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# Chapter 28

## Smart City Foundation for Smart Economy

Femi Olokesusi, Femi Ola Aiyegbajeje, Gora Mboup  
and Dennis Mwaniki

**Abstract** A smart city is viewed as a sustainable, inclusive and prosperous city that promotes a people-centric approach based on three core components and seven dimensions, all of which integrate ICT into their architecture. The three core components are *Smart City Foundation and Smart Institutions and Laws*, which in turn are the pillars of the seven dimensions of a smart city: infrastructure development, environmental sustainability, social development, social inclusion, disasters exposure, resilience, peace and security. The three components together with the seven dimensions make a smart economy. A smart city foundation is composed of three elements: urban planning and design, land policies and basic infrastructure. For a city foundation to be smart, it must be inclusive at the onset of the urban planning and promote mixed neighbourhoods where social clustering is prevented.

**Keywords** Lagos · Smart city · Smart economy · Smart city foundation · ICT · Urban planning · Streets · Public spaces · Secure tenure · Basic infrastructure · Flooding · Adaptation · Mitigation · Policies · Programmes

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## 28.1 Introduction

Lagos, the former capital of Nigeria and the largest city in sub-Saharan Africa, is located on the southwest coast of Nigeria and has a history dating as far back as the fifteenth century when it grew as a trade centre and seaport. It was captured by British forces in 1851, annexed as a British colony in 1861 and became the capital (regional administrative centre) of the colony and protectorate of Nigeria in 1914, a status it maintained until 1991 when the country's capital was formally moved to Abuja [1, 2].

The city of Lagos is among the few African cities with a population of over 10 million and hence considered as a megacity. In 2014, the population of the urban agglomeration of Lagos was estimated at 12 million. A large population gives Lagos an economic comparative advantage associated to high population density and massive youthful active population. The urban agglomeration of Lagos is part of the Lagos State that encompasses an area of 3577 km<sup>2</sup> of which 787 km<sup>2</sup> are lagoons and creeks [3]. It has a population of 17.5 million [3]. Metropolitan Lagos covers 37 % of the land area of Lagos State [4]. While the population density of the state is about 4193 persons per km<sup>2</sup>, the density in the built-up areas of Metropolitan Lagos, made up of Lagos Island, the original city, and the Mainland, is over 20,000 persons per km<sup>2</sup> [3].

Despite the movement of the federal capital to Abuja in 1991, Lagos has remained as the country's dominant economic, social, and financial centre as well as the hub of national and international communications. It is a thriving industrial and commercial centre with seaports, local and international airports, and industries concentrated in the Apapa, Ikeja and Ilupeju industrial estates. Lagos state contributes more than 30 % of Nigeria's GDP, accounts for about 90 % of the national foreign trade flows, 70 % of all industrial investments, consumes more than 60 % of the national electricity supply and generates 70 % of its revenue internally [5]. Lagos is one of Africa's five biggest consumer markets, has higher standard of living than anywhere else in Nigeria and is home to almost half of Nigeria's skilled workers [4, 6]. In addition, Lagos is a major educational centre, providing a well-educated and highly skilled labour pool. The employment opportunities continue to attract both domestic and international migrants [4].

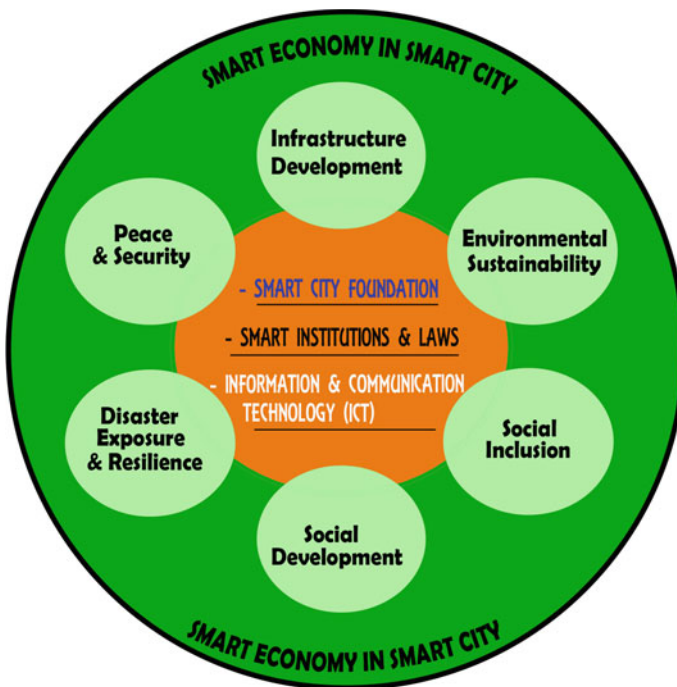
Despite its potential to be a sustainable, inclusive and prosperous city, Lagos smartness has over the decades continued to suffer from a weak city foundation, emanating from years of urban planning negligence and under investment in basic infrastructure development. Many settlements in the city lack a sewerage system and rainwater drainage facilities, and adequate waste management sites are missing, which are key components of smart basic infrastructure along with connection to water and energy. Flooding during rainy seasons as well as uncollected garbage is frequent phenomena in all parts of the city, but particularly in the poor settlements. Frequent energy shortages also affect the city's economy.

This chapter discusses the city foundation of Lagos and how it is shaping the city's prospects for smart economic growth.

## 28.2 The Concept of Smart City Foundation

A smart city is viewed as a sustainable, inclusive and prosperous city that promotes a people-centric approach based on three core components—*Smart City Foundation, Information and Communications Technology (ICT) and Smart Institutions and Laws*. These three core components are the pillars of the seven dimensions of a smart city: infrastructure development, environmental sustainability, social development, social inclusion, disasters exposure, resilience, and peace and security. The collective of these components and dimensions constitute a Smart City Economy (Fig. 28.1).

A smart city foundation is composed of three elements: urban planning and design, land policies and basic infrastructure, all of which integrate ICT into their developmental and operational architecture. For a city foundation to be smart, it must be inclusive at the onset of the urban planning and promote mixed neighbourhoods where social clustering is discouraged. Having all the poor living together creates slums and fuels instability and insecurity. Inclusive urban planning eases access to basic services (water, sanitation, housing, education and health) and to decent employment for all. A key element of smart urban planning is a smart



**Fig. 28.1** Conceptual framework—smart economy in smart cities in the African context. *Source* [7]

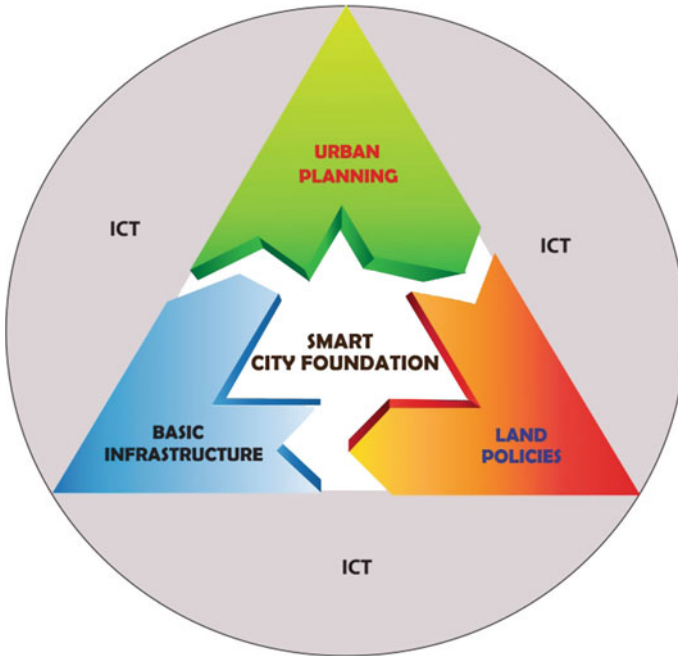


Fig. 28.2 Smart city foundation. Source [8]

street network that reduces travel time and encourages walking and social interactions. Smart urban planning enhances infrastructure development, environmental sustainability, economic and social development; makes cities resilient and prepared to overcome natural disasters; and promotes mixed neighbourhoods where services are walking distances from people's residences. ICT plays a crucial role in promoting a smart city foundation, by enabling inclusiveness in planning, policy and infrastructure provision processes such as through public participation; as well as creating enormous non-physically limiting opportunities to all city residents. Basic infrastructure constitutes access to urban basic services such as water, sanitation, housing and energy (Fig. 28.2).

**Infrastructure development** complements the basic infrastructure services under smart city foundation and extends to actual investment and advancement of services such as transport, ICT, industrial energy, education, health, etc. **Environment Sustainability** is comprised of elements of energy, transport, building and pollution. **Social inclusion** includes aspects of participation in decision making as well as according all city residents equal opportunities for growth and prosperity. **Social development** encompasses elements of education, health, public space, social inclusion and social capital. **Disaster Exposure** incorporates elements of mitigation and adaptation to various disasters such as flooding, droughts, storms and earthquakes. **City Resilience** is composed of elements of city foundation, environment, social capital and social development. **Peace and**

**security** deals with all forms of violence and conflicts, including domestic violence, violence in public places, crime, armed conflicts, terrorism, etc. An insecure city limits opportunities for investment and economic growth and cannot be a smart city.

## **28.3 Two Centuries of the Planning of the City of Lagos**

Lagos, originally known as *Eko*, has a history dating as far back as the fifteenth century when it emerged as a pepper farm, fishing post and later grew as a trading centre and sea port [9]. Lagos started around the Island and Mainland areas and served as a major slave trade centre between 1404 and 1889. It was captured by British forces in 1851, annexed as a British colony in 1861 and became the capital (regional administrative centre) of the colony and protectorate of Nigeria in 1914, a status it maintained until 1991 when the country's capital was formally moved to Abuja [1, 2]. Lagos has been administered under a variety of territorial schemes. When it was ceded to the British in 1861, it was administered as a city-state with its own separate administration. In 1866, it was included in the West African Settlements under a Governor-in-Chief resident in Sierra Leone, but retained a separate legislative council and a local administration. Various changes followed, through its status as a separate colony, to its merger with Western Nigeria in 1951. When Lagos state was carved out as one of the then 12 states in the federation, Lagos assumed new role as a regional administrative centre [10].

Owing to the historical investment by the colonialists, and with the two administrative roles (both the national and Lagos State capital) and their associated financial and administrative capacity, Lagos city had a much higher degree of infrastructural development than the larger Lagos State and the rest of Nigeria. Within Lagos, the model of infrastructure development adopted within the city itself favoured the white colonial settlements and largely ignored settlements inhabited by the indigenous African majority, resulting in unequal intra-city infrastructure provisions. Beginning in the late 1950s, a shift in Nigeria's economy from agriculture to crude oil trade made Lagos attractive to immigrants from all parts of the country, as well as from other neighbouring countries. The effect of a rapidly growing urban population was increased pressure on the existing infrastructure [4, 10, 11].

### ***28.3.1 Urban Planning as a Tool for Segregation and Development in Lagos During the Colonial Era***

Spatial planning in its general sense was part of local indigenous administration in Nigeria, long before the colonial administration. By the mid-1800s, many

indigenous cities in Nigeria, though not urbanized in the modern sense which gives population thresholds, had a form of arrangement of land uses in their domain, with deliberate spatial organizations done around palaces and to conform to community needs for defence, religion or trade. Cities such as *Kano*, *Zaria* and *Ondo* still retain their pre-colonial inner-city settlement structure [12, 13]. The traditional core area of Lagos had developed following a distinct urban design pattern that followed the typical Yoruba classical town plan which resembles a wheel, the Oba's (king's) palace being the hub, with the spokes consisting of a series of roads radiating out from the palace and linking the town to the centre [14, 15]. Some of these aspects are still evident to date [16].

Elements of European planning in Nigeria started to emerge with colonialism in Lagos in the early 1900s, but were restricted to towns and localities where the colonial administrators and European expatriates were residing [16]. The emerging planning legislation in Lagos throughout the colonial period aimed to create settlement zones throughout the city based on race. The 1863 Lagos Town Improvement Ordinance, which introduced the basis for control of development and urban sanitation in Lagos protectorate, was the first planning legislation in the country. This ordinance was followed by the 1902 Planning Ordinance which empowered the governor to declare areas as European Reservations with a Local Board of Health of their own [17]. The Cantonment Proclamation enacted later in 1904 was the first major legislation that ushered in segregation of expatriate officials and Europeans from the native areas in the guise of tackling the then prevailing public health problems in Lagos. The segregationist development would be later furthered by the Ordinance No. 9 of 1914 (on compulsory acquisition of land for public use) and the Township Ordinance No. 29 of 1917 (which classified urban settlements into different grades and established broad physical layouts of towns). The 1917 ordinance classified Lagos as the only first class township in Nigeria, giving it its own managerial authority in the form of a Town Council. Enforcement of this ordinance in Lagos advanced the segregation tendency along racial lines with the creation of European Reservation Areas for the expatriates and Europeans and encouraged subdivision of native areas into indigenes and non-indigenes [18].<sup>1</sup> Among the key developments undertaken during this period was the development of Apapa in Lagos in 1926 as a self-contained residential community that provided relief to Lagos Island of its original port functions to focus on being the Business District Centre [15], a function that the island plays to date.

With focus being put on the European areas, native areas remained largely unplanned and largely lacking in infrastructure development. Population increase in these areas subsequently led to congestion, and with lack of basic services, there was an outbreak of bubonic plague in late 1920s in the native settlements of Lagos [16]. As a result, a new inclusive planning and development approach was urgently required and was drawn in the Lagos Town Planning Ordinance of 1928. Although

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<sup>1</sup>The Native Authority Law of 1954 defined a non-indigene or stranger as any native who is not a member of the native community living in the area of its authority.

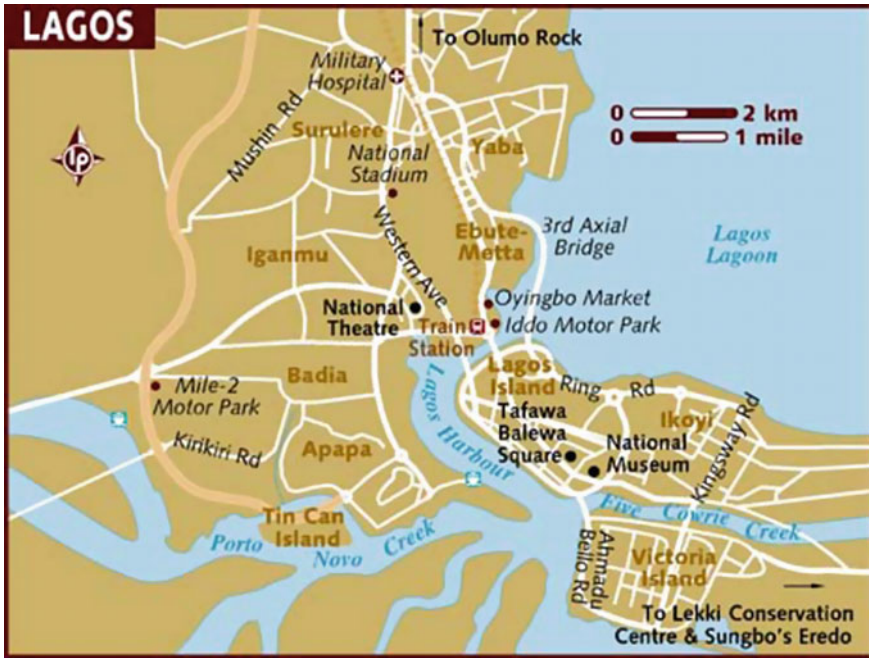


Fig. 28.3 Major historical growth areas in Lagos. Source [19]

this ordinance made Town Planning a government activity and resulted in reclamation of swampy areas of Oko-Awo in the early 1930s and resettlement of the displaced people from the area to the south of Yaba estate in Lagos Mainland area, the focus of development still remained in the affluent areas. Yaba North estate was developed during this time to provide housing to government officials [16] (Fig. 28.3). Subsequent ordinances such as the Nigerian Town and Country Planning Ordinance No. 4 of 1946 continued to emphasize on the concept of zoning, which continued to favour development in the European areas at the expense of the poor settlements occupied by the majority locals.

Throughout the colonial era, more attention was devoted to the development of parts of Lagos (such as Ikoyi) as a garden suburb, coupled with the development of private commercial and club recreational grounds. Most of the facilities developed during this era continue to shape the urban landscape of Lagos, the most famous one being the European Reservation Areas, now known as government reservation areas (GRAs) [17]. The GRAs, which were the Europeans' version of the garden city in Nigeria, were developed under the principle of creating cool fruit and flower gardens where one could sit on a veranda in the privacy of their home, and extensive public open spaces with recreational grounds and sports fields would be near both office and home, reached by shady pathways [20].



### ***28.3.2 Shifting the Focus of Urban Planning to Economic Development—Post-independence***

At the time of independence, the focus of development in the country was simply sectoral and economic planning was favoured to conscious efforts aimed at resolving physical planning challenges. National development plans, whose adoption had started a few years before independence with an objective to create policies, programmes and projects for achieving economic development in the country, become the independent government's development pathway. Subsequent adoption of master plans to guide spatial development of Lagos did not yield much post-independence as a factor of limited capacity by the city authority to control growth; limited resources and investment in housing and basic service provision; an urbanization rate that was faster than the city could respond to; focus of planning on creating physically attractive layouts as opposed to functional spaces among other challenges.

The period of military administration (1966–1979) did not bring much change, and if anything resulted in increased inequalities and deterioration of physical infrastructure in Lagos and other urban areas [21]. Focus was more on provision of infrastructure and development of agriculture in the rural areas, with emphasis on development of new towns which led to the emergence of Abuja and other satellite towns to Lagos [16]. The Federal Military Government accepted a report to construct a more central federal capital in Abuja in 1976 further increasing Lagos' woes. When development started in the Abuja Federal Capital Territory in 1980, little investment was made towards Lagos's development despite the fact that the city continued to attract more immigrants and continued to function as the country's commercial hub. The second republic period (1979–1983) and the period of return of military rule (1984–1999) did not also come with much development for Lagos, although various legislations related to planning were developed. In spite of formulation of these legislations, which were adequate at that time to promote sustainable urban growth, they were not fully utilized for the purposes they were designed for and the recurrent planning problems in Lagos remained intractable [22].

### ***28.3.3 Urban Planning, Zoning and Land Development in Metropolitan Lagos***

According to the Master Plan for Metropolitan Lagos, the urban land area was approximately 172 km<sup>2</sup> in 1976. The major part (97.5 %) of this land was in the contiguous built-up area, and the remaining 2.5 % of the total metropolitan area was separated from the contiguous area of the metropolis. Residential land use accounted for more than 50 % of the total metropolitan land area followed by transport and circulation (about 18 %), institutional and special use (about 14 %)

**Table 28.1** Lagos metropolitan area land-use structure 1976 and 2008

Land-use classification	Land area occupied (ha)		Percentage of development	
	1976	2008	1976	2008
Residential	8939	9669	51.9	52.1
Commercial	821	1021	4.8	5.5
Industrial	1444	1448	8.4	7.8
Institutional and special use	2366	2784	13.7	14.0
Open space and recreation	453	520	2.6	2.8
Transportation and circulation	3205	3340	18.6	18.0
Total	17,228	18,782	100	100

Source [17, 23]

and open space and recreation facilities occupied the least land area (<3 %) (Table 28.1) [17].

The medium-grade residential areas, mostly developed for the Europeans and government officials during the colonial era, were characterized by gridiron patterns with bungalows set within a mosaic of small plots of about 300 m<sup>2</sup> [12]. Most of the original bungalows have, however, been replaced with multi-storey buildings in response to economic demands. The residential areas of Surulere, Yaba and Ebute-Metta are examples of this kind of housing developments that been reasonably improved and can be found in Ebute-Metta West, Ojuelegba, Obalende and Inner Ikeja. The poorest land grade areas which were never planned are in Mushin, Somolu, Ajegunle, Ajeromi, Agege and Yaba East (Fig. 28.4). These varying growth regimes have resulted in varying development trends, in which, when compounded by the metropolitan areas, rapid urbanization has promoted individualization and fragmentation of land leading to increasing housing density [17].

### 28.3.4 Urban Planning and the Environment

The Ministry of Physical Planning and Urban Development's stated vision is to make Lagos a place where people live, work and recreate in an environment featuring world-class infrastructure and services that support an improved quality of life and cultural diversity. Its mission is to plan and facilitate an organized, safe, green, dynamic, economically and culturally vibrant and sustainable city that supports optimal land use. The following initiatives have been undertaken in an effort to achieve the Ministry's vision and mission: preparation of district plans; draft of state town plans and regulations; preparation of layout plans for excised villages; preparation of interim regional and structural plans; resettlement of saw mills in Epe; preparation of the metropolitan master plan for Ikorodu. City model plans have been prepared for settlements such as Victoria Island, Ikeja and Ikoyi. Other initiatives include: creation of sites for motor dealers at Mowo-Badagry;



designs and application for development permits to the Ministry of Physical Development and Urban Development are done electronically since January 2016, beginning in January 2016.

### ***28.3.5 Slum Upgrading and Redevelopment***

In the past decade and a half, the Lagos state government has progressively embarked on upgrading slum communities and making them conducive to sustainable development. Based on a 1985 World Bank study, the government created the Lagos State Urban Renewal Authority, which adopted a citywide approach supported by a \$200 million credit intervention assisted by the World Bank's International Development Association (IDA). This seven-year upgrading project began in October 2006 and ended in March 2013 [25]. The project upgraded nine of the worst slum communities. The project, which targeted 1.1 million inhabitants and 150,000 households with an average monthly income of about \$170, resulted in upgrading of nine of the worst slum communities in the state [25]. The intervention involved upgrading dilapidated roads or footpaths; providing public toilets and bathrooms; sinking boreholes; building new schools and improving existing ones; developing health facilities; and creating youth empowerment through skill acquisition and leadership development.

The Lagos state government has formulated and implemented a strategy of redeveloping slums with private-sector funding. The upgraded slums, in most cases, feed into the redevelopment scheme. Under this arrangement, the property owners and tenants of the slums are consulted. The owners contribute their properties for redevelopment through a cooperative and in return receive reasonable compensation. Property developers are brought in to build high-rise buildings on the property to prevent occupier displacement. Most properties are redeveloped from bungalows into three-to-four storey buildings, compensating for land-use allocation to roads, drainages and open spaces in the newly developed areas and avoiding displacement of slum residents [11].

### ***28.3.6 Smart Streets Are Needed to Transform the City of Lagos to a Smart City***

In recent years, streets have been recognized as an integral element of urban planning, and a key factor in the achievement of sustainable urban development. A connected street network reduces travel time and encourages walking and social interactions. With regard to planning, sufficient land should be allocated to streets and the street network should be sufficiently long to cover all areas of a city. There must be sufficient intersections available to facilitate shorter distances and reduce

travel times, and encourage walking and social interactions [26]. Well-connected streets enhance infrastructure development, environmental sustainability and economic and social development. They also make cities resilient and prepared to overcome natural disasters. A sustainable, inclusive and prosperous city expands multi-modal transport systems with sidewalks and bicycle paths, ensures eco-efficiency of infrastructural systems and supports density through integrated infrastructure development, thereby enhancing efficiency and access [26]. In addition to accommodating all kinds of users (pedestrians, cyclists, motorists), sufficient land allocated to streets promotes connections to services that contribute to good health and productivity, such as clean water, sewerage facilities, drainage systems, power supply and information and communication technologies [26]. Streets that provide space only to motorists are characterized by congestion and high carbon dioxide (CO<sub>2</sub>) emissions [27].

The city of Lagos is not benefiting from all the multiple advantages associated with well-connected streets. While 14 % of land is allocated to streets in the Lagos city core, only about 6 % of land is allocated to streets in the suburbs [26]. One effect of this has been marginalization of the most vulnerable segments of society who rely mostly on public transport and non-motorized means of transport for their day to day operations. Lagos city is not well connected to the city's water, sewer and storm water mains. In addition, infrastructure for non-motorized transport (e.g. pavements or sidewalks for walking and bicycle lanes for cycling) is often lacking, poorly developed, on the decline or does not appear to rank high among city planners' priorities. This has led to high incidences of traffic congestion and often results in fatalities involving pedestrians and cyclists.

Over the years, emphasis has been on creating smart streets to transform the city of Lagos. Such efforts have brought about the Lekki-Ikoyi link bridge built through Public Private Partnership initiatives that was to ease the heavy traffic congestion usually experienced for many hours on a daily basis by commuters plying this axis of the metropolis. This Lekki-Ikoyi link bridge has reduced the several hours spent on commuting between Lekki and Ikoyi to a less than 20 min journey. The Lekki-Epe expressway has similarly facilitated easy access to the fastest growing area in the city. The number of roads constructed rose from 6 in 2006 to 29 in 2010 and 22 in 2012 amounting to about 150.8 km. The total length of rehabilitated roads from 2007 to 2012 was about 86.22 km. To improve safety and visibility at night, a total of 38 street lights were installed in 2008, and this increased to 1217 street lights in 2012 [28]. Since the new administration was installed in 2015, additional street lights have been restored (Fig. 28.5).

Additional effort taken by the government of Lagos State to achieve smart streets in Lagos is in the area of effective management of the chaotic traffic situation in Lagos metropolis. In order to achieve this, the Lagos State Traffic Management Agency (LASTMA) and Vehicle Inspection Office (VIO) were established to deal with traffic offenders. Other roles include issuance of roadworthiness certificate, issuance of automated vehicle licence, driver licence and insurance certificate to curb car theft, issuance of fake certificates. The exercise was able to discover 12,083 fake certificates in 2010, 17,862 in 2011 and 18,252 in 2012. Aside



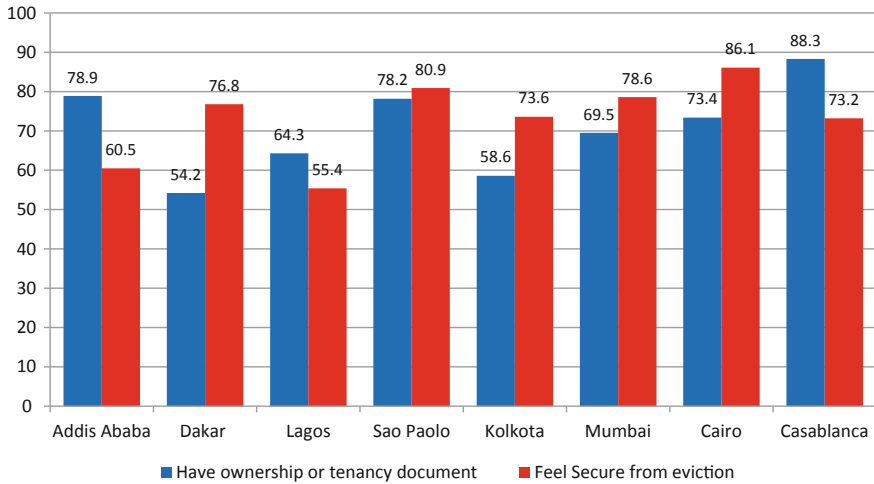
**Fig. 28.5** Lekki-Ikoyi link bridge. *Source* [29]

managing traffic problems in the city and issuance of fake certificates to unsuspecting vehicle owner, this initiative was also aimed at increasing government revenue [28].

## **28.4 Smart Land Tenure, Key for Smart City Foundation and Smart Economy**

One fundamental driver of a smart city foundation lies on the institutions and laws that govern human settlements, be it a city, a town or a village. The way the city is planned, land distributed and basic infrastructure laid down is governed and administered within functioning institutions and laws. Providing security of tenure depends on a range of policies related to institutions and laws put in place to protect people against unlawful eviction; to ensure equitable distribution of basic services to all communities; and to put in place transparent and accountable processes of land regulation, key for secure land tenure [30].

In Lagos, as is the case in most Nigerian cities, land tenure is neither well governed nor well administered. Poor land governance is surrounded by poor land administration characterized by a poor determination, recording and dissemination of information about tenure. In addition to being exposed to eviction, without legal proof of ownership, households cannot enjoy the economic and financial



**Fig. 28.6** Proportion of households with adequate document for proof of ownership or tenancy and proportion of households secure from eviction in selected cities, 2004–2007. *Source* [31]

opportunity associated with investment and savings using their property as collateral. At the community level, the municipality cannot also legally collect various taxes that can be used to improve basic infrastructures. Promotion of secure land tenure in Lagos will boost investment in property development, increase municipal tax collection and in turn promote economic growth.

Regarding security of tenure, UN Habitat and partners have now made considerable progress in developing a measurement method for security of tenure. The method had been implemented in 25 cities around the world through Urban Inequities Surveys. People or households are considered to have secure tenure when there is *evidence of documentation* that can be used as proof of secure tenure status or when there is either *de facto* or *perceived protection against forced evictions*. For owners, documents that are adequate for proof of security of tenure are: land registration certificate, title deed to dwelling, purchase agreement for land, lease agreement for land and certificate of occupation. For tenants, documents that are adequate for proof of security of tenure include registered or non-registered lease agreement and/or some form of written informal agreement.

From Fig. 28.6, possession of ownership or tenancy document varies widely across the eight cities, with 64.3 % of households in Lagos having proof of legal ownership or tenancy document [30]. However, despite the fact that nearly the two-thirds of households in Lagos have ownership or tenancy documents, only 55.4 % feel protected against eviction, implying a lack of adequate governance structures where tenure administration is clearly understood and respected. Measures to reduce the risk and stress associated with lack of documents and fear of eviction are based on recognizing and respecting a plurality of tenure systems, including intermediate forms of tenure arrangements and alternative forms of land



administration and land records [32]. The legal institutional framework in a given country or city plays a key role on various elements of security of tenure such as acquisition or adjudication which is the process of final and authoritative determination of the existing rights and claims of people to land.<sup>2</sup>

### ***28.4.1 Secure Tenure Goes Beyond Protection Against Eviction and Includes Economic and Financial Advantages***

Land shall not be seen only as a social asset providing shelter to people, but also as an economic and financial asset providing opportunity for investment and saving. At the economic and financial aspect, various social and economic advantages include access to the financial and economic market as demonstrated by De Soto [33]. De Soto argued that granting titles to the poor would liberate the plots they occupy and transform them into capital. This, in turn, could be used as collateral for loans to jumpstart their businesses, or improve their houses, among other gains that increase their quality of life. At the community level, the municipality can legally collect various taxes that can be used to improve basic infrastructures such as connection to water, sewerage facilities, energy sources and waste management facilities. This would also allow people to fully participate in the development of their communities instead of seeing properties as dead investments, which only serve as shelter. In a study by UN Habitat on “Urban Inequities in three cities: Addis-Ababa, Casablanca and Lagos”, the security of tenure questions in Lagos was gauged based on the degree of perceived security on a four and a five-point scale. The question was posed in terms of “have you ever felt threatened with eviction?” which referred either to instances in which such threats were actually issued or to the perception that eviction could occur. The findings of the study suggested that, among owners, there is little to suggest widespread concern about security, with high percentages of owning households saying that they have never felt at risk. However, there is a sub-group of owners who admit to some degree of insecurity, with about one owner out of ten in Lagos expressing such feelings.

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<sup>2</sup>Once the land is acquired, another element that depends on legal institutional framework is the acquisition of a building permit, which is at the authority of the local governing body on land use and planning for construction or renovation of a property. Another element that lies to the authority is the cadaster system, which is a parcel based and up-to-date land information system containing a record of interests in land (i.e. rights, restrictions and responsibilities). Indeed, security of tenure depends heavily on the land governance that establishes the rules, processes and structures through which decisions are made regarding access to and the use of land, the manner in which those decisions are implemented and the way that conflicting interests in land are managed. In many cities of the developing regions, poor land governance is surrounded by poor land administration or registration characterized by a poor determination, recording and dissemination of information about tenure, value and use of land during the implementation of land management policies.



About 84 % of renters say that they have never felt at risk of eviction. The reason adduced to this may be due to the land and housing markets, or in the legal and political systems that confer protection or (alternatively) induce anxieties about tenure.

## **28.5 Basic Infrastructure—Key for Smart City Foundation**

In a smart city foundation, provision of basic infrastructure such as piped water services, sewerage facilities electricity and solid waste management is considered along the city planning. These elements are a crucial part of the city planning and in an ideal situation are planned for and developed prior to (or concurrently with) housing development and human settlement. In a smart and sustainable city foundation, use of improved services such as piped water, sewerage facilities, solid waste management and electricity is quasi-universal.

### **28.5.1 Water Supply**

Water supply in Lagos is not enough to meet the level of desired demand. Out of a total estimated water demand of 540 million gallons per day in Lagos State, only 33 % of water supply is met on a daily basis [28]. The Lagos State Water Corporation (LWC) has 20 mini waterworks which produced 2630.18 gallons of water in 2011, a figure which slightly increased to 2646.56 gallons in 2012. This is a major shortfall compared to the State's combined annual water production capacity of 26,775.75 gallons in 2010, 28,070.04 gallons in 2011 and 23,402.98 gallons in 2012 from its three major water works located in Adiyin, Iju and Isashi. Additionally, the state has 17 micro-water works that produced 1424.26 gallons of water in 2010, 1208.77 gallons in 2011 and 1451.99 in 2012. Accessibility to Lagos Water Corporation among the residents rose from 14 % in 2010 and 2011, respectively, to 16 % in 2012 [28]. The water supply coverage is about 40 % through a pipeline network that runs north-south and mostly services the eastern part of the city, and excludes the large population in the western part. The informal water supply sector is substantial, serving about 60 % of Lagos State residents [28]. Cases of groundwater contamination through seepage from buried petroleum pipelines have been reported.

In an effort to address this challenge, the Lagos State government has made significant investments to rehabilitate waterworks and to privatize the LWC. It has also focused on constructing and refurbishing micro- and macro-waterworks, improving power generation for water projects, providing efficient bill collection, and repairing/rehabilitating collapsed boreholes. At the moment, 15 micro- and

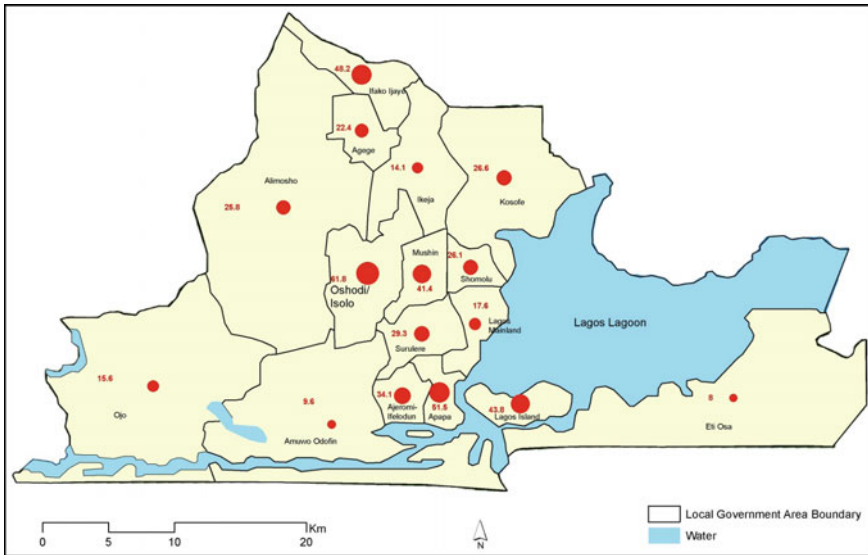
macro-waterworks have already been built with the capacity to produce 30 million gallons per day as part of a water project coordinated by the LWC [34]. For the purpose of sustainability, the Lagos State government is currently resuscitating the Adiyari/Iju waterworks, each with a total production capacity of 130 million gallons per day [34]. This is aimed at meeting the water need of the resident in a short while.

Meanwhile, fewer households in Lagos take their drinking water directly from piped sources into their homes. The most common sources of water in Lagos are boreholes and protected wells. Significant percentages of households draw water from unprotected wells or springs, or from a heterogeneous mix of “other” sources that are also likely to be at risk of contamination. Boreholes and protected wells are a more important source of drinking water for households in Lagos, accounting for 45 % of total household water sources [35]. Furthermore, the household’s standard of living greatly determines the type of access to water. Among the very poor households of Lagos, very few are fortunate enough to have piped water in the home and only small percentages have access in the yard. Moving up the relative standard of living scale, there exists a steady improvement in the ease of access to water, with rising percentages of households having access directly in the home or the yard. According to UN Habitat’s 2005 Urban Inequities Survey, the time needed to collect water for households without access to water in the home was short, with a median collection time of only 5–10 min across the city of Lagos and its neighbourhoods.

Supply disruptions are quite common in Lagos. The likelihood of disruption is highly related to the way in which drinking water is supplied, and also depends on the location of specific neighbourhoods within the larger state. While the average rate of service disruption is estimated at about 27 %, the values differ significantly between various Local Government Areas (LGAs). Lagos Island, for example, has a water disruption rate of 43.8 %, while Lagos mainland has a disruption rate of 17.6 %. Ibeju Lekki LGA has the lowest disruption rate of only 2.3 %, and Oshodi/Isolo LGA has the highest disruption rate in the entire state, estimated at 61.8 % [35] (Fig. 28.7). Households using piped water experience the highest rate of supply disruption (46 % for piped into dwelling, 44.6 % for piped into yard) against households using unprotected wells whose disruption rate was 24.2 %. Given that the very poor households in Lagos rely least on piped water sources (piped into dwelling—0.6 %, piped into yard 1.7 %, public tap 6.7 %) [35], they are somewhat less likely to experience disruptions in the service.

### **28.5.2 Power Supply**

Like most Nigerian cities, the power sector in Lagos faces a chronic shortage and erratic supply. Although there are no reliable data to describe the power situation in Lagos, estimates indicate that the current demand for power in Lagos State stands at between 5000 and 8000 MW against a supply of between 900 and 1200 MW. The



**Fig. 28.7** Percentages of disruption of water supply by Local Government Area. *Source* Author representation using data from [35]

average supply deficit, which is only about one-sixth of the demand, leaves enormous supply gaps and is largely representative of the national supply pattern, which ranges from 3400 to 4200 MW against a demand of 25,000 MW [36].

Given the importance of power supply for economic development, the Lagos State government has made the sector a priority policy area since 1999. The major outcome from the ongoing interventions include growing partnerships between the state and independent power producers to help increase the state’s supply capacity.

According to UN Habitat’s 2005 urban inequities survey, access to electricity in Lagos and its reliability vary greatly among neighbourhoods and income levels. For example, while 98.4 % of non-poor households in Lagos have access to electricity, only 51.4 % of the very poor households have access to the service. Equally, while the average rate of household electricity connection in the Lagos is 92.5 %, the LGAs of Lagos Island and Lagos mainland enjoy connection rates of 99 and 98.9 %, respectively; and the Epe LGA has the least connection rate, recorded at 69 % [35] (Fig. 28.8).

Power supply in Lagos is largely unreliable, with the average household electricity average 8.5 h per day. Within Lagos Island and Lagos mainland, the average number of hours with electricity supply is 7 and 8.5 h per day (Fig. 28.9), which is a major impediment to economic and social productivity at all levels of the population. The effect has been a major reliance on fuel reliant generators, which have significantly increased the production costs for manufacturing firms, increased operational costs for commercial enterprises and reduced productivity at the household level (Box 28.1).

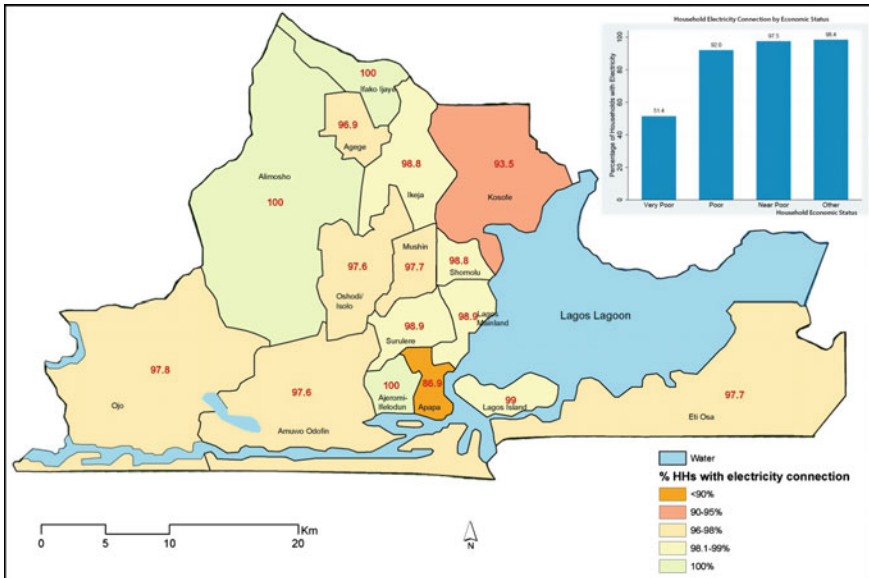


Fig. 28.8 Electricity connectivity in Lagos by LGA and household income status. Source Author representation using data from [35]

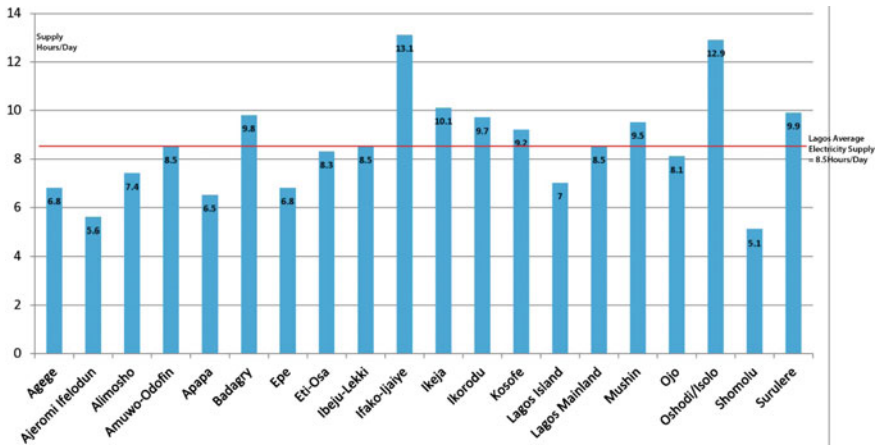


Fig. 28.9 Hours of daily power supply by local government area of Lagos—for households with an electricity connection. Data Source [35]

Several initiatives have been taken with a view to meeting the power supply challenge. In 1999 for instance, an independent power project implemented by AES Nigeria, a subsidiary of AES USA, is responsible for generating 270 MW of power through nine barge-mounted gas turbines, with an option of upgrading to 540 MW.

The US\$12 million project was financed by a consortium of four foreign banks and three foreign institutions. In addition, another independent power producer is Akute Power Limited, responsible for installing the 12.15 MW plant that supplies electricity to the Adiyani-Iju waterworks [35].

The Lagos State government has embarked on power generation. About 120 MW of power was added to the National grid by the Lagos State government and plan is on the way for additional megawatts. The Rural electrification project of Lagos State government got a boost by successfully electrifying three communities in 2010 to thirty-two communities in 2011 and 148 communities in 2012 [28]. The statistics further showed that 100 transformers were distributed to all the 20 LGAs of the State in 2010, 226 transformers in 2011, 113 transformers in 2012 amounting to 439 transformers within 3 years. At present, installation of smart meters has begun in the metropolis and is enjoying a high-level patronage. However, current estimates indicate that a minimum of 15,000 MW of generating capacity is required to position Lagos City as Africa's Mega City of Choice and place Lagos City among the most promising cities in the emerging economies. The government has also partnered with AES Nigeria and El Sewedy Electric of Egypt, a major producer of cables and electrical products in the Middle East, to build a transformer production factory in Agbara-a suburb of Lagos city, for the production of oil-immersed distribution transformers from 50 to 1500 kV-A [28].

### **Box 28.1 Electricity Supply Challenge in Lagos**

Lagos State is currently the largest consumer of power in Nigeria. Most power is consumed by industry and commerce. The Ikeja Industrial Area accounts for 35 % of total power consumption, while Lagos Island has the highest population of commercial end-users of power. Most of these businesses and individuals, faced with power shortages, have opted for generators as alternative sources of power. This places pressure on scarce resources and is expensive because it has raised the cost of electricity to the range of 45–90 Naira per kWh. Electricity constitutes on the average between 20 and 40 % of the cost of production in a typical manufacturing company. This suggests that it costs a Nigerian company more than double what a company in emerging or developed nations pays for the same unit of electricity, judging by current international figures.

Transmission and distribution technology is increasingly obsolete in a number of areas. This causes endless disruptions to power supply. Some generating stations are currently idle because of lack of turn-round maintenance, shortage of gas and limited transmission capacity. Criminal activity exacerbates problems. Vandalism has been reported in the form of damages or theft of transmission and distribution cables, not only in Lagos State but in other States. The centralized grid means sabotage at a transmission tower disrupts the entire network.

The transmission and distribution losses are estimated at 40 %, higher than the rest of the continent estimated at 11 %. Transmission and distribution

infrastructure needs rehabilitation to restore system stability and security. There is also some room to reduce demand. At present, the Lagos State Electricity Board (LSEB) is performing Energy Audit, which will help in developing more Independent Power projects to help match demand with supply. LSEB has also introduced Energy Calculator to help consumers manage their power consumption. Source: [36].

### ***28.5.3 Solid Waste Management and Sanitation***

#### **28.5.3.1 Solid Waste Management**

Solid waste management started to become a major challenge in Lagos in the early 1970s when the oil boom, which compounded the emerging industrialization and urbanization, resulted in high volume of waste which became increasingly difficult for the local government councils in Lagos State to manage [10]. With only 40 % sanitation coverage, and an estimated 10 % solid waste collection rate, garbage heaps on the city streets are a testimony to the logistical nightmare of clearing over 10,000 tonnes of refuse generated daily in the state [4, 5, 37].

In an attempt to address the inherent solid waste management challenge, the state government created the Lagos State Waste Management Authority (LAWMA), which works together with the local government authorities, the Ministry of Environment and private-sector participants to streamline and create an efficient waste collection, transportation and disposal structure. While LAWMA is responsible for managing waste generated within the city (including waste management enforcement and compliance, highway sanitation, landfill operations, managing landfills and dumpsites, etc.), the Ministry of Environment is the environmental policy regulator, and private-sector participants are the collection and disposal partners in the waste management chain [36]. In its effort to offer sustainable highway sanitary services, LAWMA's level of recruitment of highway managers (whose responsibility is cleaning highways throughout the metropolis) increased from 42,887 HMs in 2010 to 12,633 HMs in 2011 and 50,746 HMs in 2012. The Private-sector participants have greatly assisted LAWMA in domestic and industrial waste collection, with a record waste collection increase from 1,386,847 metric tonnes in 2010 to 2,356,634 metric tonnes in 2012; against LAWMA's collection of 907,298.75 metric tonnes in 2010 and 1,273,472 metric tonnes in 2012 [28]. Other LAWMA's responsibilities include, among others, evacuation and prevention of backlog, clearance of public and markets wastes, management of existing landfill sites, development of policy initiatives for future waste management activities, provision of counselling to private operators on waste management, identification

of sites for development of waste management facilities and appraisal of proposals on establishment of waste management activities [38].

Through partnerships between LAWMA and private-sector players, waste management alternatives which include conversion of waste into fertilizer and the construction of transfer-loading stations that serve as transit camps for refuse to be regularly compacted are being undertaken. As a result, Lagos has already become the largest producer of compost, which it supplies throughout Nigeria and to the Federal Ministry of Agriculture [38]. Other ongoing projects on solid waste management which the state government is implementing in a bid to create a safe, friendly, and sustainable environment conducive to residential, business, and recreational development include: (i) efficient community-based waste management, (ii) Aggressive “greening” and beautification of open spaces, decrepit loops, verges, and medians under Operation Green Lagos (iii) social rehabilitation and economic empowerment of so-called area boys<sup>3</sup> by engaging them in environmental beautification and landscaping projects (iv) Upgrading of the Olusun landfill (Ikeja) by constructing three access roads to tackle the perennial Oregun traffic, as well as installing deodorizers to eliminate pollution and enhance the air quality and public health of adjoining neighbourhoods (v) construction and equipping of eight waste transfer-loading stations at Yaba, Ogombo, Ebute-Elefun (Simpson), Oshodi, Ishasi, Ajegunle, Abule-Egba and Oba Ogunji Street (Agege) (vi) procurement of 240 waste collection trucks and three (3) Tana giant landfill compactors for efficient waste management at the landfills, and (vii) introduction of Dino bins in over 2000 locations across the state and evacuation of illegal dumpsites at ten locations including Obele Oniwala (Surulere), Oba Ogunji Street (Agege), Opebi (Ikeja), Ajah (Eti-Osa) and Festac Gates (Amuwo), as part of a new environmental and waste disposal project [34].

### 28.5.3.2 Access to Sanitation

Like in most cities in sub-Saharan Africa, sanitation provision in Lagos city is grossly deficient. Access to hygienic toilet is very low among the residents and this is likely to increase the level of infectious disease burden and quality of life [39]. USAID [40] opined that the deficiency of accurate data makes it impossible to determine whether Nigeria is making progress to meet its MDG targets which may also translates to lack of accurate data in Lagos. There is no sewerage system in Lagos except for very small systems serving institutions and private estates. Also, there are no major wastewater treatment facilities. About 35 million cubic metres of waste water is generated per day in Africa, and Lagos State alone generates 1.5 million cubic metres per day. This includes 119 million gallons per day (mgd) (66 %) from surface water—51 mgd (34 %) from groundwater [40].

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<sup>3</sup>The term *area boys* refers to able-bodied, unemployed and possibly drug-dependent men who harass pedestrians and motorists for money.



Less than 2 % of the population is served with off-site sewage treatment plants, and only toilet wastewater is connected to septic tanks and soak-away systems [40]. Other household liquid wastes are discharged directly into the mostly open gutters in front of houses or on the streets. The wastewater eventually percolates or is washed into the water bodies by rainstorms. Septic tanks and soak-away systems used in the collection of toilet wastewater often contaminate and pollute the shallow groundwater—a vital source of water to most low and middle income residents. Also, there is no sewerage treatment plant in the megacity and the untreated sewerage is mostly evacuated into the Lagos Lagoon [40]. The faecal contamination of the megacity's water system and the environment through the inadequate management of wastewater is an important health concern.

The sanitation situation is direr in the low-income districts and slum communities. About 70 % of Lagos residents are estimated to live in slum communities that are often subjected to severe flooding, and with population densities of 800–1200 people per hectare [40]. In these settlements, most people have no access to a hygienic toilet, and most faecal waste is discharged directly into the environment without treatment. The common sanitation solutions in these areas include open defecation, plastic-bag defecation, various types of latrine, and in some cases pour-flush toilets discharging into open drains. Much rarer are pour-flush toilets discharging to septic tanks. This has grave implications on the sustainable use of groundwater. The problem may worsen with the rapid sprawling and growth of the population if not properly developed and managed.

To check the challenge of massive inadequacies in wastewater treatment in Lagos, the state government set out a five-year sanitation plan in 2010, which includes a goal to improve water treatment infrastructure [34].

## 28.6 Conclusion

Lagos as a coastal city offers multiple opportunities as a hub of economic activities as well as a link to local, regional and global economies. Today, it has an added advantage associated with its high population density and its youthful population, two important drivers of economic productivity and growth. **Cities are built by people for people**; with their concentration offering agglomeration of economies starting from their land and housing assets that constitute more than half of their wealth. With functioning institutions and laws, land and housing assets contribute to the planning, management and provision of services in settlements. However, in absence of functioning institutions and laws providing legal propriety rights, most of these assets remain dead investments sheltering only people. To tap into the potential of high densities, the city of Lagos must formalize its land system, which will be the driver of many other components of its foundation such as streets and public spaces, and also aid in the provision of basic infrastructure such as water, sanitation, energy and waste management. To drive Lagos towards a smart city, it is urgent that national and local authorities recognize the wealth of their citizens and



involve them in the planning, building and the management of their city. No city can claim to be smart when the wealth of its citizens is not fully taken into consideration in the economy.

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