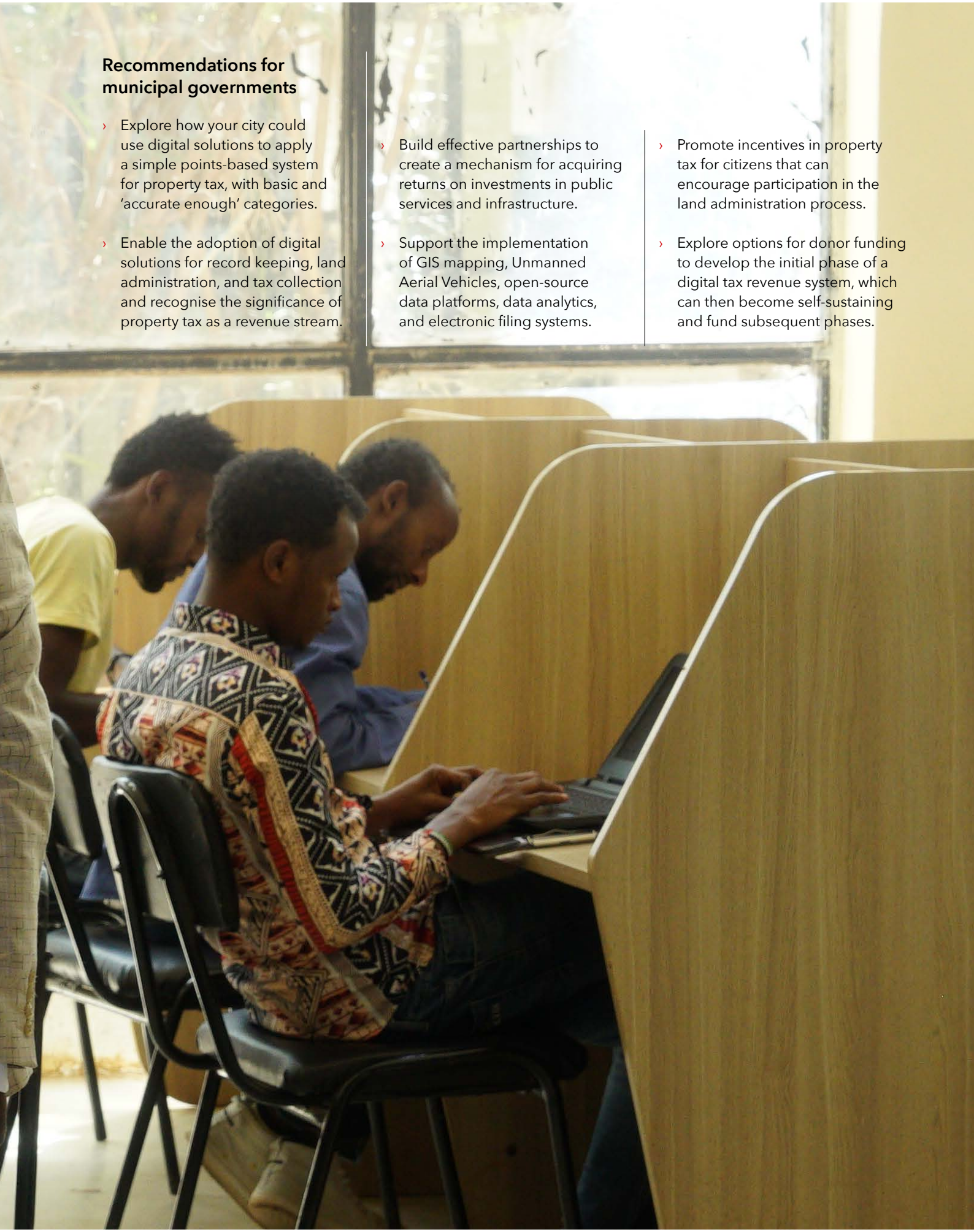
107 McCluskey, W., Huang, C.Y. 2019. "The Role of ICT in Property Tax Administration: Lessons from Tanzania." CMI Brief. Accessible at: https://www.cmi.no/publications/file/6880-the-role-of-ict-in-property-tax-administration-lessons-from-tanzania.pdf.

108 World Bank. 2017. "Modernization, Taxpayer Education Provide Good Foundation for Tax Collection in Tanzania." 5 January. Accessible at: https://www.worldbank.org/en/results/2017/01/05/modernization-taxpayer-education-provide-good-foundation-for-tax-collection-in-tanzania.

109 World Bank, "Modernization, Taxpayer Education Provide Good Foundation for Tax Collection in Tanzania."

Recommendations for municipal governments

- Explore how your city could use digital solutions to apply a simple points-based system for property tax, with basic and 'accurate enough' categories.
- Enable the adoption of digital solutions for record keeping, land administration, and tax collection and recognise the significance of property tax as a revenue stream.
- Build effective partnerships to create a mechanism for acquiring returns on investments in public services and infrastructure.
- Support the implementation of GIS mapping, Unmanned Aerial Vehicles, open-source data platforms, data analytics, and electronic filing systems.
- Promote incentives in property tax for citizens that can encourage participation in the land administration process.
- Explore options for donor funding to develop the initial phase of a digital tax revenue system, which can then become self-sustaining and fund subsequent phases.



DIGITAL INNOVATION FOR SANITATION AND WASTE MANAGEMENT SERVICES

Highlights

- Digital tools can enable private sector business models to support service delivery in solid waste management and sanitation, improving cost-effectiveness and customer service throughout the value chain.
- Digital solutions can help across the public and private sector in terms of identifying waste hotspots, making waste management services more efficient, and using machine learning to help identify plastic waste types, to give a few examples.
- Digitisation of the waste management sector increases data that governments can use in decision-making for waste management sanitation needs.

Outlining how the solution can address specific challenges

SOLID WASTE MANAGEMENT

The world generates over two billion tonnes of municipal solid waste per year, 33 per cent of which is managed in a manner that is harmful to the environment. Waste generation is expected to grow by more than three times by 2050.[110] The way in which waste is handled, sorted, and disposed of impacts the environment and living conditions in rapidly urbanising low and middle-income countries. Household waste generation and storage, reuse and recycling of waste, waste collection, transport, and disposal in landfills are the typical elements of a waste management system in LMICs. Waste collection is typically practised by informal sector 'waste pickers' and transported to a chain of dealers or processing enterprises before being sold to manufacturing enterprises.

110 World Bank. "Trends in Solid Waste Management." Webpage "What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050." https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html.

In the context of waste disposal, inefficient waste management damages livelihoods in emerging economies. Burning, dumping, and landfilling waste in open areas result in exposure to chemicals present within the components of the waste. This creates health implications for populations surrounding waste disposal areas, and blockages from undisposed waste in waterways and drains cause airborne diseases and flooding. It is estimated that between 400,000 and one million people die each year due to the negative impacts of mismanaged waste.[111] A majority of low and middle-income countries in Africa and Asia are not equipped with a formal waste collection system.

Low recycling rates and negative environmental impact produce challenges that can be mitigated by encouraging private sector digital innovation.[112] Although generally considered a service industry delivering a public service, solid waste systems can also be described as a dynamic market system with waste seen as a resource. Where inefficiently managed, waste plastic causes significant harm to the environment and society. However, when viewed through the lens of a market system, the management of waste becomes a value-adding process, with numerous opportunities for adding value, reducing social and environmental costs, and promoting economic development through the creation of employment at each stage of the value chain.[113] This is an important part of the transition towards more circular economy models of materials and resource use.

Integrating digital technology for waste management provides an entry point for private sector start-ups and innovators by launching waste management solutions.[114] There are a number of high impact digital innovation areas. Open-source mapping platforms or analysis of satellite or drone imagery using machine learning can support governments and private sector partners to identify plastic waste hotspots. Mobile apps and marketplace platforms can help connect people and businesses within the waste management value chain, as shown by Coliba in West Africa, making the process more efficient and cost effective. AI and robotics can help with waste sorting and recycling and IoT sensors can enable waste management companies to identify the weight of waste collected in bins for collection. In addition, GPS monitoring of data collection areas helps in understanding the key sectors and locations in cities where waste is generated to create efficient routes for waste collection. All of this creates much-needed data on waste generation and waste flows, which further support the development of waste management infrastructure and business opportunities.

111 Williams, M., et al. 2019. *No Time to Waste: Tackling the Plastic Pollution Crisis Before It's Too Late*. Tearfund, Fauna & Flora Intl., WasteAid and the Institute of Development Studies. https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/14490/J32121_No_time_to_waste_web.pdf?sequence=1&isAllowed=y.

112 Wilson, M., et al., *Digital Dividends in Plastic Recycling*.

113 Ibid.

114 K-water, et al. 2018. Smart Water Management Case Study Report, Executive Summary. Smart Water Management Project, K-water and the International Water Resources Association. Accessible at: https://www.iwra.org/wp-content/uploads/2018/11/SWM-report-exec-summary-web-1.pdf.

SANITATION

One in three people on earth – around 2.5 billion – lack decent sanitation. As the population continues to urbanise at a rapid pace in Africa and South Asia, outstripping available infrastructure and municipal capabilities, this crisis looms over cities, particularly for informal settlements generating significant public health challenges. It is clear that LMICs cannot wait for appropriate sewer infrastructure to be constructed.

There are a wide range of private sector-driven, digital solutions for sustainable and circular approaches to sanitation that are emerging in LMICs. The most notable viable solution is container-based sanitation, a service-based business model built around standalone toilets that store waste in sealable, removable cartridges.[115] A number of start-ups have integrated a circular approach into their commercial models for CBS, providing a collection service, processing the waste via anaerobic digestion, and then selling the resulting by-product on for use in fertiliser or biogas energy. This creates a significant opportunity to displace conventional fertilisers that are causing soil degradation on a massive scale globally.[116]

Container-based sanitation has great potential in dense urban environments and low-income settlements that are hard to reach. However, the logistics involved often present challenges in affordability, and digital technologies and related business models can lower the cost to make them more viable. Mobile apps can connect customers with the CBS business. Geospatial data helps decide where sanitation facilities need to be implemented, specifically in the case of vulnerable and informal communities.

115 Shepard, J., and N. Jeffery. 2017. *The World Can't Wait for Sewers: Advancing Container-Based Sanitation Businesses as a Viable Answer to The Global Sanitation Crisis*. Ernst and Young and Water and Sanitation for the Urban Poor. Accessible at: https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/corporate-social-responsibility/ey-wsup-the-world-cant-wait-for-sewers.pdf.

116 The Toilet Board Coalition. 2017. *The Circular Sanitation Economy: New Pathways to Commercial and Societal Benefits Faster at Scale*. The Toilet Board Coalition. Accessible at: http://www.toiletboard.org/media/34-The_Circular_Sanitation_Economy.pdf.

Real-time data collection helps to realise the supply and demand gap in sanitation and waste management services.[117] For limited data for sanitation planning, big data can support mapping infrastructure needs and planning expansion. Poor logistics can be addressed by digital solutions such as GIS and IoT that help optimise operational management and logistics. Furthermore, mobile applications and gamification drive behavioural change and incentivise using the sanitation service, increasing awareness and usage. Mobile money and applications enable affordability with flexible payment plans.[118]

117 Njoroge, B. 2021. "Using Digital Tools to Improve the Commercial Sustainability of Container-Based Sanitation Models." GSMA blog. 10 November. Accessible at: https://www.gsma.com/mobilefordevelopment/blog/using-digital-tools-to-improve-the-commercial-sustainability-of-container-based-sanitation-models/.

118 Njoroge, B. "Using Digital Tools to Improve the Commercial Sustainability of Container-Based Sanitation Models."

Partner types typically involved

Stakeholders and decision-makers (local, regional, or central administration)

These play a critical role in providing sanitation services through waste collection, recycling services, delivering incentives and awareness programmes, maintaining waste collection logistics, and managing and operating landfill sites. Government cooperation is necessary to develop the infrastructure needed for the digitalisation of waste management and the partnerships associated with it.

Micro enterprise/ private partner

Funding is necessary for innovative solutions to be implemented on a community to national scale, as technological solutions may stress the national economic priority.

Multilateral banks/donors

They are part of the agenda to meet the SDGs and universal goals for a healthier global climate, and they can play sponsorship roles, strengthen partnerships, and support governing bodies in the absence of a large private partner fund.

Citizen

Participation of citizens enables waste collection and a sanitary environment on a community/ local level to reach national scale. Trust in government-led innovative initiatives will also bolster them.

Innovation experts/ researchers

These provide the essential technology and expertise required to carry out the innovative solution approach. Together with private partners, the collaboration of innovation experts and researchers can strengthen connectivity infrastructure.

NGOs

These provide accessibility to harder-to-reach areas present in the most rapidly urbanising contexts where connectivity infrastructure is lacking, and connectivity is an issue. NGOs enable access to services for marginalised groups and the underserved.

Civil society

Like NGOs in this sector, civil society plays an important role in the management hierarchy in recycling initiatives, the delivery of waste management services, monitoring and reporting, raising awareness, and advocacy.

Case studies and learning points

The following case studies explore digital interventions in basic sanitation and waste management in sub-Saharan Africa and Asia. Four case studies have been selected. Coliba in West Africa is a strong example of using mobile-enabled tools for plastic recycling services at a local level. Recykal in India demonstrates the power of a digital marketplace platform for recycled plastic at a larger scale. Sanergy in East Africa is a leader in the application of digital solutions to enhance and improve cost effectiveness of its CBS model. Finally, the Kampala Capital City Authority's use of GIS-based tools for pit latrine management is a public sector initiative that harnesses and coordinates multiple private sector suppliers.

BOX 8
COLIBA – INNOVATIVE RECYCLING SOLUTION IN GHANA

In West Africa, plastic waste is a major challenge. Plastic pollution accounts for disasters such as flooding and vector-borne disease outbreaks. On an average, Ghana generates 302,192 kg of plastic waste per day, and open burning of plastic waste leads to air pollution causing over 28,000 deaths in Ghana every year.[119]

Coliba was founded in Ghana in 2016 to tackle plastic pollution for environmental sustainability.[120] It aimed to address issues caused by rapid urbanisation and a weak waste infrastructure, in the absence of an authoritative motive to mitigate plastic waste management.

In 2018, Coliba received a grant from GSMA Ecosystem Accelerator Innovation Fund, which is supported by UK Aid, to develop a Coliba-designed mobile application, SMS, and web platform to implement plastic waste collection service in ten districts of Abidjan. The door-to-door plastic bottle collection created value for both the organisation and their mobile network operator partner. After recognising the large engagement levels, a commercial and co-branding partnership was formed with MTN Côte d'Ivoire, which enabled Coliba users to earn reward points in MTN data credit by participating.[121] Coliba also received $25,000 in funding from four lead investors, including UNICEF StartUp Lab and GreenTec Capital partners.[122]

Coliba collects and transports recyclables based on requests received from the mobile application Coliba 2.0. The plastics and recyclables are sorted to minimise contamination in the processing of waste plastics. The recyclable items are then supplied to companies that export plastic flakes onto the international recycling market.[123] There are significant benefits for municipal governments in encouraging such private sector innovation based on circular economy models.

Important waste management services are provided at no cost to the government, while recyclable materials are diverted from landfills into recycling markets and local jobs are created.

LEARNING POINTS:

- **Mobile applications enable on-demand services for waste management and formalise the waste management process.**
- **Promoting incubator platforms can result in accelerating ideas that need a platform to address large-scale challenges.**
- **Partnerships with mobile operators can create incentives such as mobile credits to use the internet and encourage households to use an application for waste management services.**
- **Such initiatives alleviate the burden on governing authorities to implement large-scale solutions while establishing a relationship with users, thus building citizen trust.**

119 Chasant, Muntaka. 2019. "Plastic Pollution in Ghana: Causes, Effects and Solutions." ATCMask blog.10 November. Accessible at: https://www.atcmask.com/blogs/blog/plastic-pollution-in-ghana.
120 Young World One. 2018. "Ambassador: Prince Agbata, Coliba Ghana." Webpage. Accessible at: https://www.oneyoungworld.com/ambassador-projects/coliba-ghana.
121 Gaekwad, R. 2021. "Five Key Insights from User-Centred Evaluation and Design Thinking Sprint of a Recycling Start-up in Côte d'Ivoire." GSMA Mobile for Development article. 11 March. Accessible at: https://www.gsma.com/mobilefordevelopment/blog/five-key-insights-from-user-centred-evaluation-and-design-thinking-sprint-of-a-recycling-start-up-in-cote-divoire/.
122 Crunchbase. 2022. Coliba Company Financials. Accessed April 2022. Accessible at:https://www.crunchbase.com/organization/coliba/company_financials.
123 Wilson, M., et al., *Digital Dividends in Plastic Recycling*.

BOX 9

RECYKAL IN INDIA: CONNECTING THE WASTE VALUE CHAIN WITH A DIGITAL MARKETPLACE

As consumption rises in urbanising cities, waste generation and the need to manage waste increases. In some cases, it is difficult to access data on the amount of waste generated and sources of waste generation.

A specific challenge is the informality in the waste management sector, where most transactions happen offline due to the absence of a formal ecosystem.[124] Recykal addressed this challenge in Hyderabad, India and has since grown to cover many urban areas. In a space that is dominated by NGOs or Corporate Social Responsibility (CSR)-inclined corporations, Recykal worked to digitise the waste management process. A marketplace platform connects waste generators such as households and offices and bulk waste generators such as manufacturers and hospitality firms to recyclers that depend on waste for income.

Recyclers can simply buy waste and create a steady supply, thus creating a steady income.[125]

It is a two-pronged revenue model; there is a marketplace commission for each transaction between waste generators and recyclers, and Software as a Service (SaaS) fees from the enterprise customers. An end-to-end, cloud-based system connects and aggregates generators, waste collectors, *kabadiwalas* (informal waste collectors), processors and recyclers. Their digital platform technology aims to assure transparency and traceability in the supply chain and is able to authenticate 10,000 metric tonnes of plastic waste each month. They work with hundreds of aggregators, plastic processors, and over 160 brands, including Coca Cola, Unilever, and LG. Recykal has also created an Extended Producer Responsibility (EPR) tool for brands in collaboration with the Indian government, helping firms to understand and demonstrate their EPR requirements.[126]

As a private company, Recykal is financed by venture capital funding, starting with an initial seed funding of $2 million and scaling up with the latest VC funding of $22 million from Morgan Stanley in early 2022.[127]

The circular model is reducing leakage of plastics into the environment and open burning of waste, which is harmful to the air quality of surrounding areas.

LEARNING POINTS:

- **It is important to recognise and enable integration of the informal waste management sector, for example by creating a formal ecosystem for waste-related transactions.**
- **Data collected (the locations where the waste is being generated, the sector generating waste, information on recycling) reports solutions to help policymakers, governments, and organisations adopt sustainable waste management practices.**
- **Digital solutions can enhance transparency and traceability via online transactions and order tracking, which helps to meet the due diligence requirements of corporate buyers of recycled plastic.**
- **Calculating the sustainability impact for organisations, creating best value for materials, and managing waste from multiple locations improves the visibility of waste streams.**

124 Recykal. 2022. Recykal website. Accessible at: https://recykal.com/.

125 Mitter, S. 2019. "This Hyderabad-based Startup Has Built an Udaan-Like Marketplace for Sustainable Waste Management." Your Story article. Accessible at: https://yourstory.com/2019/12/hyderabad-startup-recykal-waste-management-solution/amp.

126 Recykal website.

127 Crunchbase. 2022. "Recykal Company Overview." Crunchbase website. Accessible at: https://www.crunchbase.com/organization/recykal/company_overview/overview_timeline.

BOX 10
SANERGY'S USE OF DIGITAL SOLUTIONS TO ENHANCE CBS IN NAIROBI

In Kenya, the lack of access to safe sanitation facilities results in waste disposal that endangers community health, causing outbreaks of diseases such as cholera.

It also has a negative economic impact; the high cost of sanitation makes it difficult to provide sanitation services to poor and informal urban areas, and the loss or productivity from health repercussions of unsanitary conditions causes a drop of 1 per cent in GDP every year.[128]

In this context, Sanergy estimates that the cost of providing sewer infrastructure costs around $56 per person a year. In partnership with government partners in Nairobi, Kisumu, and other cities, Sanergy is realising a vision to bring sanitation to at least over a million Kenyan citizens at much lower costs. In 2015, Sanergy received a grant from the GSMA M4D Utilities Innovation Fund to build and implement a digital tool. Using mobile-enabled sensors, information is collected when a toilet is full and needs to be serviced. After testing several methods, Sanergy now uses two mobile applications, data collection, and mobile money to connect with its network, as well as Unstructured Supplementary Service Data (USSD) for customer support application. The platform is used for mobile money payments such as M-Pesa Mobile Money Services.

QR technology is used to monitor waste collection, with the support of tracking software to indicate cleanliness levels per toilet.[129]

The business model initially worked with a franchise system in which each partner paid installation fees to Sanergy and then a renewal fee. The franchise fees covered the costs of toilet installation, technical support, and waste collection. The waste was taken to treatment and transformation process to form by-products that could be sold. After reconsidering its business model, Sanergy now offers the toilets to municipal governments at no cost up front and charges $30 per year to remove waste, a pay-per-service solution that has proven to be highly successful.[130] The circular model is cost efficient and brings the sanitation cost per person per year down to $13, of which governments have to support only $6. The approach will result in the public sector saving approximately five times the money that would be spent on sewer infrastructure.[131]

LEARNING POINTS:

- **Affordable and accessible sanitation solution promotes hygiene and health improvements for impoverished areas where hygienic sanitation is entirely inaccessible.**
- **It is important to also train citizens to use smartphones to scan QR codes, which is an important part of the container-based sanitation model. Collecting aerial imagery as part of the initiative enabled better planning and service provision to remote areas of informal urban settlements.**
- **Lowering the cost of sanitation services creates a compelling case for government partnerships and investments to provide sanitation solutions for citizens.[132]**
- **Microentrepreneurs can join a franchise network in return for accessible credit in investing in sanitation services, helping to scale.**
- **Pay-per-service models can be a viable option to cover the cost of public service provision if initial installation of the services is provided free of cost.**

128 Social Business Design. "Sanergy Business Model: Sustainable Sanitation in Kenya." Social Business Design website. Accessible at: https://socialbusinessdesign.org/sanergy-business-model-case-study/.

129 Morais, C. 2019. "Sanergy: Using Mobile to Unlock Circular Economy Approaches to Sanitation in Nairobi." GSMA Mobile for Development blog. Accessible at: https://www.gsma.com/mobilefordevelopment/blog/sanergy-using-mobile-to-unlock-circular-economy-approaches-to-sanitation-in-nairobi/.

130 Waldman-Brown, A., and G.C. Flatter. 2018. Scaling Sanergy: Growing a Promising Sanitation Startup. Massachusetts Institute of Technology Legatum Center for Development and Entrepreneurship. Accessible at: https://legatum.mit.edu/wp-content/uploads/2018/07/Sanergy-Case-Study_6.29.2018.docx.pdf.

131 Sanergy website.

132 Saul, C., and H. Gebauer. 2018. "Digital Transformation as an Enabler for Advanced Services in the Sanitation Sector." Sustainability 10(3), 752. https://doi.org/10.3390/su10030752.

BOX 11

KAMPALA CAPITAL CITY AUTHORITY'S USE OF GIS-BASED TOOLS FOR PIT LATRINE MANAGEMENT

Over 90 per cent of Kampala does not have a sewer system, and the city had very limited services for emptying, collecting, transporting, and processing faecal sludge, which impacts environmental pollution and public health.

Since 2017, there have been various outbreaks of cholera in Kampala. To help solve the issue, KCCA wanted to understand where faecal sludge is being collected and dumped. It developed a low-cost, GIS-enabled mobile platform and geodatabase to connect consumers with pit emptying entrepreneurs. With the platform and database, KCCA can track the collection, transportation, and disposal of faecal sludge.

Following an initial trial, GSMA provided a grant of $128,100 over 15 months to help implement and scale up the innovative digital solution. Strategic partnerships with MNOs, the National Water and Sewage Corporation, and GIZ strengthened the pilot programme to receive funding in later years.[133] The grant enabled KCCA to scale up the GIS application, enable ICT training, and roll out applications for employment in its call centre. Pit emptiers are provided with a mobile phone equipped with a GIS-enabled application already downloaded and internet data and airtime from MTN Uganda, leveraging the fact that the vast majority of citizens have a mobile phone. Citizens can call the pit emptiers, provide them with directions, and they go to the locations to collect the waste. This helps provide sanitation services to the harder-to-reach areas and increases the capacity to connect with people in densely populated informal settlements.

Eighty per cent of pit emptiers use mobile money to pay for dumping fees at treatment plants. To encourage this digital payment ecosystem, MTN Uganda has provided zero tariff rates for calls to registered waste management entrepreneurs.[134] KCCA has completed over 6,000 emptying jobs with the support of digital solutions by improving its ability to trace service delivery across the sanitation value chain.[135]

There are many benefits. The system has improved sanitation and faecal sludge management for the urban poor living in hard-to-reach informal settlements. It is reducing environmental risks and disease outbreak by promptly emptying out latrines, which are mapped and easy to locate on the GIS-enabled system. The initiative has led to job creation, as pit emptiers and call centre workers provide support to keep the programme running. The app created new job streams, and over 60 per cent of sanitation entrepreneurs using the app declared an increase in income.[136]

LEARNING POINTS:

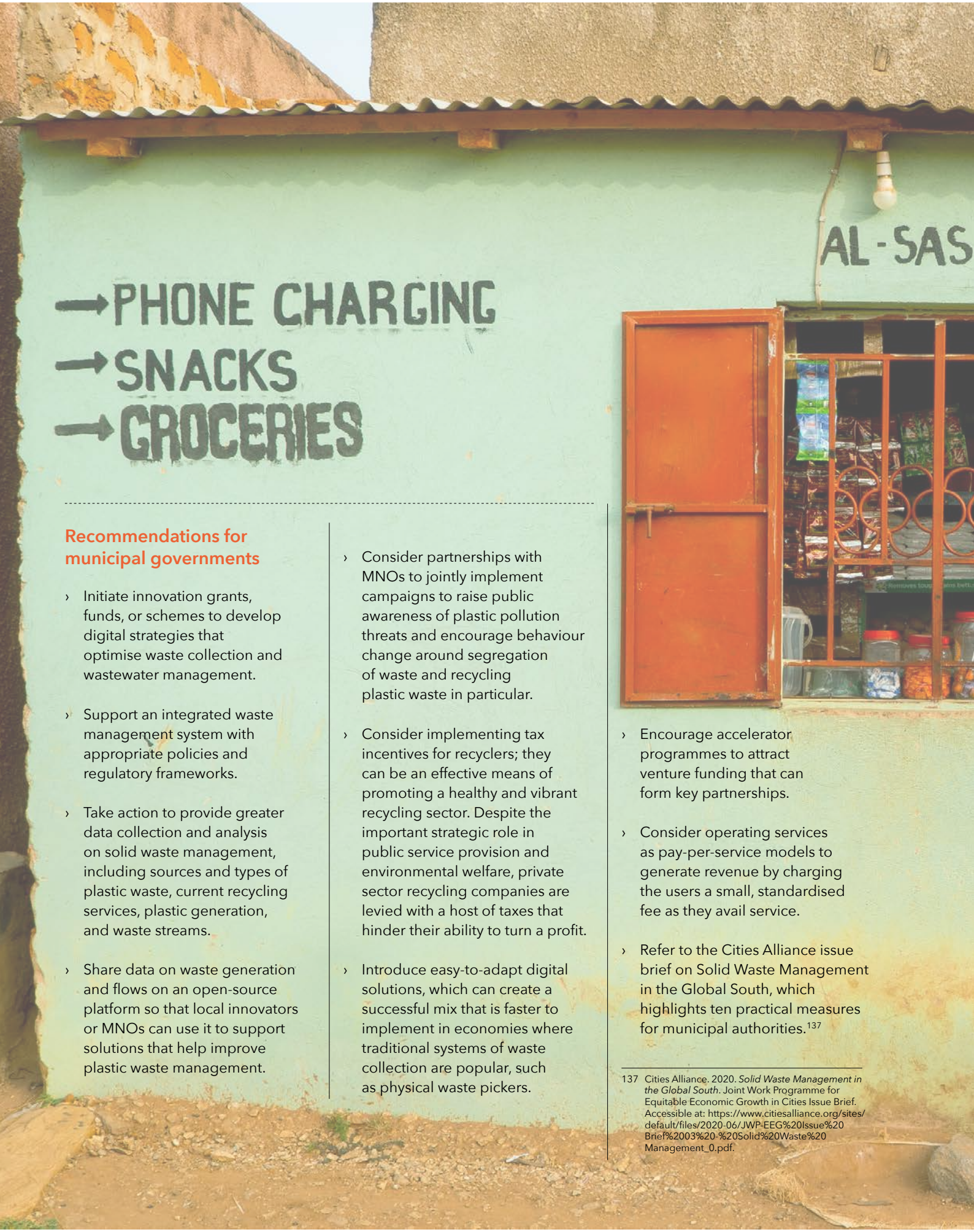
- **Mobile money as a tool to collect and perform payments reduces the friction that is caused by cash payments and provides income records that enable pit emptiers to access financial services such as loans.**
- **Partnerships with MNOs for zero-tariff calls and mobile money services incentivise greater use and uptake across the faecal sludge management value chain.**
- **Expanding the government's initiative with donor-funded grants helped develop and expand the digitally enabled sanitation solution.**
- **Mapping hard-to-reach areas with a need for sanitation services helps in understanding the waste management requirements, such as sewage treatment plants and drainage channels across the cities where the GIS-enabled solution is implemented.**

133 GSMA. 2018. Mobile for Development Utilities Innovation Fund 2017: Our New Grantees. GSMA Association. Accessible at: https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2018/01/Mobile-for-Development-Utilities-Innovation-Fund-2017-Our-new-grantees.pdf.

134 Mobile for Development. 2019. "Providing Pit Emptying Services Through a GIS-Enabled App – KCCA." Video. Accessible at: https://www.youtube.com/watch?v=Im4K0SNY4ts.

135 Sharma, A. 2019. "Can Mobile Help Solve the Sanitation Challenge?" GSMA Mobile for Development blog. Accessible at: https://www.gsma.com/mobilefordevelopment/blog/can-mobile-help-solve-the-sanitation-challenge/.

136 Morais, C., and L. Kore. 2020. "Kampala Capital City Authority – Unlocking the Power of Mobile-Enabled Sanitation." GSMA Mobile for Development blog. Accessible at: https://www.gsma.com/mobilefordevelopment/blog/kampala-capital-city-authority-unlocking-the-power-of-mobile-enabled-sanitation/.



Recommendations for municipal governments

- Initiate innovation grants, funds, or schemes to develop digital strategies that optimise waste collection and wastewater management.
- Support an integrated waste management system with appropriate policies and regulatory frameworks.
- Take action to provide greater data collection and analysis on solid waste management, including sources and types of plastic waste, current recycling services, plastic generation, and waste streams.
- Share data on waste generation and flows on an open-source platform so that local innovators or MNOs can use it to support solutions that help improve plastic waste management.
- Consider partnerships with MNOs to jointly implement campaigns to raise public awareness of plastic pollution threats and encourage behaviour change around segregation of waste and recycling plastic waste in particular.
- Consider implementing tax incentives for recyclers; they can be an effective means of promoting a healthy and vibrant recycling sector. Despite the important strategic role in public service provision and environmental welfare, private sector recycling companies are levied with a host of taxes that hinder their ability to turn a profit.
- Introduce easy-to-adapt digital solutions, which can create a successful mix that is faster to implement in economies where traditional systems of waste collection are popular, such as physical waste pickers.
- Encourage accelerator programmes to attract venture funding that can form key partnerships.
- Consider operating services as pay-per-service models to generate revenue by charging the users a small, standardised fee as they avail service.
- Refer to the Cities Alliance issue brief on Solid Waste Management in the Global South, which highlights ten practical measures for municipal authorities.[137]

137 Cities Alliance. 2020. *Solid Waste Management in the Global South*. Joint Work Programme for Equitable Economic Growth in Cities Issue Brief. Accessible at: https://www.citiesalliance.org/sites/default/files/2020-06/JWP-EEG%20Issue%20Brief%2003%20-%20Solid%20Waste%20Management_0.pdf.

E-GOVERNANCE SERVICES TO SUPPORT LIVELIHOODS

Highlights:

- E-governance enables economic growth, societal equity, and a good governance structure by providing public services from government authorities that are easy and cost effective to access.
- Flexibility provided by e-governance allows citizens to carry out government administrative tasks while saving costs and time in transportation to government office centres.
- An integrated approach makes cities liveable and supports livelihoods of citizens, and while connectivity infrastructures remain a key challenge in LMICs, platforms can be designed in partnerships with relevant technology partners to make them accessible.

Outlining how the solution can address specific challenges

A government-to-citizens (G2C) information exchange platform can be an entry point for better governance and service delivery in rapidly urbanising LMICs. These e-governance platforms enable the delivery of a range of public services and provide a flexible approach for citizens to request government services and interact with the government, making it more inclusive. Mobile applications and web-based portals are most commonly used for this purpose. Another service area for e-governance is government-to-business (G2B), in which a digital tool is developed to facilitate the business community to make transactions with the government. This provides a transparent and fair government interaction with formal and informal private sector businesses. In addition, government services such as information exchange between the multiple levels of government, property tax revenue collection, and information dissemination can benefit from the digitalisation of e-governance services.[138]

Measures by city governments to cope with rapid population growth need to be resident-driven, participatory, socially comprehensive, and just.[139] E-governance services can facilitate an inclusive vision for city economic growth while creating greater equity and access to services. To support livelihoods, the online delivery of services by governments promotes entrepreneurship and job creation through services such as business plan competitions, entrepreneur training and consultation, new business incubation, and promotion of local products in government procurement. Many countries have made the process of pre-registration, registration, and post-registration procedures simple, helping small to medium-sized enterprises thrive and generate revenue for the local economy.[140]

E-governance platforms can also support early warning system alerts, along with other digital channels such as mobile phone cell broadcasts, to protect communities from natural disasters. Platforms that enable risk and vulnerability reduction can improve early warning and preparedness. Digitising early warning systems can help cities better understand the risks and likelihood of disasters in certain areas and their consequences, making it possible to prioritise appropriate action.[141] This can help protect livelihoods that depend on natural resources, such as fishing, farming, and other enterprises, from revenue losses.

138 Ruzindana, E. 2019. "User Satisfaction of E-government Platform in Government Service Delivery Process: Case Study – IREMBO Platform." Thesis, University of Rwanda. Accessible at: http://dr.ur.ac.rw/bitstream/handle/123456789/1272/RUZINDANA%20ERIC.pdf?sequence=1&isAllowed=y.

139 Karmakar, J. 2020. *Understanding the Role of E-Governance in Urban Areas of West Bengal. Role of IT-ITES in Economic Development of Asia*. Springer Singapore.

140 Das, A., and S.S. Das. 2021. "E-Government and Entrepreneurship: Online Government Services and the Ease of Starting Business." *Information System Frontiers*. March. doi:10.1007/s10796-021-10121-z.

141 EWCII. 2003. "Integrating Early Warning into Relevant Policies." Second International Conference on Early Warning. Accessible at: https://www.unisdr.org/2006/ppew/info-resources/ewc2/upload/downloads/Policy_brief.pdf.

The digitalisation of direct delivery of public services to marginalising groups without intermediary powers creates a stronger capacity to facilitate sustainable and inclusive growth.[142] In dense urban contexts, it is not unusual for there to be a non-structured approach to governing bodies. A divide between levels of governments and authorities, citizen engagement, and public services creates a further gap between equal and equitable city development. The challenges of accountability in urban planning, security of land tenure, property tax generation, and access to basic sanitation and waste management services present the opportunity for e-governance tools to streamline public services, administration, and government interaction, as well as enabling public participation by promoting socio-economic development.[143]

Furthermore, e-governance is effective for disseminating information through ICT platforms; governments can provide services at much less cost at a much faster rate compared to traditional systems of information delivery. This creates citizen trust by establishing transparency and increasing citizen awareness of factors such as their rights and powers. E-governance has been successful in various areas, including online payments for utilities (such as water bills, revenue taxes, license fees, and school fees) and municipal services (house tax assessments, billing and collection, land and property records, registration and attorneys of properties, reviews, and approval authorities for site plans). Rural areas benefit by streamlining agriculture to local information, which has had a powerful impact.

142 Yadav, K., and S. Tiwari. 2014. "E-Governance in India: Opportunities and Challenges." *Advance in Electronic and Electric Engineering* (4)6, 675-680.
143 Dhaoui, I. 2021. "E-Government for Sustainable Development: Evidence from MENA Countries." *Journal of the Knowledge Economy*. https://doi.org/10.1007/s13132-021-00791-0.

Partner types typically involved

Stakeholders and decision-makers (local, regional, or central administration)

These are responsible for implementing e-governance systems by leveraging existing capacities, strengthening partnerships, inviting expertise, allocating funding for development, and implementing digital solutions.

National policymakers

They can prioritise e-governance initiatives and create conceptual and technical frameworks for ICT departments to follow.

Government bodies/ public sector service

Employees of departments that are willing can adopt e-governance tools in a governing system or initiative.

ICT departments

They are national information centres responsible for establishing and managing ICT platforms. They look over the implementation, act as an interface across multiple state-wide e-governance initiatives and address the ICT requirements of participating departments at central and state levels. They can create mobile applications for public services with application developers to enable accessibility on mobile devices.

IT service providers

They deliver the technological resources required to design ICT platforms used in governance and the capacity to run the initiatives.

Mobile Network Operators

These can assist in the dissemination of mobile applications to carry out e-governance services and work towards enhancing network coverage or presenting solutions to connectivity for citizen engagement with e-governance initiatives.

Citizen

Participation of citizens in e-governance systems determines the success of the initiative, and feedback surveys enable discovering bottlenecks for citizen services in e-governance platforms.

BOX 12
THE IREMBO DIGITAL PLATFORM, RWANDA

The Irembo digital platform was created as an e-government portal to enable access to government services and built through a public-private partnership framework. Within just two years, it was able to provide more than 96 e-government services such as birth certificate applications, driver's license registration, and land title transfers across six different government agencies.

More than 90,000 citizens a month use the platform, which services over 4 million citizens. In Rwanda 97 per cent of people own a smartphone or feature phone, and the service caters to 'mobile first' access.[144]

Today the Irembo platform provides services in additional areas, including e-payments, e-learning, remittances, and e-tourism, resulting in holistic benefits across Rwanda's economy.

144 Sear, M. J. 2021. "e-Rwanda: One of the Beacons of Digital Governments in Africa." Accessible at: https://www.linkedin.com/pulse/e-rwanda-one-beacons-digital-governments-africa-mohammad-j-sear.

The service has been very successful at reducing service delivery times and providing cost-effective access. More than half of Rwanda's population lives on or below the poverty line. Services that would require money for transport, paperwork, and long waiting periods are all reduced due the platform, enabling the urban poor to be included in public services.

In 2019, Irembo was recognised as one of 40 digital innovations making a real impact on society at the World Summit Awards Global Congress in Portugal.[145] And in 2021, Rwanda experienced a start-up boom that can be partially attributed to quick access to business registrations, obtaining licenses, and making online payments through Irembo.[146]

A local private sector entrepreneur has a 25-year public-private partnership concession to build and operate the government-wide service delivery and payment platform using a build-operate-transfer model.[147] The e-government platform model collects $1 per transaction. There has therefore been very little cost to the Government of Rwanda in its implementation.

145 CNBC Africa. 2020. "Rwanda's Digital Platform Irembo Gets Global Recognition." 19 March. Accessible at: https://www.cnbcafrica.com/media/6016020078001/.

146 NEC. "e-Governance in Africa." Webpage. Accessible at: https://www.nec.com/en/global/insights/article/2020022516/index.html.

147 Wille, J., and C. Masinde. 2017. "Home-grown Technology Firms Help Drive eGovernment Expansion in East Africa." World Bank Private Sector Development blog. Accessible at: https://blogs.worldbank.org/psd/home-grown-technology-firms-help-drive-egovernment-expansion-east-africa.

LEARNING POINTS:

- **Homegrown entrepreneurship should be encouraged to harness the advantage of innovative solutions that can be tested on a small scale and apply for larger external funding to scale up.**
- **Irembo is making government service provision efficient and affordable, while strengthening public-private partnerships.**
- **Irembo is enabling an innovation ecosystem for youth entrepreneurship and recognising the role of youth in the digital transformation of Rwanda.**
- **Transparency is enhanced by recording all transactions on the system and only providing access to citizens who can provide formal registration details such as national ID. This may exclude groups that do not have a national ID).**
- **Partnerships with e-payment platforms can enhance financial inclusion by creating credit streams for payments to access public services.**
- **Platforms like Irembo can enhance participation and accessibility to services for the urban poor by providing a majority of services on an application that can be accessed in remote areas. They also improve economic opportunity by creating an easy channel to formalise SMEs.**

BOX 13
EASYGOV, INDIA

Governments struggle with vast amounts of paperwork and data involved in welfare deployment schemes across India. There is often no system able to adequately monitor, track, and distribute funds in a transparent and efficient way to millions of welfare recipients.[148]

EasyGov, an AI start-up focused on digitising and deploying government welfare services, is an example of a company that monetises the savings incurred by the government using the EasyGov platform. Typical state government budgets in India do not allow such upfront software purchases, which can also incur bureaucratic hurdles, fear of risk, and time delays to adoption. By waiving upfront fees and taking a portion of the cost savings, EasyGov allows for quicker customer acquisition sales cycles and risk-free usage until the solution is proven.

148 OECD. 2020. "The Territorial Impact of Covid-19: Managing the Crisis Across Levels of Government." OECD Policy Responses to Coronavirus (COVID-19). Accessible at: https://www.oecd.org/coronavirus/policy-responses/the-territorial-impact-of-covid-19-managing-the-crisis-across-levels-of-government-d3e314e1/.

EasyGov has created a one-stop platform for welfare recipients to fill in their data, with data analytics to recommend the right welfare programmes the user is eligible for. Funds are distributed and monitored through the app by the government. This is an end-to-end solution to solve issues in human services with a family-centric, progressive focus.
The solution's interventions are designed around government parameters for welfare eligibility, rules, guidelines, etc. It also allows the tracking of progress of each recipient/family based on various human development metrics and benchmarks.

Recently, EasyGov launched the Government of India's Covid-19 relief scheme (PM Garib Kalyan Yojana) and around 20 welfare schemes from state governments. There is a record usage of 150,000-plus active daily users, and in the last six months, EasyGov has empowered 10 million families across India with over 1,700 welfare schemes.[149] The typical savings for a government client would be 20 to 25 per cent of the welfare budget. The software platforms are managed and maintained by EasyGov, making the process efficient and cost-free for the government.

EasyGov also provides an ecosystem that mitigates barriers for collaboration across various actors involved in the provision of government welfare. Using national ID and analytics enhances transparency, as a record is kept digitally for each user interaction on the system. To further scale-up the solution, EasyGov will integrate social protection programmes to provide accessibility for vulnerable groups to access government welfare, transforming the government welfare programme from a programme-centric to family-centric intervention.[150]

149 EasyGov website. Accessible at: https://www.easygov.co.in/.
150 ANI. 2022. "EasyGov Enhances Digital Solution for Social Protection Programmes." Accessible at: https://www.aninews.in/news/business/easygov-enhances-digital-solution-for-social-protection-programmes20220103145505/.

LEARNING POINTS:

- **Challenges include connectivity and awareness for rural users, negative perceptions of government workers towards the AI tool if they feel threatened about AI taking over their jobs or having to learn a new technology platform, and political continuity with changes in government administration.**
- **Buy-in from the top of government leadership is critical for success.**
- **Using a metric system such as a 'needs' score indicates the requirement for social protection and welfare provision.**
- **An easy-to-understand interface and AI tools for actionable information enable seamless interaction with the platform, thus making it popular for citizens to use.**
- **Software-as-a-service model allows for improvements with the user bearing no costs.**
- **The citizen-driven approach uses technology to make accessibility to government services simpler for citizens and government officials.**

BOX 14
JAKI, JAKARTA

Integrating government services is essential to a megacity such as Jakarta, whose metropolitan area covers over 6,000 km² and where rapid urbanisation presents complex challenges.

The infrastructure to formulate the data about citizens and service provision alone was unsustainable for Jakarta in early 2000s. As technological developments advanced, in 2019 Jakarta Smart City Management developed JAKI to integrate various public services, improve citizen engagement, and enhance functionality.[151] The one-stop platform integrates services from the central and regional government as well as business actors, all while streamlining services that meet the needs of citizens.[152]

As Indonesia is located along the Pacific Ring of Fire, it faces many natural threats such as earthquakes, tsunamis, flooding, volcanic eruption, and droughts. Upwards of 3,000 disasters occur across the country in any given year.[153] Additionally, with the economic impact of the Covid-19 pandemic, Indonesia shifted from upper-middle income to lower-middle income status in 2021.[154]

To address such complex challenges, the JAKI app integrates services that can enhance living conditions for all citizens. Jaki's application allows access to over ten kinds of services, including Jaklapor, which is used to report problems using geo-tagging and integrated into rapid community response; JakRespons, which reports problems by residents and can be monitored for a follow-up; Jakpangan, which lists market commodities, briefly enabling the public to calculate the cost of food before buying it; and JakPantau, which enables preparedness during heavy rainfall and provides access to latest information about river flows and conditions of floodgates in Jakarta.

LEARNING POINTS:

- **Efficient disaster response has the benefit of saving lives, enabling time to mobilise communities.**
- **Ability to calculate costs of food expenditure allows budgeting for consumption in every household, creating a sustainable financial situation.**
- **JAKI has greatly improved public services in parts of Jakarta and its features meet the requirements of today's society.**
- **Digital platforms form part of the broader framework for smart city solutions, fostering digital transformation for access to inclusive public service initiatives.**
- **Unique public services, such as calculation of food costs and early warning systems, integrated in one platform can be adopted in LMIC contexts.**
- **A comprehensive Citizen Relations Management application that requires employees to resolve public complaints increases jobs.**
- **The benefit of a multifunctional application such as JAKI is the cost of running one application, enabling several services that can potentially save government funds in the long run.**

151 GovPH. 2022. "Integrating Government Services Through the Creation of the Super-App: Jakarta Kini (JAKI) App." Webpage. Accessible at: https://coe-psp.dap.edu.ph/compendium-innovation/integrating-government-services-through-the-creation-of-the-super-app-jakarta-kini-jaki-app/.

152 ITU (International Telecommunication Union). 2021. Jakarta Kini WSIS Prizes Contest 2021 Nominee Overview. Accessible at: https://www.itu.int/net4/wsis/stocktaking/Prizes/2022/DetailsPopup/16121992608128064.

153 CFE-DMHA. 2021. *Disaster Management Reference Handbook – Indonesia*. CFE-DM. Accessible at: https://reliefweb.int/report/indonesia/disaster-management-reference-handbook-indonesia-december-2021.

154 World Bank. 2021. "The World Bank Indonesia Overview." Webpage. Accessible at: https://www.worldbank.org/en/country/indonesia/overview#1.

Recommendations for municipal governments

- Ensure dedicated government department support and coordination to maintain and upgrade e-governance platforms.
- Create effective partnerships with private sector innovators to implement ICT solutions for public service delivery and facilitate efficient government working systems, while also creating jobs and demonstrating ICT innovation in the city.
- Provide entrepreneurial services such as business registration, licensing, and small grants to maintain the momentum in revenue generation for economic growth.
- Encourage businesses and entrepreneurs to link to the platform, thereby harnessing public data that can drive other innovative solutions to help solve urban challenges.

CONCLUSIONS

Over the next decade, half the population of Asia and Africa will be living in cities. At present, a billion people are living in informal settlements that lack basic services. Sixty per cent of urban dwellers are at risk of pollution and natural hazards, leading to an estimated increase of 2 billion people in urban slums by 2030. As a result of rapid urbanisation, pressing issues include insufficient and poor-quality housing solutions, overcrowding, food insecurity, limited electricity and sanitation infrastructure, threats of eviction due to lack of secure land tenure, and settlements in areas prone to natural disasters due to lack of space in more resilient areas. In addition, a major rising challenge is the increasing vulnerability of women, children, the urban poor, and other marginalised groups.[155]

155 Payne, G. et al., "Land Tenure in Urban Environments."

The areas of digital innovation highlighted in this report can provide a much-needed impetus towards addressing these challenges. In particular, the following five areas show significant potential to support more sustainable urbanisation:

Mobile big data sources to understand highly mobile populations.

Mobile big data helps support data-driven planning, meeting the needs and improving resilience of vulnerable populations. While the evidence base is still thin, it appears that the costs of purchasing big data sets and data analytics services are greatly exceeded by the cost savings in terms of life and property due to disaster preparedness and response. Mobile big data is also likely to be much more cost-effective than conventional surveys for aspects such as transport and mobility data.

Digital systems for land governance and tenure

Digital solutions can help improve participatory land tenure registration systems and urban land governance, which links to better urban planning and unleashes commercial land markets, in turn supporting investment in infrastructure and services. Implementing such schemes can be expensive (although they are often supported by donor grants) but is an investment that can leverage much greater social and economic benefits, including unleashing land markets and encouraging investment in property and infrastructure.

Increasing property tax revenue with digital systems

This helps to greatly improve the efficiency, transparency, and effectiveness of tax revenue generation, providing much-needed own-source revenue for investment in infrastructure and services. The cost of implementing a digital tax system can be rapidly offset by the increased public revenue it is likely to generate.

Digital innovation for sanitation and waste management services

Harnessing private sector innovation to help provide basic services is necessary to meet the significant deficit in funding available for water, sanitation, and hygiene infrastructure, particularly in informal settlements. This is a sector where circular economy business models can enable service provision at no or very low cost to the government.

E-governance services to support livelihoods

Enhancing easy access to basic public information and services, such as applying for a small business license, can greatly improve economic development prospects. There are a range of models, from a public sector-funded and implemented platform that requires investment to the EasyGov model, which is funded from public funds that are saved due to more efficient processes. There are many social and economic benefits that greatly outweigh the initial costs, including more inclusive access to public services and aspects such as disaster early warning alerts.

This knowledge product recommends the important partnership and enabling considerations for city managers in LMICs to help unleash digital innovation in these areas. Enabling environment considerations are particularly important, and there are often barriers that city governments and development partners must address. These include mobile and internet connectivity; data availability and quality; data infrastructure; human resources and digital skills in government; digital skills and literacy among the public; data security and privacy regulations; and private sector innovation and new business models. It is also vital to work with private sector partners to maximise digital inclusion by addressing barriers such as accessibility, affordability of devices and mobile services, relevance of online content, the population's digital skills, and data and personal security online.

Overall, digital transformation offers promising possibilities to secondary cities and other urban areas throughout LMICs. There are already many tried and tested examples of how digital solutions can support more inclusive and sustainable development, some of which are mentioned above. Each urban area and municipal government must aim to identify how it can best harness digital innovation and raise its state of digital readiness, working in partnership with the private sector, civil society, academic institutions, and development partners. The five areas of innovation highlighted in this study represent high impact initiatives that can be carried out at a fairly basic level of digital readiness.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