

URBAN MAPPING FOR SUSTAINABLE MEGACITY GOVERNANCE AND DEVELOPMENT: THE CASE OF LAGOS, NIGERIA

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Abstract

The Lagos Metropolis in Nigeria is fast assuming the status of a “megacity”. Undoubtedly, the process of becoming a megacity places enormous responsibility on the administrators of an urban centre, especially with respect to good governance, provision, and maintenance of basic infrastructure, environmental management, revenue generation, security, as well as socio-economic development and wellbeing of the inhabitants. However, to govern a megacity effectively, a range of reliable, comprehensive, and timely geospatial information is essentially required, amongst other things. This paper, therefore, examines the status of urban mapping in Lagos State as well as the level of map usage in the administration of the State. Adopting largely a quantitative approach, various relevant agencies of the state government involved in several aspects of mapping namely, the Ministry of Lands and Survey, the Ministry of Physical Planning, the Minis-

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try of Science and Technology, and the Lagos State Geographical Information Systems (LAGIS) Centre, were involved in the study. Structured face-to-face interviews with key officials together with an assessment of available geospatial products (e.g. maps, aerial photographs, and satellite imageries) and facilities were conducted. The study reveals that, for now, Lagos State is deficient in urban maps and map usage, which are crucial to effective municipal administration and development. The performance of the Lagos Digital Mapping/GIS Project, which is aimed at enhancing the provision of a broad and reliable geospatial information base for efficient management of the emerging Lagos Megacity, is currently suboptimal. The study identifies a wide range of specific urban map types, which the State would require for effective governance and sustainable development. More so, urban mapping in the State is faced with some identified human and technological challenges. Thus, the study concludes that the Lagos state government needs to mainstream urban mapping in its governance and developmental efforts.

Keywords: Urban mapping, sustainable megacity, urban governance, and development, Lagos, Nigeria

INTRODUCTION

Lagos is fast becoming a megacity. The megacity status of Lagos is bound to pose some real and potential challenges for the administrators. Already the administrators are struggling to grapple with the myriad of social, economic, and environmental problems bedevilling the Lagos Metropolis. Preparatory to heralding the official declaration of Lagos as a megacity, various plans and projects are currently being put in place to ensure that the megalopolis is governed and developed in a sustainable manner. In order to effectively govern an urban system, however, a toolbox that fur-

nishes both the government and the governed with accurate, reliable, comprehensive, up-to-date, easily accessible and usable geospatial information is indispensable. Typically, that toolbox is composed of different kinds of map.

Maps and data associated with geographical locations are resources used daily for delivering public services, managing public resources and setting public policy in all tiers of government throughout the world. For governance to be effective, maps of different kinds and for varying purposes are necessarily required (Balogun, 1999). A typical urban centre is complex and, hence, needs to be properly planned and managed in order to ensure that its various facets develop in an orderly and harmonious manner (Uluocha, 1999). Maps provide geographically referenced information, without which urban governance, or indeed the governance of any geo-political unit, will only proceed in an awkward, uncoordinated, fractional, lopsided, and less cost-effective way.

“A broad and reliable information base is essential if cities are to be managed effectively. Lack of information contributes to problems such as ineffective urban development programs and activities; uneconomical and badly planned investment projects, poor functioning of land markets, property tax and transport and utility systems; and disregard of the environmental impact of development on the population. . . .

“Throughout the world, urban managers and policy makers make strategic decisions on environmental protection, infrastructure development and maintenance, land development, and land administration and taxation Yet rarely do they have access to up-to-date base-maps and systematic information on the extent of settlements, land-use patterns, environmental problems, and infrastructure facilities.” (Paulsson, 1992, p6).

The quality of a decision is largely dependent on the quality of the information upon which the decision was based. Governance necessarily involves taking far-reaching decisions. Such decisions are often informed

by several factors, one of which is availability of information. Apart from technological development, a better-informed urban policy-making and management system is also needed to mitigate several of the problems of mega-cities (Ilusanmi, 2010). Maps provide the much-needed geo-referenced information for effective decision-making and implementation. For instance, poverty of urban maps has the potency to influence the formulation and implementation of government policies and measures that are put in place to tackle the problems of economic poverty, inequity, and inequality amongst urban dwellers. Maps are among the basic documents needed for urban land planning, development and management. In the absence of appropriate maps, urban development can only proceed in the most haphazard, dangerous, uneconomical, inefficient, and unsustainable manner. Hence, Mabogunje (2007) strongly canvasses for the adoption of the Geographic Information System (GIS), which is largely used in, among others, the generation of various urban maps necessary for the governing of a megacity.

Participatory governance [of megacities] requires that the megacity develops a robust geographic information system with a database, which enables it to mobilize its citizens on a neighbourhood basis. Such mobilization allows for easy consultation of residents and their being informed on the nature and costs of the infrastructural facilities needed to meet their particular requirements. Such consultations also facilitate the effective mobilization of rates and tax revenues from them and provide opportunities for public enlightenment on such issues as environmental upkeep, improved sanitary habits, and security measures to making the neighbourhood a safer and desirable place for raising their families (Mabogunje, 2007, pp 25-26).

Presently, the level of urban mapping in Lagos State is generally low. Several types of urban maps are simply not available. Some of the existing urban maps and allied cartographic products are either inadequate or deficient by being either outdated, lacking in full geographical coverage, or of a low spatial resolution and scale. Urban mapping is not yet an integral part of the ongoing Lagos Mega-city Project (LMCP). An analytical look

at the LMCP blueprint, however, shows that a massive and comprehensive mapping of the metropolis is required to actualize and sustain the planned physical development schemes. Without appropriate maps, it would be difficult to make Lagos a smart megacity and achieve an effective, orderly, and sustainable governance and development of the area. Both basic topographic and thematic maps are needed for any form and level of city administration. To stay informed, city administrators constantly require urban maps that show the location and condition of important natural and cultural features.

The major objectives of this study are to:

- i) Review and establish the status of urban mapping in Lagos State.
- ii) Identify the extant urban maps, allied products (analogue and digital), and services.
- iii) Ascertain the various uses of the maps and related products such as aerial photographs, orthophotomaps, satellite imagery, LiDAR images, etc., in the administration and services of the State.
- iv) Identify the maps required for efficient governance and sustainable development of Lagos as a Megacity.
- v) Ascertain the major challenges of urban mapping in the state and identify how best they can be resolved.

MATERIAL AND METHOD

THE STUDY AREA

The study area is primarily Lagos State, but particularly the Lagos Megacity Region (LMCR). Lagos State (Fig. 1) lies approximately between Longitudes 2°42'E and 4°22'E, and Latitudes 6°22'N and 6°42'N. It is bounded by Ogun State to the north and east as well as by the international boundary of Nigeria with the republic of Benin to the west. The southern boundary is the 180km coastline of the portion of the Atlantic Ocean known as the Bight of Benin. Lagos State is divided into 20 Local Government Areas (LGAs) with Ikeja as the state capital.

Lagos is the most urbanized state in Nigeria. The sprawling Lagos metropolis accommodates the state capital, and a large industrial and com-

mercial hub. In addition, the Lagos metropolis is a fast growing urban setting. The population structure of Lagos State reveals the highly urbanized nature of the State. According to the 2006 national population census, the Lagos metropolis alone had a cumulative population of about 7,937,932 out of a total population of 9,019,534 for the entire state. This indicates that only a little above 1 million people were actually living in what can be called rural communities in Lagos state, thereby making the rural population less than 12% of the entire population of the state. About a decade and a half after that census, the picture has not changed, as Lagos State remains largely a metropolitan area. Out of the twenty Local Government Areas (LGAs) of the state, sixteen are found within the boundaries of the Lagos Metropolis. The four LGAs that are considered to be outside the Lagos Metropolis are Badagry, Ojo, Ikorodu and Epe.

The rapid expansion of the Lagos metropolitan area has led to a number of social, cultural, political, economic, and environmental challenges. These challenges include shortage of housing and road facilities; incessant worrisome traffic congestion; lack of dependable supply of electricity, water and other amenities; poor storm drainage system; high level of unemployment; high crime rate; poor waste collection and disposal system, etc. There is need, therefore, for a regular provision of current, comprehensive, and relevant geospatial information or mapped data, for effective governance and development of the State.

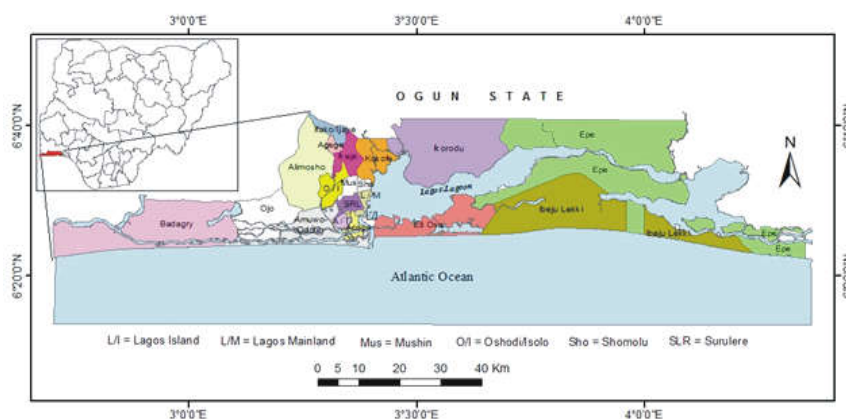


Fig. 1: The study area: Lagos State, Nigeria

The Lagos Metropolis would form the core of the Lagos Megacity Region (LMCR). The reality of the Metropolis upgrading to the status of a megacity coupled with the attendant seemingly intractable challenges facing the city prompted the Federal Government to decide to partner with both the Lagos and Ogun State Governments to establish the Lagos Megacity Development Authority (Mabogunje, 2007), which oversees the Lagos Megacity Project. The ultimate goal of this laudable initiative is to achieve an orderly transformation of this burgeoning mega-city into a viable and sustainable urban scheme. This is to be done without inflicting injuries on its social, cultural, and ecological dimensions as well as ensure it does not degenerate into a mega-slum of despair (Ilesanmi, 2010). Mabogunje (2007, pp 16-17) gives a brief geographic and demographic description of the Lagos Megacity Region (LMCR):

“The Lagos Megacity comprises ... the Lagos municipality as well as numerous towns and settlements forming a continuous urbanized built-up area of some 154,000 hectares extending from the Atlantic Ocean northwards beyond Otta in Ogun State. For the moment, the Megacity spreads across most of the 20 local governments of Lagos State and four of the local governments of Ogun State notably Ado-Odo/Ota, Ifo, Obafemi Owode and Sagamu. Within the area so delimited [lived] some 13.4 million people as of 2000. The prognosis is that this population will grow to close to 25 million by the year 2015.”

Although the Lagos Mega-city occupies only 37 percent of the land area of Lagos State, it accommodates nearly 90 percent of the population. The average population density within the LMCR is about 20,000 persons per square kilometre (Ilesanmi, 2010).

METHODOLOGY

This study was embarked upon largely to review the status of urban mapping and map usage in the administration of Lagos State. An in-depth in-situ investigation was conducted on certain relevant agencies of the state

government known to be significantly involved in various aspects of mapping in the State. Specifically, the agencies are the Ministry of Lands and Survey, the Ministry of Physical Planning, the Ministry of Science and Technology, and the Lagos State Geographic Information Systems (LAGIS) Centre.

Several study visits were made to each of the agencies. Structured face-to-face interviews were conducted with some key officials of the relevant agencies. Both the hard and soft copies of some of the available maps and remote sensing imagery were examined to ascertain their resolution, subject matter, information content, newness, and quality. Moreover, an assessment of some of the available mapping facilities was conducted. Additional relevant information was elicited from the internet, scholarly literature, and other useful publications.

CONCEPTUAL FRAMEWORK

THE CONCEPT OF SUSTAINABLE URBAN DEVELOPMENT

Sustainability is a broad concept that encompasses many aspects of the social, economic, and ecologic environment. Generally, sustainable development is considered the process of meeting the needs of current and future generations without undermining the resilience of the life-supporting properties of nature or the integrity and cohesion of social systems. In other words, sustainable development is “economic and social development that meets the needs of the current generation without undermining the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987).

Sustainable development is conceived as a holistic and integrative concept. The concept is hinged on three overlapping pillars or areas of concern namely: economy, society, and environment. That is to say, sustainable development is “a policy principle incorporating some balance of economic, environmental, and social priorities” (Connelly 2007, p269). Similarly, to become sustainable, a social system needs to be characterized by four “process-conditions” namely: (i) Ecological systems that will

demonstrate balance and resilience; (ii) Economic and other activities that protect ecological systems; (iii) Governance with participation and responsiveness; and (iv) Institutional performance with adaptation and feedback (GSSD, *url*).

Urban areas are globally recognized as being very vital for delivering sustainable development. This is so because of a number of factors. Consider the following facts taken from the “World Urbanisation Prospects: The 2011 Revision” by the United Nations Department of Economic and Social Affairs (UNDESA, 2012a), cited in Lepuschitz and Pisano (2014): (i) between 2011 and 2050, the world population is expected to increase by 2.3 billion, passing from 7.0 billion to 9.3 billion. At the same time, the population living in urban areas is projected to gain 2.6 billion, passing from 3.6 billion in 2011 to 6.3 billion in 2050. Thus, the urban areas of the world are expected to absorb all the population growth expected over the next four decades while at the same time drawing in some of the rural population; (ii) Most of the population growth expected in urban areas will be concentrated in the cities and towns of the less developed regions. Asia, in particular, is projected to see its urban population increase by 1.4 billion, Africa by 0.9 billion, and Latin America and the Caribbean by 0.2 billion; (iii) Overall, the world population is expected to be 67 per cent urban in 2050.

Increasing urbanization is expected to lead to increasing environmental burdens, as well as exert much pressure on available resources such as fresh water supplies, sewage, the living environment, and public health (Lepuschitz and Pisano, 2014). Because of the much-anticipated significant impacts of urbanization, the concepts of sustainable cities, urban sustainable development, smart cities, and effective urban governance have gained significant importance at the international level. Sustainable urban development and governance is conceived as a veritable platform towards achieving liveable, productive, and inclusive cities, which embrace social harmony, economic vitality, and environmental sustainability.

As shown in Fig. 2 the concept of sustainable cities or urban sustainability is predicated upon four main pillars, which is composed of the three pillars

of sustainable development, namely social development, environmental protection and economic development, and an additional fourth pillar – effective urban governance (UNDESA, 2013).

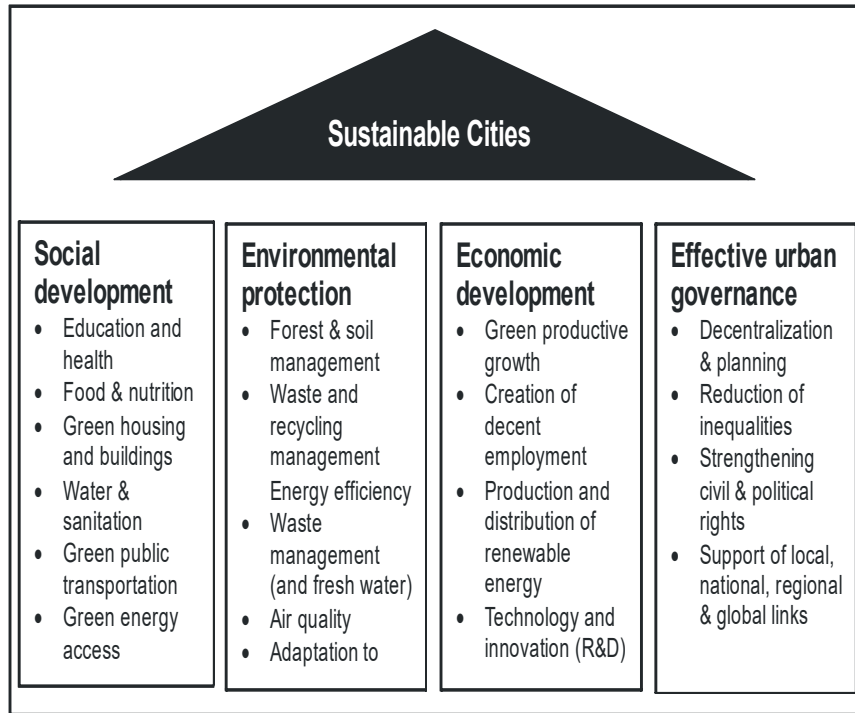


Fig. 2: Pillars of Sustainable Cities (*Modified from UNDESA, 2013*)

The United Nations Human Settlements Programme (UN-HABITAT) is the United Nations lead agency for human settlements. Its mission is to promote socially and environmentally sustainable towns and cities with the goal of providing adequate shelter for all. The organisation’s focus lies within urban areas in developing countries and puts an emphasis on poverty and sanitation issues. UN-HABITAT runs a series of strategic programmes designed to help make cities safer, bring relief to countries suffering the aftermath of war or natural disasters, and promote sustainable cities and good governance (Lepuschitz and Pisano, 2014). Currently, UN-HABITAT has five priority themes: governance; environmen-

tal planning and management; urban economy; education, training and research; and urban planning (UN HABITAT, 2013).

THE CONCEPT OF MEGACITY

A mega-city is defined as a continuously urbanized area with a population of at least 10 million people (UNCHS, 1996). Cities are not just intentionally transformed into megacities, instead, as Ilesanmi (2010) observes, mega-cities gradually evolve into such when they attract and accumulate human populations with skills, opportunities, and avenues for advancement. In other words, megacities evolve largely in an organic manner, as they are not usually the result of some master plan or deliberate processes of development (Mabogunje, 2007).

Across the globe, modern megacities are generally identified with certain common characteristics and challenges (Encarta e-encyclopaedia; Mabogunje, 2007; Olokesusi, 2011). Some of such characteristics and challenges are: (i) they dominate the urban settlement structure with a disproportionate number of people living in them compared to other towns. (ii) Their rapid growth tends to outstrip local resources, creating deplorable environmental conditions and social problems, including widespread poverty. (iii) The supply of housing, water, sanitation, power, and transport services is often seriously inadequate. (iv) The supply of jobs does not always keep pace with the arrival of rural migrants from other parts of the country, leading to further problems of social segregation and economic inequality. (v) There is usually limited job mobility and lack of legal protection for workers, mostly those in the informal sector. (vi) rapid migration (frequently coupled with a high birth rate) often causes pressure on land and housing, thereby leading to the development of inner-city slums or ghettos, or more often the creation of extensive, makeshift, and unofficial shanty settlements on the outskirts of the mega-cities. (vii) There is, sometimes, insecurity owing to increasing crime rates and types. (viii) There is the possibility of a vulnerability to changes in world markets.

The urban environment irrespective of its class or magnitude is a highly complex and dynamic system. However, it comprises various subsystems, which undergo changes, albeit at different rates. Cecchini (1999) identi-

fies some of such subsystems and the rate at which they change. These subsystems include (a) *Networks* and *land use* that undergo slow changes; (b) Identification of *economic activities* and *residential areas* that undergo middle-to-slow changes; (c) *Employment* and *population* that undergo rapid changes; (d) *Transport* and *mobility* with their immediate changes; and (e) The *environment*, which changes at various speeds. For the entire urban system to function effectively and be a liveable environment, the subsystems must function superbly and harmoniously too. This calls for constant governmental intervention, which will ensure that each of the subsystems are properly planned for, developed, and managed vis-à-vis the current and potential needs of the urban inhabitants. However, as Rizzi (1999, p149) has rightly observed, “in order to intervene it is essential to have some knowledge of the city’s dynamics and to be able to forecast them, in the belief that in order to *provide* we must *predict*.” Maps and allied products can efficiently disseminate the knowledge city administrators need to understand and effectively govern the urban system. In other words, geospatial information, which is competently conveyed by maps, is a sine qua non for orderly and sustainable planning, development and management of the urban centre.

THE CONCEPT OF URBAN GOVERNANCE

It is expected of a good government to be proactively responsive to the needs and aspirations of her citizens. In other words, the essence of urban governance is to address the needs of the citizenry, especially the low-income cadres. Globally, urban governments are very important to low-income groups especially with regard to the potential for getting or building housing, being able to pursue livelihoods, having access to water, sanitation, health care and education, as well as to the rule of law (Satterthwaite, 2009, p4).

Both the government and the governed should be actively involved in urban governance. In the words of Alipour et al (2011, p34), “Generally speaking, [good] governance and its processes are participatory, consensus oriented, accountable, transparent, responsive, effective, efficient, equitable, inclusive and follow the rule of law.” A formidable synergy between the public and private sectors is definitely required if the megacity is to be

developed and managed in a sustainable manner. Such a synergetic arrangement will create room for the much-needed participatory approach towards governing the megacity. Globally, it is gradually being realized that no megacity can be properly administered without making its governance participatory (Mabogunje, 2007, p25).

Making the Lagos Megacity work will surely require an all-inclusive governance – one that encourages the active participation of various stakeholders and regular consultations for effective partnership and role sharing. Moreover, effective communication and information sharing is required. Geographical mapping is one sure mechanism by which the sharing of knowledge, experience, resources, and opportunities needed to keep citizens and government abreast of activities can be effectively achieved.

LITERATURE REVIEW

Geographical mapping is all about providing accurate geospatial information that is acutely needed in decision-making. The global discussion on the Sustainable Development Goals (SDGs) has renewed interest in strengthening the quality and availability of statistics for management, programme design, and monitoring performance. There is a need to provide the information base that will inform the sustainable development agenda at any level – local, national, regional, global. The international community has recognized the overwhelming need to use geospatial information in addressing sustainable development issues. It is estimated that roughly a quarter of the proposed SDG indicators require geospatial data and by geo-tagging other data, almost all could be cartographically visualized to monitor progress across spatial scales (Fischer, 2015). As noted by Broekhof and Van Marwijk (2012), setting goals on what ‘type’ of sustainability we want to achieve in a specific spatial context can make spatial information even more valuable in supporting sustainable urban development. There is every need, therefore, to formalize and mainstream geospatial information and mapping as part of the broad data collection architecture for pursuing the SDGs.

The outcome document of the 2012 United Nations Conference on Sustainable Development (otherwise known as Rio+20) *‘The future we want’*

specifically recognized the importance of “reliable geospatial information” in the areas of national disaster risk reduction strategies and plans, and for sustainable development, policymaking, and so on. The pivotal role of geographical information in achieving sustainable development was specifically reflected in the Doha Declaration of 6 February 2013. In it, the participants resolved “to promote the greater use of geospatial information in sustainable development by supporting the activities under the programme of the Global Map for Sustainable Development (GM4SD) with an initial focus on managing risks of natural disasters to urban populations and developing effective mitigation strategies” (Lepuschitz and Pisano, 2014). The Doha Declaration additionally affirmed the importance of having a stable, credible, and reliable national geospatial information infrastructure in each country. This infrastructure must be built on internationally recognized standards that will integrate, manage, and deliver geospatial information for timely, evidence based, authoritative decision-making, and policy formulation on location-based development issues, including disasters and humanitarian needs.

Planning for sustainable development requires updated information on natural resources, which have to be necessarily integrated in national development programmes. Cartography, remote sensing, and geographic information systems are important working instruments for environmental development, monitoring and follow-up. Geospatial information tools (cartography, remote sensing, GIS, etc.) are eminently able to integrate the three pillars (economic, social, environmental) of sustainable development as well as the four pillars of sustainable urban development. These tools can be efficiently used to create maps, which will serve as high quality and authoritative geospatial information platform that will contribute data and knowledge to support informed and coordinated decision-making by policy-makers. Innovations in mapping technology and geospatial data collection can help make the SDGs more successful and targeted than the MDGs. They also have the potential to illustrate needs and success in a more understandable way (Fischer, 2015).

The critical role of maps and other forms of geospatial data in advancing sustainable development goals (SDGs) has been succinctly summarized by Fischer (2015) thus:

Geospatial tools complement traditional data systems such as census data, administrative data, household survey data, vital statistics, and economic data. The report notes that roughly, a quarter of the proposed SDG indicators require geospatial data and by geo-tagging other data, almost all could be visualized to monitor progress across spatial scales.

From infrastructure to environmental and socioeconomic features, the ability of geospatial tools to provide location-specific information can enable valuable insights into the distribution of needs and how to optimize development investments and planning. Policymakers can track poverty rates across regions or monitor incidence rates and hotspots of diseases, whether endemic, such as malaria, or an outbreak, like the recent Ebola crisis in West Africa. Investors can use spatially defined infrastructure and population data to understand existing service coverage and opportunities for future investment. Citizens can use mobile devices to find their closest public transportation options, government offices for voters' registration, or schooling options. And integrating geospatial data with household surveys, like demographic and health surveys, can enable disaggregation and analysis by spatial characteristics, such as proximity to roads, health clinics, public transportation, or levels of urban development.

Governments would also systematically inventory and map critical national facilities and infrastructure, such as schools, health clinics, water systems, irrigation systems, waste treatment facilities, agricultural facilities, tourism facilities, and public transportation.

The global community is in a position to make it happen – to ensure that every country has the data and tools to visualize key socio-economic and environmental data down to the smallest administrative units, to more accurately direct aid and development resources and ensuring no one is left behind.

Geospatial information is mostly held in form of maps. Maps provide invaluable information that can be used to develop sustainable policies on the local scale. We can actually map our way to sustainable development and good governance. In urban land use, geographical maps are used to visualize plans and future directions. These visualizations could be used to increase cooperation between the different departments and units of the municipal administration and in public participatory processes (Broekhof and Van Marwijk, 2012). Maps give us an opportunity to: (i) create a snapshot of a place in time. (ii) Create a visual display of specific data and abstract ideas. (iii) Develop a broader perspective of the relationships in an area of interest. (iv) Understand community dynamics and plan for sustainable change. (v) Engage in development planning with knowledge and sensitivity to local habitat, culture and other community values; and (vi) Identify and delineate protected areas.

Geospatial information can effectively advance sustainable urban development goals. For instance, geospatial information can be used to spur the discussion on planning sustainable cities, just as it can be used in strategic decision making for sustainable city development and governance. Based on the outcome of their work, Broekhof and Van Marwijk (2012) conclude that spatial information can support decision-making in the planning process and help policy makers to identify possible alternatives for 'unsustainable' actions in the planning area.

RESULTS AND DISCUSSION

STATUS OF URBAN MAPPING IN LAGOS STATE

Over the years, the status of urban mapping in Lagos State, as indeed other parts of the country, has remained somewhat appalling. At various times, the state has been mapped at different scales. However, urban maps of various information content and scale are still grossly lacking. In the 1960s and 1970s, township maps of some parts of the State were produced at various large scales such as 1:1,000; 1:1,200; 1:2,000; 1:4,800, and 1:12,500. Medium scale topographical maps of the State at 1:50,000 and 1:25,000 scales are available, albeit largely outdated. Pres-

ently, the Lagos State Geographic Information System (LAGIS) Centre is making concerted efforts to produce digital maps of both the urban and rural areas of the State. The Centre has orthophotomaps of different parts of the State. It has also created large-scale digital line maps of some urban and rural areas of the State at a scale of 1:500 and 1:1000, respectively.

From the foregoing, it is obvious that the existing urban maps of Lagos are inadequate for very meaningful development purpose. This is especially in terms of their numbers, scale, variety, areal coverage, accuracy, and how contemporary they are. Most of the extant urban maps are rather obsolete, having been produced several decades ago. Hence, they can hardly meet the present needs for them. In a bid to shore up the status of urban mapping in Lagos, the Lagos Digital Mapping/GIS Project was initiated by the state government in 2006. The lack of up-to-date base maps for the Lagos Megacity Projects was identified as a missing link for actualizing the various proposed development programmes in the State (Adeoye, 2010). Consequently, the State Government decided to initiate the Digital Mapping/GIS Project aimed at a comprehensive digital surveying and mapping of the whole State. The intention was to create a robust, comprehensive, and integrated state wide Enterprise Geographic Information System (GIS), for an orderly development of the State. This intention, however, is yet to be fully realized, although it has given rise to the Internet-based Lagos State Geographic Information System (LAGIS). The vision of the Lagos State Government Enterprise Geographic Information System is “To promote optimal use of Geospatial Information for sustainable development, poverty alleviation, and improvement in the quality of life of the people of Lagos State by establishing and sustaining Lagos State Geospatial Data Infrastructure”. (<http://www.lagis.lagosstate.gov.ng/>). The main purpose of the LAGIS project is to furnish the State Government, its agencies and personnel with the tools required to drive the vision and programmes of the government. As part of the project, a Continuously Operating Referencing Station (CORS) has been installed at the office of the Surveyor-General of Lagos State (see Fig. 3). The CORS is equipped with Global Navigational Satellite Systems (GNSS) receivers (GRS1200GG). Plans are afoot to deploy an integrated network of CORS (10) at strategic locations across the State to collect highly accurate, real-

time, and post-processed data for various surveying, mapping, construction, and road-traffic control applications. The CORS is not a mobile tracking device; instead, it is usually installed at a permanent location. Just as the name implies, a CORS operates continuously, tracking Global Positioning System (GPS) and GNSS satellites in order to receive, store, and transmit geo-location data. The system enables users to fix and validate exact position information in the field throughout Lagos to an accuracy of under 1 cm. The CORS data are made available to Lagos State Ministries, Departments and Agencies (MDAs), surveying and mapping outfits, engineering contractors, public transportation agencies and construction companies.

Lagos State Geographic Information Systems (GIS) and digital mapping is online. Automation of the land documentation and administration processes in the state has commenced. Data from the CORS and other sources such as the Land registry and the GIS are held in dedicated functional GIS server and cloud infrastructure in order to make the data easily accessible online from anywhere in the world. The system is already being used to facilitate activities such as electronic-based land survey verification, online submission, and retrieval of land information for processing and issuance of land titles, especially Certificate of Occupancy (C of O), Land Information Certificates, and Consent Letters, amongst others. Currently, however, owing to some technical hitches, applicants for any of the above-mentioned official documents occasionally encounter some challenges while trying to access the website and portals. Official commercial land transactions are conducted online via a portal. To gain access to the portal a concerned applicant has to make the appropriate payment through a card system. *Once payment is made, the applicant is allowed access to the web page containing the Geospatial Information System and Digital Maps, for further transactions.*

Although the LAGIS project is operational, it is yet to achieve its mandates fully. These include (i) First/second order Geodetic Controls, their signalisation and densification. (ii) Aerial photos at 1:4000 for the whole state. (iii) Contour lines, digital (vector) maps at 1:500 for Lagos Metropolis and 1:1000 for rural areas, orthophoto for the whole state at

1:2000 and Digital Terrain Models (DTMs). (iv) GIS Database creation, GIS Applications and GIS Enterprise (v) Geoid and an active GPS reference Station (vi) Navigator system that will provide a route map in electronic format (vii) Hardware, Software, ICT Infrastructure and Staff training development (viii) Bathymetric Chart of the major waterways (especially Lagos lagoons and creeks) (ix) Public enlightenment and stakeholders meeting (x) Revenue generation. Some of the reasons the LAGIS scheme is yet to actualize its mandates fully are briefly enunciated in the next subsection.



Fig. 3: The CORS located at the Lagos State Surveyor-General's office, Alausa, Ikeja

CHALLENGES OF URBAN MAPPING IN LAGOS STATE

Urban mapping in Lagos State is bedevilled by certain challenges. For instance, currently, the LAGIS project, which is supposed to serve as the flagship of mapping in the state, is not functioning as effectively as one would expect. This is largely due to some technical/technological, institutional, fiscal, and legislative challenges. The project is equally being subtly threatened by sustainability issues. In a nutshell, the identified major challenges facing the LAGIS project in particular and urban mapping in Lagos State in general, include: (i) Lack of a strong mapping culture; (ii) Non-mainstreaming of mapping into the governance process; (iii) Weak or inadequate enabling legislation. The state still lacks a very clear and strong mapping mandate backed by appropriate legislation; (iv) Weak institutional framework/development; (v) Poor funding of public surveying and mapping activities by the government; (vi) Insufficient personnel and routine human capacity building; (vii) Technological challenges; (viii) Inadequate data and poor quality of available data. The available geospatial data available in the state in form of maps, aerial photographs, and satellite imagery including LiDAR, are not sufficient and comprehensive in terms of geographical coverage. They are also not quite up-to-date and fall short of the very high spatial resolution required for effective urban mapping; (ix) Poor data accessibility and poor data sharing amongst governmental agencies and other stakeholders; (x) Low revenue generation from maps and other geospatial information products. Currently, the revenue raised through the sale of analogue and digital maps and other geospatial or mapping information is rather low. This is largely because of the somewhat low patronage of geospatial products and services being experienced in the public sector of the state. The low patronage is mostly the resultant effect of the public not being sufficiently aware of the availability of the products and services of the mapping agencies in the State.

MAPS REQUIRED FOR SUSTAINABLE GOVERNANCE AND DEVELOPMENT OF LAGOS MEGACITY

As already noted, the status of urban mapping in Lagos State is hardly encouraging. Geographical mapping and maps play catalytic roles in every aspect of urban governance and development. Effective governance

requires the use of different kinds of maps for diverse purposes (Balogun, 1994 and 1999; Uluocha, 1999*a*). As one of the objectives of this study, therefore, effort has been made to identify the various types and classes of maps currently required for effective and sustainable governance and development of Lagos State. Some vital maps are simply non-existent while a good number of the existing ones are deficient one way or the other. Considering the environmental, social, economic, and political peculiarities, needs, dynamism, and challenges of Lagos State, certain geographical maps would be required to guide and fast track the administration and socioeconomic advancement of the State. In no particular order, the following specific major types of maps, which were found to be either grossly inadequate or totally lacking, would be required for the efficient, effective, rapid and sustainable governance and development of the Lagos Megacity.

GEOPOLITICAL/ADMINISTRATIVE MAPS

Lagos State requires accurate, detailed, and up-to-date geopolitical maps that give vital information about the geographical boundaries of various levels of administrative divisions of the State; Local Government Areas (LGAs), Local Council Development Areas (LCDAs), senatorial districts, wards, constituencies, census units, electoral units, operational/service zones or districts, territorial waters, etc. Usually, such maps contain information on the names and classes of settlements like capital, cities, towns, villages, wards, streets, rivers, lagoons, creeks, etc.

TOPOGRAPHIC MAPS

Current topographic maps, which portray the locations of physical, natural, and cultural landscape features of various parts of the State, are required. Apart from landform features, the topographic maps will also show roads, vegetation, and other prominent features across the State. Furthermore, a typical topographic map will contain place-names as well as names of some other geographical features. The topographic maps are highly needed for proper urban and regional planning, urban renewal, urban land cover/land use change studies, feasibility studies, land use mapping, site selection, location of industries and other facilities/amenities, development

and management of slum settlements, etc. Large-scale topographic maps at 1:20,000 or larger, will be needed by the state.

TOWNSHIP MAPS

A complex weave such as the Lagos Megacity would surely require reliable and current township maps for its efficient, effective, holistic, and cohesive governance. Township maps are large-scale general maps that show the features of the natural and built landscape of urban areas and environs. The features depicted on a typical township map are normally selected according to some citywide specifications. Geopolitical boundaries, such as the limits of wards and towns, are shown. Such a map might also display the settlements (suburbs, towns, and cities), transport networks (roads, railways, footpaths, inland waterways, and airports), hydrographic features (rivers, lagoons, canals, and shoreline features), the shape, and altitude of the land, etc. Township maps are quite useful in urban administration. They are a prerequisite for the integrated and sustainable development of cities and their environs. City administrators need the maps to greatly enhance their ability to make informed policy decisions that affect the daily lives of the inhabitants. Township maps are also very useful in town planning and the regulation of land use, the physical arrangement of neighbourhoods, industry, commerce and other city structures, as guided by architectural, engineering, and land-development criteria, as well as aesthetic and functional standards. Township maps are equally needed for the provision and maintenance of urban public amenities, infrastructural facilities, services, safety, security, prompt emergency response, etc.

LAND COVER/LAND USE (LC/LU) MAPS

No meaningful and sustainable urban development can take place without adequate land-use and land-cover mapping of the urban environment (Uluocha, 1999a). As a highly dynamic society, Lagos State is constantly witnessing the emergence of diverse activities involving the use of land space. Since her available land space is not limitless, there is every need for the State to continuously monitor and properly regulate the allocation

of her limited land resource. Achieving this will require keeping abreast with the nature, rate and pattern of land cover and land use change in the State. Thus, without accurate, current, comprehensive and relevant land cover/land use (LC/LU) maps, it will be difficult for Lagos State to properly monitor and regulate land use changes within her territory. Unfortunately, for now, the state does not have an up-to-date, high resolution and comprehensive LC/LU map of the entire State. The land use maps will equip the state government with the requisite geospatial information for making prompt, knowledgeable, and far-reaching decisions with respect to land use allocation and management. The absence of such maps often leads to land misuse and unguided physical development coupled with its attendant consequences.

CADASTRAL MAPS

Land speculation and disputes over properties are quite common in Lagos. In addition, land administration is a herculean task in the state. These underline the need for appropriate cadastral maps that cover different parts of the state. A cadastral map is a large-scale map that shows the location, boundaries, dimensions (and area), geometric shapes, and ownership of land parcels in a place. The map may also give some additional information such as details of individual houses, section and/or lot numbers, unique parcel identification numbers (PIN), Certificate of Occupancy (C of O) numbers, survey district names, any existing structures on the parcel, adjoining and adjacent streets and their names, etc. In practical terms, a cadastral map is quite useful in the allocation, valuation and taxation of land as well as in tenement or property (building) rate administration. They are equally useful for general land administration, as well as the processing and issuance of C of O. Cadastral maps are typically produced at scales between 1:500 and 1:5,000. Lagos State needs detailed, complete series of cadastral maps that cover every part of its urban areas. Currently, only cadastral maps of some parts of Lagos Metropolis especially Ikeja, Ikoyi, Victoria Island, Yaba, Apapa, and Ebute Metta, are in existence.

UTILITY MAPS

Lagos State is in dire need of public utility maps. A utility map is a special map used to show the distribution pattern and location of any public utility in a town, city, etc. The public utilities that could be shown on a utility map include pipe borne water, wells/boreholes, electricity, communication networks (especially telephone and postal services), man-made drainage channels (i.e. gutters and canals), natural gas, oil, as well as solid waste and wastewater utilities. A utility map gives vital details about the facilities relating to the particular public utility shown on the map (Uluocha, 1998). Utility maps are also necessary for facilities (e.g. power, pipeline, cables and drainage) distribution, location and management; network expansion; customer enumeration and location, as well as revenue collection. In addition, the map can show the boundaries of the service areas of major utility companies, transmission lines, or distribution routes of the utility, substations, zonal offices, etc. Utility maps are vital in the effective use and management of utilities. They enable the user to easily search, identify, and obtain information on various aspects of utilities including service area boundaries, telephone exchanges, roads, artificial drainage channels, individual buildings (as in the case of large-scale utility maps), institutions, local or regional districts, ward boundaries, cities, railway crossings, etc. These maps are also needed in the field by officials, damage assessment personnel, and repair crews, so they can promptly find the location of facilities and carry out necessary repairs, routine maintenance, replacement, or extension of existing facilities, or installation of entirely new facilities.

TRANSPORTATION MAPS

Lagos needs a comprehensive and current land transport map that shows the network of roads and railways in the State. The types, alignment, pattern, and connectivity of the railways and roads including Bus Rapid Transit (BRT) lanes are to be clearly shown. Road maps also show the location of important bus terminals, hospitals, airports, and buildings in the city. Road maps are required for intelligent navigation, search and rescue operation, traffic planning and monitoring, as well as alternative routes planning. Similarly, the state needs navigational charts for inland water

transport planning, development, operations, and management. Lagos State is still far from fully harnessing the potentials for inland water transportation that abound in the state especially in the lagoon waters. To this end, the State would need high-resolution, accurate, current, and well-detailed bathymetric and marine or nautical charts. Expectedly, such charts covering various parts of the State would contain vital information as latitudes and longitudes, scales, the depths of water bodies, topographical features of adjacent lands (including land elevations), marine routes, locations of natural, and manufactured navigation aids such as lights and radio beacons. The chart would also contain information on the local Earth's magnetic field, natural features of the lagoon, water depths, navigational hazards, and warning notices, as well as information on ocean tides and currents, details of the coastline, landmarks, and artificial structures such as jetties, harbours, buildings, and bridges. Such body of information is useful for plotting a safe course and checking progress while sailing. Nautical charts are essentially needed for safe and efficient marine transportation. Bathymetric maps are also useful in the construction of different underwater oil, gas and water pipelines, as well as communication facilities (e.g. cables).

TOURIST MAPS

Lagos State has huge tourism potentials that are yet to be tapped. To effectively harness and manage the various natural and cultural tourism resources in each of the three tourism zones of the state, tourist maps will definitely be needed. Uluocha (1999b and 2018) identifies the specific areas where mapping can be applied for tourism development and the maps needed for tourism management in Lagos State and elsewhere. Suffice it to say here that basically, tourist maps provide information on the types and locations of the major tourist attractions as well as allied and ancillary facilities and services available at a place. The maps help tourists to identify a suitable place of interest and its location. They also guide the tourists to explore their environment safely and effectively. They are also needed for tourism facilities planning, development, and management. Tourist maps are also important powerful tools for advertising and marketing tourism.

DEMOGRAPHIC MAPS

Typically, population maps are used to show the spatial distribution of various demographic variables of a place, such as population density, sex composition, age distribution, income levels, occupation, education or literacy levels, ethnic composition, etc. In other words, population maps are used to graphically store, portray and communicate the information gathered through population censuses and household surveys. For proper urban planning, administration, and development, Lagos state requires up-to-date large-scale demographic maps, preferably at the Enumeration Area or Ward level. Presently, such maps are non-existent.

HEALTH AND EPIDEMIOLOGICAL MAPS

Various health and epidemiological maps are required for the good governance of Lagos Megacity. Thus, there is need for maps depicting the spatial location and distribution of available health facilities, personnel, and services. In the same vein, epidemiological maps detailing the types, prevalence, and spatial distribution of various diseases in the state are of necessity. Altogether, the health and epidemiological maps are useful in a number of ways. They are required for health facilities planning, allocation and management; epidemic location, prevention, control and forecasting; location of emergency ambulance services points; planning mobile hospital routes; efficient and effective geographical targeting of disease control and intervention measures, etc.

CRIME MAPS

Undoubtedly, crime is one of the major challenges in the Lagos Metropolis. Unfortunately, at present Lagos State lacks up-to-date, comprehensive, and accurate high-resolution crime maps. Without proper crime maps, it will be difficult to effectively, professionally and easily undertake crime control and management. Crime maps are required to graphically show the types, frequency, clustering, factors, as well as spatial and temporal distribution of crime in Metropolitan Lagos. Such maps are needed for a wide range of security and safety operations, including defence,

neighbourhood policing, crime prevention, crime control and monitoring, search and rescue operations, vehicle and cargo tracking, Close Circuit Television (CCTV) location and coverage determination, effective monitoring of international boundaries by the Customs and Immigration authorities, etc.

SCHOOL MAPS

School mapping is central to the planning and provision of adequate education (both in terms of quantity and quality), especially at the local level. School maps can be used to furnish vitally important geo-referenced pieces of information relating to each school, such as name, address, location, ownership (public or private), year of establishment, primary physical features, school enrolment (number of pupils by gender), number of teachers, number of classrooms, educational resources, etc. School maps are needed for effective facilities planning, micro-planning or local-level planning of educational development, teacher recruitment and deployment, distribution of instruction/learning aids, location of institutions (public and private Nursery/Primary, Secondary, Tertiary), and Educational Districts. School mapping will provide the much-needed information that would enable UBEC and other concerned stakeholders to, among other things, have a clear view of the location and distribution of educational facilities in the state, as well as their condition, and the number and availability of instructors. In other words, school facility maps help decision makers in the educational sector to determine what exists where, their distributional pattern, areas not served, accessibility of existing facilities, as well as the distance of one facility to the other. School facility mapping, therefore, serves as a veritable tool for diagnosing and analysing the current state of facilities available and identifying those requiring urgent attention. In addition, a comprehensive school mapping of the state will greatly assist in revealing communities lacking or not adequately served by, primary and secondary educational institutions.

HYDROLOGICAL MAPS

Lagos State is aptly referred to as the state of aquatic splendour. The state is naturally endowed with a drainage network of lagoons, creeks, rivers,

and streams. Therefore, there is need to fully map the hydrological resources of the state for optimum utilization. In particular, hydrographic and water resources maps of the state are acutely needed for several purposes. These include the charting of tides and changes in coastal bathymetry; the measurement and recording of river flow; the scientific study of coastal maritime waters, lagoons, rivers, and creeks; proper water resources development and management; economic activities (e.g. agriculture, fishing, and sand mining); tourism development; inland water transport planning, development, operations and management; flood and erosion management.

INDUSTRIAL AND COMMERCIAL MAPS

As the industrial and commercial nerve centre of the country, the Lagos Metropolis has a very high concentration of industrial and commercial concerns and activities. Thus, the state needs reliable maps showing the types, ranks, locations, and distribution of the various industrial and commercial interests. The maps are useful for planning, development, and management purposes. Moreover, the maps will assist the state government in its internal revenue generation drives.

GEOLOGICAL, SOIL AND SOLID MINERALS MAPS

Lagos State is blessed with various solid minerals, including silica sand, bitumen, sharp sand, gravel, petroleum, and laterite. There is also the possibility of discovering more minerals. More so, the state experiences intense and widespread construction works on a daily basis. There is, therefore, an obvious need for the State to have good geological and soil maps that would fully identify and properly guide the harnessing of mineral resources and construction activities. Geologic mapping is an important task in solid minerals exploration and exploitation. Geological maps are used to compile detailed field notes on the location of minerals, rock types, geologic structures, stream data, and manufactured structures. Good geological maps and mapping techniques provide a means for planning and undertaking reconnaissance, exploration, drilling, dredging, development, reclamation, equipment transports, logistical activities, and day-to-day

operations of mining companies. Besides, various other mining activities such as calculation of material volumes, location of physical elements, determination of mining conditions, monitoring and management are expedited by the use of maps.

In the same vein, soil maps provide useful information about the major soil types and/or other properties of the soil cover in a particular area. Such maps are the source of vital information related to soils, which are used to monitor land degradation and improvement, changes in land use and water resources, and to predict climatic and other environmental changes. The information is also useful to agriculturists (farmers and ranchers) for determining whether a particular soil type is suited for crops or livestock and the type of management practice that might be required. Additionally, soil maps can be used to provide information on the engineering properties of a soil, which architects, builders, and civil engineers can use to determine whether a particular piece of land is suitable for a certain type of construction. Simply put, soil, and geological maps help us to understand the type of soil and rock we are building on, to avoid erecting a building on an unstable ground, which may unfortunately lead to the building sinking, tilting towards one side or even collapsing, as is often experienced in different parts of the State.

ECOLOGICAL/ENVIRONMENTAL HAZARD MAPS

With a teeming population coupled with large concentration of industrial and commercial activities, Lagos is often faced with certain environmental challenges. Many forms of land use activities such as wetland reclamation, civil engineering construction works, improper disposal of solid wastes, incessant heavy road traffic, industrial and vehicular air pollution, open-cast mining, agriculture, which often involve the disturbance or removal of a considerable area of vegetal and/or aquatic cover, are quite common in Lagos State. Undoubtedly, these anthropogenic activities affect the physical environment and often result to hazards such as flooding, erosion as well as soil, water and air pollution. These environmental problems often affect human beings and properties. Therefore, the need for environmental mapping and maps in the state cannot be overemphasized. For the

attainment of a sane environment, the state needs to undertake regular comprehensive risk zone assessment and mapping, environmental inventory and monitoring, flood and erosion monitoring, land degradation, Environmental Impact Assessment (EIA), as well as coastal zone and riverbanks monitoring, mapping and management.

The potential sectoral uses of mapped geospatial information in achieving sustainable urban administration and socioeconomic development in Lagos State are summarized in Table 1.

Table 1: Potential sectoral usage of maps in the Lagos Megacity administration and development

Sectoral Application	Typical Usage	Maps Required*
Finance	Revenue Generation, Customs and Immigration, Tax Administration	LM
Local Government	Taxation, Land use, New Town development, Utility Services management and monitoring, tenement rates, licences, boundary administration, road maintenance	CM, LM
Agriculture	Cultivation Inventory, Vegetation Cover, Soil Study, River, Dams and Irrigation, Land Use, crop yield monitoring, livestock and marine resources management	LM, SM
Forestry	Forest mapping, forest inventory, change detection, forest development, timber production for export and domestic uses	SM, LM
Political / Administration	International, Interstate and Local Government Area boundary demarcation, Constituency delimitation	LM
Transport and Aviation	Roads and Airport Runway design, Aeronautic charts for navigation, search and rescue operation, traffic planning and monitoring, alternative routes planning	LM
Petroleum Resources	Oil and Gas Exploration, Exploitation, Distribution, Marketing, and Monitoring	LM, SM
Geology and Soil Minerals	Photo geology, reconnaissance, soil study, soil mineral exploration, exploitation, distribution, marketing and monitoring	LM, SM
Planning	Urban and Regional Planning Urban renewal and Change Studies, Feasibility studies, land use mapping, land administration, land certificate, location of industries	LM, SM, CM
Environment	Risk Zone Mapping, Environmental Inventory and Monitoring, Desertification, Flood and Erosion Monitoring, Land degradation, Environmental Impact Assessment and Coastal zone or riverbanks monitoring and management	LM, SM
Security	Defence, Crime Prevention and Monitoring, Search and Rescue Operations and Vehicle Tracking, Close Circuit Television Location and Coverage Determination	LM
Population Census / Elections	Planning, Enumeration Areas Delineation, Demographic Studies and Analysis, Polling Booths Locations	LM
Tourism	Road network maps and streets guides, tourist centres and hotel locations, wildlife game reserves and parks management	LM
Health	Epidemic Location, Prevention and Forecasting, Facilities Planning, Management and Distribution Location of Emergency Ambulance Services Points, Planning Mobile Hospital Routes and Rural Health Management Planning, geographical targeting of disease control and intervention measures	LM
Education	Facilities Planning, Instruction/Learning Aid Distribution, Location of Institutions	LM
Sport Development	Facilities planning, development and management	LM
Archaeology	Geo-referencing of historical and archaeological sites, research studies, etc.	LM
Communication (Telecommunication and Postal services)	Distribution and location of communication lines and other facilities. Distribution and location of postal services Road network services and coverage	LM
Electricity and Power Distribution	Power Distribution network location; facilities distribution, location and maintenance; customer location and revenue collection.	LM
Water Corporation	Facilities distribution and location, pipeline distribution, location and management, customer enumeration and revenue collection	LM
Banking and Insurance	Distribution and location of banks, customer enumeration facilities maintenance	

Sources: Compiled from fieldwork with additional information from Uluocha (1998, 1999c, 2007, 2012, 2018, 2019); Oluwamotemi (2005); Onuche and Shabu (2011); and Opaluwa et al (2014); Uluocha and Oraukwu (2019).

*LM = Line Maps (These contain topographical, road, utilities, boundary, administrative layers at various scales).

*SM = Specialized Maps (These are customized maps for specific purposes. They include Geological, Land Use/ Land Cover, Vegetation, Mineral and Soil Maps at various scales).

*CM = Cadastral Maps (These contain Land Parcel Identifier, Ownership, Use and Tenement Rate, Conveyance History)

SUMMARY

The status of urban mapping in Lagos State is poor. The state is deficient in many urban maps. In addition, most of the existing maps are either outdated or lack full geographical coverage of the entire state. Several human, technological, fiscal, and legislative challenges are affecting urban mapping in the State. The flagship Lagos Digital Mapping/GIS project (a.k.a LAGIS – Lagos Geographical Information System) needs repositioning in terms of human capacity building and provision of more state-of-the-art geoinformation facilities and equipment including the installation of the proposed additional CORS to ensure full coverage in real-time satellite tracking of the State.

Urban mapping is crucial to the attainment of a sustainable Lagos urban governance and development. Municipal administrators seeking increased customer engagement, trip planning, commercial real estate, revenue generation, socio-economic development, etc. require various urban data categories. Particularly, in order to achieve an effective, orderly, and sustainable development and governance of the Megacity urban system, city administrators will need a variety of maps. They would need large and medium scale maps dealing with issues relating to variables like demographics, business analytics, education, crime, health, markets, environmental conditions, landfills and neighbourhood waste disposal sites, electricity transformers, public transportation systems/infrastructure, consumer segmentation, natural hazards, school performance, unemployment, historical climate patterns, voting patterns, consumer expenditures, etc.

Urban maps are needed by virtually every city dweller and stakeholder involved in the urban development project. City administrators, law enforcement agents, town planners and developers, architects, city engineers, and indeed the citizenry in general – all need urban maps. The urban maps perform sundry functions. Therefore, they are needed for various purposes. In many ways, they can assist in achieving good and sustainable city governance. It is rather common knowledge that there is a very strong positive correlation between mapping and socio-economic development (Uluocha, 2007). With particular reference to urban governance, maps provide the much-needed spatial data infrastructure for the identification, planning, allocation, development, and management of urban resources. The maps also guide city administrators/policy-makers in the equitable distribution and siting of infrastructural facilities and social amenities such as roads, healthcare facilities, schools, recreational centres, waterworks, electricity transformers, landfills, among others. Maps are equally needed in spatial targeting of intervention measures such as in the areas of disease control, crime management, poverty alleviation, and so on.

RECOMMENDATIONS

As earlier observed, certain challenges militate against mapping in Lagos State. Nonetheless, the challenges can be overcome. Urban mapping should not be seen as a one-off exercise; instead, it is a continuous activity. A megacity, just like every other urban system, is a complex and dynamic entity. There is, therefore, every need to continually map the urban environment in order to keep track of the changes that often take place therein.

To significantly improve and sustain the status of urban mapping in Lagos State on a continuous basis, a number of far-reaching steps would necessarily have to be taken. As a starting point, a formidable mapping culture would need to be entrenched in the state. Similarly, mapping should be absorbed into the mainstream of governance. More so, legislative and institutional reforms should be initiated to give mapmakers in the state civil service a greater leeway to discharge their responsibilities. The official mapping machinery in the state, particularly the LAGIS project, should be

rejigged in order to make it more robust and effective in producing the expected deliverables and services. In the same vein, those in the business of official mapping of the state should regularly be exposed to appropriate human capacity building training and retraining programmes and courses. The various public mapping agencies in the state such as the Ministry of Lands and Survey, the LAGIS Centre, the Ministry of Physical Planning, and the Ministry of Science and Technology, which are involved in the collection, processing, archival, production, dissemination, distribution, as well as marketing of maps and other geospatial data in the state should be synergized. Their functions could also be harmonized and streamlined, for greater efficiency.

There is need to maintain and strengthen current efforts in the state for a more efficient utilization of earth observation data, geographic information systems and cartography. Relatedly, there is also the need to fully sensitize policy and decision makers and other stakeholders on the importance of modern geospatial technologies in achieving sustainable development. The products and services of the LAGIS project and other mapping initiatives of the state government need to be made more visible to the public. This will significantly increase the level of map awareness as well as map usage, which will in turn increase revenue generation to the government. The sensitization could be achieved through radio and television jingles, newspaper ads, routine publication, and distribution of flyers and bulletins as well as periodically organizing series of seminars, symposiums, workshops, town hall meetings, etc.

It will be important for the state government to have a clear understanding of the sustainable development needs and agenda of the state in order to develop appropriate maps and other geospatial information products that can meet such needs. In other words, mapping for sustainable governance and development should be guided by the SDGs as they are applicable to the state. Progress in the attainment of these goals would need to be monitored and measured using geospatial information and tools. The pursuit of sustainable development and good governance anywhere requires the creation of a pool of data and information that is supported by the tools and technology to produce maps and detect change over time in

a consistent and standardized manner. This could be achieved by investing more in core geospatial divisions, ensuring provision of adequate human capacity, equipment, and software as well as strengthening the extant relevant policy, legislative and institutional frameworks. With good policy, planning, and the involvement of all arms of government and other key stakeholders, the challenges of urban mapping in the state can be effectively managed.

CONCLUSION

The role of maps and mapping for sustainable development in general and sustainable urban development and governance in particular, cannot be overemphasized. Geographical maps provide the much-needed geospatial information for achieving the Sustainable Development Goals (SDGs). Hence, mapping is one of the core urban governance issues that must be adequately addressed to ensure a sustainable Lagos megacity development. Mapping should serve as the nexus for urban planning, development, and management. Maps eminently equip urban administrators with incisive geospatial information for effective control and management of urban resources, activities, as well as challenges. This information helps the government to be able to meet the needs and aspirations of the present and future urban dwellers. The current state of urban mapping in Lagos state still leaves much to be desired. Nonetheless, if the urban mapping limitations identified in this study are adequately addressed following the recommendations herein proffered, the status of urban mapping for sustainable development and governance in the state will be greatly enhanced.

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