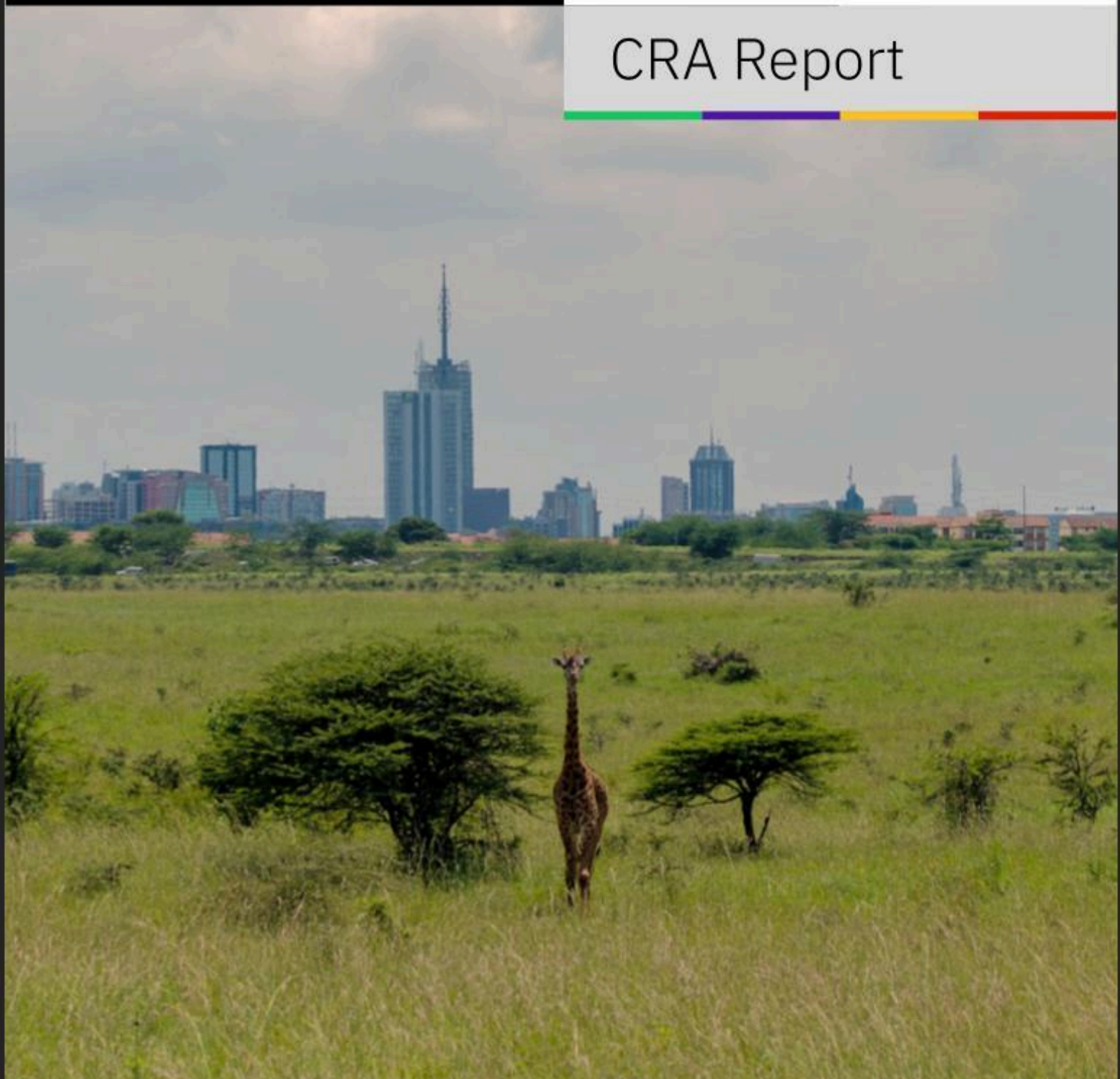
Kitengela

MSDI Capacity and Readiness Assessment Report

CAPSUS CITY PLANNING LABS WORLD BANK GROUP

CRA Report



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Content

Introduction

Municipal Spatial Data Infrastructure MSDI in Kenya

Data is essential for cities to address urban challenges and create sustainable environments. By enabling evidence-based decisions, it ensures resources are allocated efficiently. However, effective data management requires more than just access to data; it must be supported by a robust ecosystem of institutional arrangements, capacity building, standards, and protocols. Together, these elements empower cities to plan, manage, and invest in a sustainable future.

Data needs to be adequately stored and managed to be accessible for useful analysis. Local governments need to possess comprehensive information within an organized system that utilizes standardized data formats and is staffed by personnel with a deep understanding of operational policies, GIS expertise, and relevant competencies. This enables data to be shared between different agencies, thereby breaking down information silos. The availability of adequate information, supported by Urban Planning Tools (UPTs), can help cities access data easily, address planning challenges, and execute strategies by examining urban trends at the municipal level.

The Municipal Spatial Data Infrastructure (MSDI) creates an ecosystem that empowers and encourages municipal governments to harness the power of data in addressing the challenges of rapid urbanization and promoting sustainable development. The framework aims to promote strategic thinking and equip local government officials and stakeholders with the technical skills needed to manage data effectively, supporting informed decision-making and urban management. City governments are ideally positioned to become champions of Spatial Data Infrastructure (SDI). Cities are drivers of economic growth and hence prominent in decision-making spaces. They are closely connected to the community, allowing them to directly understand and address relevant priority issues. At the same time, city governments operate at a high enough level within the governance hierarchy to propose and implement effective programs, policies, and regulations.

The MSDI framework is structured around four key building blocks: Institutional Arrangements, People, Data, and Systems (IPDS). These blocks are interdependent, forming a comprehensive approach to the establishment, operation, and monitoring of MSDI implementations across short, medium, and long-term planning periods.

Table 1. MSDI Building Blocks

Building Block	Description
Institutional Arrangements	Refers to the capacity of the city to develop and sustain formal policy, regulatory frameworks, and organizational structures that support geospatial-related activities, as well as the role of the city's government in fostering the growth of the broader geospatial ecosystem. The successful implementation of this building block often relies on appropriate regulatory protocols and organizational structures with clear roles and responsibilities.
People	Refers to creating an awareness of capacity needs and identifying gaps in human resource supply concerning the production, maintenance, and utilization of spatial data. Achieving success with the building block frequently hinges on the establishment of capacity-building processes, geospatial competency frameworks, and geospatial workforce planning.
Data	Refers to the current state of affairs concerning data availability, quality, and related policies regarding formats, analysis, and sharing of geospatial information. To effectively implement this building block it is important to develop Fundamental Datasets (FDS), data standards, metadata, and data classification systems for data sharing.
Systems	Refers to the software, hardware, and physical Information Technology (IT) infrastructure required to support MSDI. A key component lies in the adequacy, functionality, and user interface of the city-level geoportals that combine Geographic Information Systems (GIS) and spatially referenced tabular data. The successful implementation of this pillar often relies on the implementation of city-level geoportals and Urban Planning Tools (UPTs).

MSDI and its operational IPDS framework can be viewed as an evolving process involving the collaborative design and development of products, regulatory frameworks, and technological solutions.

While many Kenyan cities have access to data and technical tools, they often struggle to use them effectively due to the absence of a comprehensive data governance framework. An assessment conducted by Mutua and Mwaniki for the Council of Governors revealed that 87% of the counties studied hired external consultants for GIS-related work, primarily for developing

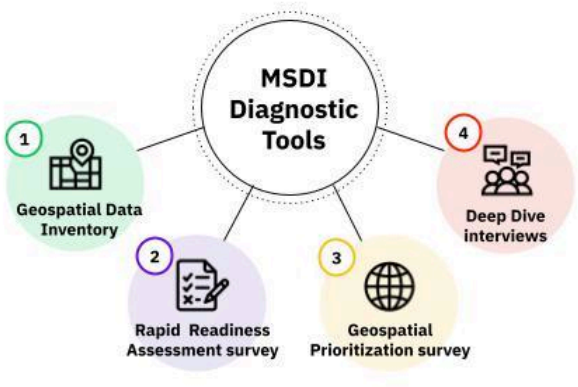
County Spatial Plans (CSP). This was the case for both counties with and without GIS labs. As a result, GIS activities within the counties were limited in scope, with most of the budget being allocated to external resources rather than internal capacity building. Another key finding from the report highlighted that although a wealth of data and knowledge exists at national institutions, it is not readily accessible to counties. Additionally, the lack of standardized practices for data collection and dissemination has led to incompatibility issues with much of the available data (Mutua and Mwaniki 2017). Establishing an MSDI platform will facilitate informed planning and resource optimization, empowering cities to better leverage data, enhance strategies, increase citizen participation, and improve resource efficiency.

To address this, the **Technical Assistance for MSDI Implementation in Kenya project aims to support three Kenyan municipalities—Kathwana, Nakuru, and Kitengela—in taking initial steps toward building a robust MSDI.** This will facilitate data-driven decision-making for effective urban planning and governance.

Because there is no one-size-fits-all approach for municipalities to develop a robust MSDI it is important to lay the right foundation upon which Kenyan municipalities can customize, based on their specific needs and capabilities.

An MSDI roadmap provides a foundation by outlining the purpose, goals, and steps required for the city government to lead the collaborative implementation of MSDI. Before developing a roadmap, however, there must be consensus on municipal needs based on a diagnostic review.

This report represents the culmination of a comprehensive capacity assessment conducted in Nakuru, as part of the project's main objectives. Actionable recommendations are not included in this report but will be included in the municipality's Roadmap. The assessment involved the use of four tools to evaluate the city's capacity and readiness for MSDI.



The **Geospatial Data Inventory** provides a comprehensive overview of the available data within the city.

The **Rapid MSDI Readiness Assessment** offers a high-level evaluation of the municipality's readiness for MSDI implementation across the IPDS building blocks.

The **Geospatial Prioritization Survey** helps achieve consensus on which sectors should be prioritized from a geospatial development perspective.

Deep Dive Interviews provide an in-depth understanding of the current state of MSDI and the IPDS building blocks within the city.

Country Context

Urbanization in Kenya

The urban population in Kenya has grown significantly over the decades. From 1960 to 2020, the urban population surged from 570,000 to 14.5 million, with 30% of the population currently residing in urban areas. Projections indicate that by 2050, approximately 39.4 million people, or 46% of the national population, will live in urban areas (World Bank 2019; KNBS 2019).

Urban populations are expected to grow at a much faster rate than the total population. By mid-century, while the total population is projected to increase by 64%, the urban population is anticipated to grow by 171% (World Bank 2019). This rapid urbanization presents both opportunities for economic growth and innovation, as well as significant challenges. Without effective urban planning, these challenges may include resource strain (such as water scarcity), insufficient access to urban amenities like sanitation, increased pollution levels, and the expansion of slum areas.

The pace of urbanization has surpassed the development of adequate housing and infrastructure. By 2017, the nationwide housing deficit had exceeded 2 million units (World Bank 2023). Additionally, urbanization has exacerbated urban poverty. In 2019, 38.3% of the population lived below the national poverty line, though this marked a slight improvement from previous years (UN Habitat 2023). The informal sector also saw a rise in employment, with over 80% of the population engaged in informal work in 2017, reflecting a trend of increasing informal employment (International Labor Organization 2021).

These conditions have made formal housing inaccessible for many, with 60% of the population living in informal settlements (UN Habitat 2023). These settlements often face precarious tenure security, inadequate housing and basic amenities, overcrowding, and limited access to services such as sanitation and healthcare. Residents also experience heightened exposure to environmental hazards and deteriorating environmental quality. The Kenyan Constitution guarantees citizens' rights to accessible and adequate housing, reasonable standards of sanitation, and freedom of residence. This raises concerns about how disparities in access to basic services will evolve if current trends continue.

Despite these challenges, urbanization has also brought benefits to Kenya. Since the 1990s, urbanization has coincided with increased wealth. GDP per capita grew from US$1,282.7 in 1990 to $1,559.5 in 2020[1]. The national GDP has steadily risen at around 5% annually (World Bank 2022). Access to public services has expanded, with 69% of the population having full access to electricity by 2019. Internet access grew from 0.3% to 22% between 2000 and 2019. Additionally, electricity produced from renewable sources increased by 763% between 2000 and 2015, contributing to sustainable development goals and a reduction in greenhouse gas (GHG) emissions (World Bank 2022). Access to electricity rose from 15.2%

[1] GDP data is in constant 2015 prices, expressed in U.S. dollars.

to 71.5% of the population between 2000 and 2020, and internet access increased from 0.3% to 25.5%, fostering economic development and improving educational access (World Bank 2022).

Urban planning

The County Government Act specifies planning scales at County, Sub-county, City, Municipal, Town and Ward levels. Municipalities are devolved units of county governments established under the Urban Areas and Cities Act of 2011 (amended in 2019). Towns may be granted this status if they meet specific criteria, most notably: 1) have a population of at least 50,000 inhabitants or serve as the headquarters of the respective county, and 2) possess a local economic development plan (Republic of Kenya 2019). The management of municipalities is required to be administered on behalf of the county government by a city or municipality board, an appointed manager, and any other staff or officers determined by the county public service, at three levels: city, municipal, and town.

Urban planning is primarily the responsibility of county and municipal governments, while national-level agencies provide policy direction. These national agencies include the State Department for Lands and Physical Planning, the National Land Commission, and the State Department of Housing and Urban Development. Additionally, other key organizations, both at the national and county levels, play supportive roles. These include the Kenya Space Agency, the Kenya National Bureau of Statistics, the Council of Governors, the County Executive Committee, and Municipal Boards at the sub-national levels.

At the national level, three main laws govern urban planning: the Physical and Land Use Planning Act (PLUPA), the County Government Act, and the Urban Areas and Cities Act. Each of these acts has specific provisions related to urban planning, GIS integration, and development plan requirements, but there are also notable gaps and overlaps among them.

1. Physical Land Use and Planning Act (PLUPA)

This Law outlines the principles, procedures, and standards for preparing and implementing physical and land use development plans across national, county, urban, rural, and city levels. Sections 22 to 24 detail the contents and objectives of the National Physical and Land Use Development Plan. Section 37 defines the objectives for county-level physical and land use development plans. Section 46 mandates that county governments create local physical and land use development plans to provide a framework and guidelines for building and development in cities, municipalities, urban areas, smaller urban centers, local centers, and market centers. Section 47 assigns planning authority to the County Executive Council Member (CECM). Additionally, Section 48 specifies that a local physical and land use development plan must include a survey report for the area and necessary GIS-based maps and descriptions indicating land use. This empowers county-level planning authorities to collect municipal spatial data for the development of local plans. The Second Schedule emphasizes the need for spatial analysis and land use suitability maps, but the Act does not address specific data requirements or establish data and metadata standards.

2. County Government Act

The County Governments Act No. 17 of 2012 in Kenya mandates the use of Geographic Information Systems (GIS) in spatial planning at the county level. The Act outlines the framework for county planning, integrating national and county plans, and establishing a county planning unit. It also defines the roles of various actors in the planning process and emphasizes public participation. Section 105 assigns the county planning unit responsibility for coordinating integrated development planning, collecting, storing, and updating data for the planning process, and establishing a GIS-based database system. Section 110 of the County Government Act requires each county to have a 10-year GIS spatial plan based on a database system that integrates with the county's development plan and aligns with regional and national plans. The plan includes provisions for two (Systems and Data) of the four MSDI building blocks. The GIS-based system refers to a geographic information management system that integrates hardware, software, and data for managing and analyzing geographical information. Additionally, Sections 108 and 113 mandate that development plans include or reference GIS-based maps and statistics (Mutua and Mwaniki 2017). However, while the Act specifies the need for GIS databases, it does not address data-sharing protocols, data and metadata standards, or geospatial capacity-building needs. Counties are left to develop their own approaches to data management, which can result in inconsistent practices and reliance on external consultants for spatial planning.

3. Urban Areas and Cities Act

The law governs the classification, management, and governance of urban areas and cities. It sets criteria for establishing urban areas, structures for resident participation in planning, and guidelines for information management, including public access to information. Sections 36 to 42 detail the requirements for integrated development plans for urban areas and cities, including the creation of GIS systems for cities and municipalities that must be integrated into the development planning framework. Additionally, land use management systems are required as part of the spatial development framework and development plans must include disaster management considerations. However, like the other laws, it does not include specific provisions for geospatial data,data-sharing protocols, data standards, or the implementation of a sharing platform.

Together, the three acts empower both county (PLUPA, County Government Act) and municipal governments (Urban Areas and Cities Act) to create and analyze geospatial data as part of urban planning. However, only the County Government Act specifies the requirements for using hardware, software, and data in a spatial format. It is also the only act that assigns specific roles and responsibilities related to spatial data usage, assigning specific roles and responsibilities to the county planning unit. Despite these provisions, none of the acts include detailed guidelines for data-sharing protocols or data and metadata standards. While the County Government Act does mandate the creation of a GIS database, it does not clarify the database's role in facilitating data sharing. Furthermore, aside from the County Government Act, the acts do not clearly outline roles and responsibilities related to data management within municipal or county governments. This gap has led some counties and municipalities to rely on external consultants for spatial planning.

The aforementioned Acts state provisions for the following urban plans:

1. National, intercounty, county, and local Physical and Land Use Development Plans (PLUPA)
2. County integrated, Spatial and Sectoral Plans (County Government Act)
3. City/urban Integrated Development Plans (Urban Areas and Cities Act)
4. City/municipal land use plans, building, and zoning plans (County Government Act).
5. Special Areas Plans (PLUPA)

Plans are developed at both national and sub-national/local levels. National agencies provide policy and legal frameworks but are not responsible for preparing or approving the plans. Some examples include the National Land Commission's Urban Land Use Planning: Monitoring and Oversight Guidelines, and the County Spatial Planning: Monitoring and Oversight Guidelines (Mutua and Mwaniki 2017).

However, overlapping plan contents can create confusion. For instance, Physical and Land Use Development Plans are overseen by the State Department for Physical Planning, whereas Integrated Urban Development Plans fall under the jurisdiction of the State Department for Housing & Urban Development.

Municipalities are required to develop three primary urban plans: Spatial Plans, Integrated Development Plans, and Local Physical and Land Use Development Plans[2]. These plans often share similar objectives, planning processes, and content, potentially resulting in duplication. **Despite these challenges, planning laws aim to ensure coherence**. The Physical and Land Use Planning Act (PLUPA) requires that local physical and land use development plans align with the Integrated City or Urban Development Plan (section 45). The County Governments Act (section 37) assigns the county executive committee the responsibility of aligning city and municipal integrated development plans with county government plans and programs. Additionally, the Urban Areas and Cities Act mandates that city or urban area integrated development plans must align with county government development plans and strategies.

While geospatial data infrastructure provisions are common across these laws, coordination remains weak, and roles can overlap. Improving data governance through standardization and better data-sharing practices could enhance coordination.

Spatial Data Infrastructure in Kenya

The Kenya National Spatial Data Infrastructure Policy (Draft) aimed to create a framework for the collection, integration, distribution, and sharing of geospatial information and services across public, private, and civil society sectors. Its objectives included:

- Eliminating resource wastage and duplication in geospatial information production.
- Establishing standards for data production and distribution.
- Creating solutions for easy discovery and access to geospatial data.
- Promoting and coordinating national participation in international spatial data infrastructure initiatives.

(Mutua and Mwaniki 2017)

Efforts to develop the Kenyan National Spatial Data Infrastructure (KNSDI) began in 2001 (Ministry of Lands, Public Works, Housing, and Urban Development 2021; Mwange, Mulaku,

[2] Local physical and land use development plan means a plan for the area or part thereof of a city, municipality, town or urban center.

and Siriba 2017). The initiative was intended to promote the production and sharing of spatial data for sustainable development and facilitate its use in decision-making.

From 2001 to 2009, the Japan International Cooperation Agency (JICA) provided financial support for the KNSDI's development. During this period, several stakeholders contributed to the initiative, including the Survey of Kenya (SOK), the Nairobi City Council (NCC), the Ministry of Lands (MOL), and the Institution of Surveyors of Kenya (Mwange, Mulaku, and Siriba 2017).

The KNSDI initiative achieved notable progress, including the development of the Kenya Profile for Geographic Information Standards (KPGIS), which encompasses technical competencies in map digitization, data sharing guidelines, training, capacity building, and the establishment of an organizational framework. Additionally, a draft KNSDI policy was created. However, the draft policy has not yet been ratified (Mbaria 2015; Mwange, Mulaku, and Siriba 2017).

The policy's formulation stalled in 2016 (Mutua and Mwaniki 2017). Although the policy was listed among the flagship programs for 2018-2022 in Kenya's Vision Third Medium Term Plan, the final version of the policy has not yet been completed.

The implementation of the KNSDI has been hindered by several factors, including uncertainty regarding the institution responsible for hosting the KNSDI[3] (Mwange, Mulaku, and Siriba 2017), **ad hoc and fragmented development** efforts[4] (Okuku, Bregt, and Grus 2014), lack of **sustainable funding**, a **weak institutional framework,** insufficient promotion of custodianship due to the **absence of an enabling policy**, and concerns about the project's sustainability stemming from its initial approach (Mwange, Mulaku, and Siriba 2017).

Spatial Data Infrastructure Guidelines

The only available spatial data management-related guidelines are the national spatial planning guidelines. This includes the County Spatial Planning Guidelines, developed by the Ministry of Lands and Physical Planning and the Council of Governors, and the Guidelines for Urban Land Use Planning, developed by the National Land Commission.

The County Spatial Planning Guidelines emphasize that spatial plans must be GIS-based. These guidelines detail the requirements for establishing a GIS lab, including recommendations for hardware and software. They also identify potential data sources and stress the importance of considering satellite and aerial imagery characteristics such as spatial resolution, spectral resolution, temporal resolution, and image extent. **However, they do not address metadata or data storage.**

[3] Since its inception, the responsibility for KNSDI leadership was vested in the Survey of Kenya (SOK), under the Ministry of Lands. However, after the launch of the Kenya Open Data Portal pilot in April 2012, KNSDI responsibility was transferred to the Information and Communication Technology Authority (ICT). In December 2014, responsibility for KNSDI was moved back to the Ministry of Lands (Mwange, Mulaku, and Siriba 2017).

[4] Key efforts to operationalize KNSDI were undertaken by the Survey of Kenya (SoK) with support from JICA as part of the "Project for Strengthening the Survey of Kenya for GIS Promotion in the Republic of Kenya" (2006-2008)(Murage, Gitimu, and Sato 2008). See Annex VI for a description of the project activities and outcomes.

The guidelines stress the importance of recruiting staff with appropriate skills and competencies and defining staffing requirements at both county and municipal/city levels. They specify minimum qualifications in terms of formal training and relevant experience, emphasizing the need for a multidisciplinary team. The guidelines recommend that municipalities assign a Director of planning, four municipal planners, one GIS manager, and two GIS technicians.

The guidelines recognize the importance of involving various stakeholders in the plan preparation process and promote a collaborative approach. Stakeholders include ministries, departments, agencies, professional and academic institutions, civil society, resident associations, political and opinion leaders, and development partners. They also provide insights on improving public participation.

Additionally, the guidelines discuss data considerations, including data types, sources, and the acquisition of data through satellite and aerial imagery.

The guidelines specify essential hardware components for the county GIS lab, including desktop and laptop computers, plotters, printers, GPS receivers, and server and network infrastructure. They also outline the hierarchical structure of the GIS lab personnel, which includes a GIS Manager and GIS and Photogrammetry Technicians.

The guidelines also highlight the importance of creating Terms of Reference (ToRs) for outsourcing the preparation of spatial plans. While they outline the necessary content for these ToRs, they do not provide specific recommendations (Ministry of Lands and Physical Planning and Council of Governors 2018).

The National Land Commission's Guidelines for Urban Land Use Planning include detailed instructions for preparing, approving, implementing, and reviewing urban land use plans. They specify that these plans must be GIS-based, requiring land use information to be stored in a geodatabase that supports easy storage, retrieval, querying, and presentation. The final plan must be available in both digital and hard copy formats. The digital version must be compatible with GIS software for querying and analysis; formats such as PDF or JPEG are not acceptable. **While the Urban Land Use Planning: Monitoring and Oversight Guidelines do not address metadata requirements, they mandate that all plan layers include attribute information such as area, name, and dimensions.** They also recommend basemaps, including required data layers, suggested scales, and symbology like land use codes and colors. The guidelines outline methods for procuring planning services, such as Request for Proposals (RFP), design competitions, or restricted tendering.

Data availability

It was not possible to locate open and publicly available spatial data officially published by the Kenyan government. This does not imply that such data does not exist. An extensive online search revealed several maps in image format covering various themes, including:

- Administrative and political units
- Current and projected land uses
- Major and secondary roads
- Population distribution and characteristics
- Locations of public and private primary schools
- Households with access to improved water and sanitation
- Environmental features such as topography, hydrological basins, rainfall, and dominant soil types

The maps mentioned above were published in urban planning instruments, such as Integrated County Development Plans.

According to the 2017 GIS Needs Assessment report, **Kenyan national institutions possess a substantial data pool that is both broad in scope and high in resolution**. Most of this data is available in digital reference map formats. Data is primarily compiled from government institutions (28.6%) and collected through field visits and satellite image interpretation (42.9%) (Mutua and Mwaniki 2017)[5].

While national institutions report[6] sharing data with county governments, government agencies, NGOs, and private companies, they also cite weak data-sharing practices and data compatibility issues as major challenges (Mutua and Mwaniki 2017). Notable data-generating agencies include the Department of Surveys and the Kenyan National Bureau of Statistics.

The Department of Surveys, or Survey of Kenya (SoK), is the government agency responsible for land surveys and mapping in Kenya. Established in 1903, SoK is one of the oldest departments in the country and serves as the national focal point for GIS and Remote Sensing. It has a dedicated Geodetic and GIS division and is the primary source for spatial data, particularly cadastral records and fixed boundary surveys (Mutua and Mwaniki 2017).

SoK collaborates with county governments, international institutions, and academia to advance GIS use in Kenya. It provides data to both county governments[7] and the general

[5] This was also evident during the municipal deep-dive interviews. However, the exact proportion of data obtained from government institutions, fieldwork, and satellite imagery remains unknown.

[6] The national institutions assessed include: Department Of Lands, Department Of Physical Planning, Department Of Survey, National Environment Management Authority, Directorate Of Resource Surveys And Remote Sensing, National Land Commission, Independent Electoral and Boundaries Commission, Regional Centre For Mapping Of Resources For Development, Kenya National Bureau of Statistics, Kenya Power , Technical University of Kenya, University of Nairobi, Institution of Surveyors of Kenya, ICT Authority , and EDRI.

[7] SOK has long been recognized as the primary authority on spatial data in Kenya, particularly for cadastral records related to fixed boundary surveys. County governments can request data from SOK, though the frequency of SOK's data updates remains unclear. The organization has occasionally partnered with counties, such as Kiambu, to support the digitization of survey and parcel records,

public in both hardcopy and digital formats for a nominal fee, such as approximately Ksh. 3,000 for a digital GIS road layer. Prices can be reduced through partnerships, such as those with Kiambu and Nairobi counties (Mutua and Mwaniki 2017).

The Kenyan National Bureau of Statistics (KNBS), established in 2006, is tasked with collecting, analyzing, and disseminating statistical data. KNBS provides crucial economic indicators, such as GDP, inflation rates, and unemployment rates. It supports county governments, conducts population censuses, and addresses regional challenges, including water and sanitation needs.

KNBS has developed several online data-sharing platforms, including the **Kenya Data Portal** and the **Kenya National Data Archive (KeNADA)**, which contains 80 surveys[8]. However, neither platform currently offers spatial data.

In Kenya, several digitalization initiatives have been launched. The Ministry of Land and Physical Planning (MoLPP) and the National Land Commission (NLC) developed the **Ardhisasa platform, an online Land Information Management system**. This platform enables citizens to access reliable and efficient land and land-based services.

Ardhisasa is fully operational in Nairobi and Murang'a. Digitalization efforts in Murang'a began in 2021, focusing on converting 387,635 land registers and 269,694 files into digital format (Ministry of Lands, Public Works, Housing, and Urban Development 2024).

Although the Kenyan government does not officially publish publicly accessible spatial data, there are over 368 spatial datasets available in SHP, KML, and TIFF formats **on geoportals not managed by the government.** These datasets can be found on the Regional Centre for Mapping of Resources for Development (RCMRD)[9] and the IGAD Climate Prediction and Applications Centre (ICPAC)[10] websites. While all datasets are available for download, only 66% (242 datasets) meet interoperability standards with geographic references.

The topics covered include, but are not limited to:

- Administrative boundaries
- Population distribution
- Climate-related hazards
- Crop production by region
- Agroclimatic zones
- Location of health facilities

providing comprehensive quality assurance for data produced by the counties' GIS experts. Additionally, SOK has played a key role in quality control and validation efforts for locally digitized data in other counties, including Nairobi, Mombasa, Isiolo, and Kilifi (Mutua and Mwaniki 2017).

[8] The surveys hosted on the Kenya National Data Archive (KeNADA) span various socio-economic, health, industrial, and demographic areas. Examples include the Kenya Demographic and Health Survey (KDHS), Continuous Household Survey, Survey of Industrial Production, Kenya Population and Housing Census, and the Malaria Indicator Survey, among others.

[9] RCMRD, an inter-governmental organization founded in Nairobi in 1975, currently includes 20 Contracting Member States from Eastern and Southern Africa. It was established under the auspices of the United Nations Economic Commission for Africa (UNECA) and the Organization of African Unity (OAU), now the African Union (AU).

[10] ICPAC is a Climate Center accredited by the World Meteorological Organization that offers climate services to 11 East African countries.

- Road and railway networks
- Locations of major towns, markets, and airports
- Environmental features such as soil characteristics, wetlands, protected areas, river basins, and lakes

For additional information on national-level spatial data, please refer to the **Kenya Geospatial Data Inventory.**

In Kenya, accessing and managing spatial data presents several challenges. Despite the availability of substantial data from various sources, the Kenyan government does not officially publish open and publicly accessible spatial data. Key issues include:

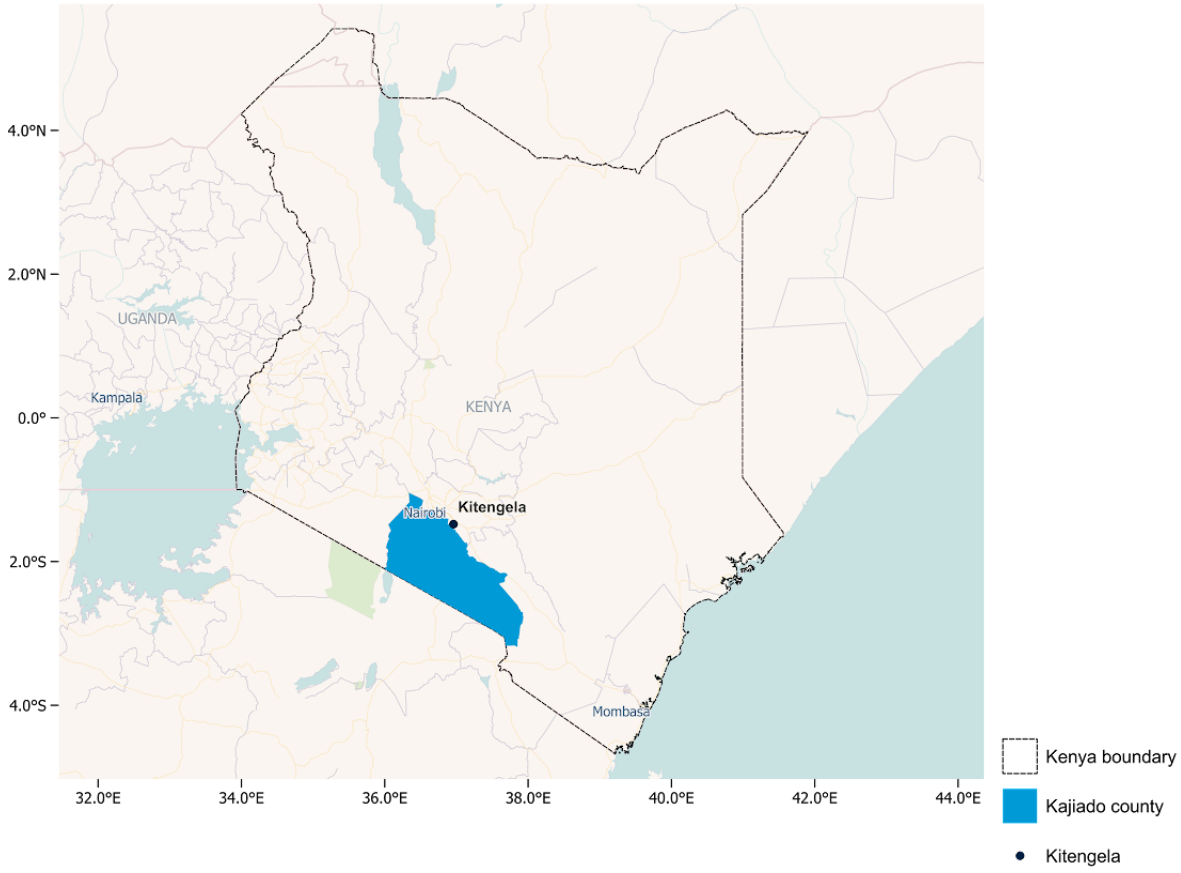
- **Lack of Access:** There is no centralized, publicly accessible repository for government-published spatial data, making it difficult to locate and utilize official sources.
- **Data Sharing and Compatibility:** National institutions report weak data-sharing practices and compatibility issues, which hinder the integration and usability of spatial data across different platforms and organizations. This can lead to data duplication and inefficient use of resources.
- **Interoperability Issues:** Although many datasets are available online, only 66% meet interoperability standards, limiting their effectiveness for comprehensive spatial analysis and integration.

These challenges underscore the need for improved data management and sharing practices to enhance the accessibility and utility of spatial information in Kenya.

Municipal Context

Kitengela is a municipality in Kajiado County, Kenya, situated 30 kilometers south of Nairobi within the greater Metropolitan Area. Many residents commute to Nairobi for work, benefiting the transport sector. As of 2019, Kitengela had a population of 62,956 and covered an area of 87.2 km², with a population density of 718 inhabitants per km² (KNBS 2019). Kajiado County is divided into five constituencies (Kajiado Central, West, East, South, and North), which are further subdivided into 5 electoral wards. Kitengela Municipality is located in the constituency of Kajiado East (County Government of Kajiado 2019).

Figure 1: Kitengela Municipality Location



The municipality has experienced significant growth, with an average annual population increase of 6.3% from 2009 to 2019, the third highest rate in the country (KNBS 2019). Most of this expansion has occurred in peri-urban areas, highlighting the need for additional public infrastructure and housing. Currently, 28.3% of Kitengela's population lives below the poverty line, which is lower than the national average of 45.2% and the county average of 38% (County Government of Kajiado 2019).

A significant portion of Kitengela's population is employed in the informal sector, engaging in various activities such as commerce, services, industrial operations, horticulture, and floriculture. The commercial sector, including markets, supermarkets, and retail shops, is the primary source of employment. Manufacturing and mining also play crucial roles, driven by the availability of sand and quarries. Other key economic sectors include tourism, transportation, and agriculture, the latter benefiting from fertile land and water boreholes despite unreliable rainfall patterns (KNBS 2012). The ongoing growth in these sectors creates a demand for expansion in industries and the workforce, making Kitengela an attractive area for investment across sectors such as manufacturing, real estate development, infrastructure, financial services, agro-processing, agrochemicals, chemicals, pharmaceuticals, mining and mineral processing, electrical and electronics, engineering, and construction. These opportunities also aim to meet the growing demand in the Nairobi metropolitan area.

Between 2018 and 2022, Kajiado County contributed an average of 1.5% per year to Kenya's Gross Domestic Product (GDP). The county's annual growth rate was 5.8%, exceeding the national average of 4.6%. The average GDP per capita in Kajiado was 120,312 Kenyan shillings, which is approximately 45.6% of the national GDP per capita (KNBS 2023).

According to Kajiado'sIntegrated Strategic Urban Development Plan from 2023 to 2027, Kitengela is set to undergo significant development, including the construction of new sewerage infrastructure, storage facilities, and a sub-county hospital (County Government of Kajiado 2019).

Key Concerns

Kitengela Municipality faces numerous challenges related to environmental pollution, inadequate infrastructure, climate change impacts, and unemployment. Key concerns were identified through a literature review on common urban performance indicators. Those that were identified by international agencies or the local government as key concerns were selected. The following sections highlight the key concerns facing Kitengela.

Environmental Pollution

Air pollution in the area results from various sources, including manufacturing plants, power stations, quarries, waste incinerators, motor vehicles, and construction activities. In a study, participants reported negative views on air quality as a result of mining activity, with 70%

reporting vegetation degradation, 90% reporting concerns over suspended particles, and up to 92% reporting respiratory issues (Mbandi 2017). More research is needed to adequately assess the state of air quality in Kitengela.

Another major concern is waste disposal. Individual households often manage their own solid waste. Currently, refuse collection and disposal are handled by private garbage collection firms. However, some residents dispose of waste in open spaces, riparian areas, and along roadsides, leading to environmental pollution. One of the motivators for this is the low frequency of waste collection; in one study, 76% of participants reported that waste is collected once a week or less frequently. Up to 22% of household waste in Kitengela is plastic. Outside of households, solid waste is generated mainly by markets (41%), followed by industries (23%) (Ibrahim 2017).

Water and soil pollution constitute another issue. Water pollution stems from the improper disposal of domestic and industrial wastewater. Additionally, the use of fertilizers and chemicals in agriculture has led to soil contamination.

Lack of Public Infrastructure

The rapid population growth, particularly in peri-urban areas, has outpaced the development of public infrastructure. There is a notable shortage of public primary and secondary schools, as well as basic infrastructure facilities, housing, and essential services (County Government of Kajiado 2019). The town, which in 2022 reported having a population of 154,436 inhabitants, has only four public primary schools located in the area, all of which are full to their capacity (Kenya News 2022). Other concerns at the sub-county level include the lack of essential infrastructure like piped water, interior estate roads, and sewerage systems.

Climate Change Vulnerability

Kajiado County is experiencing intensified climate-related challenges, including more frequent droughts, famine, flash floods, and strong winds. These effects have led to increased livestock mortality, reduced animal production and productivity, crop failures, and lower school attendance (County Government of Kajiado 2019). Additionally, the loss of agricultural land further exacerbates these issues. The main climatic challenge facing the agricultural sector in Kajiado, one of the main economic activities and means of sustenance for its population, is drought. The frequency and severity of droughts in the county have resulted in crop failure and livestock losses and triggered severe food shortages in the past. In 2009, crop failure in the county was reported at more than 90%, while livestock losses were in excess of 70% in most areas within the county (Kenya Climate Smart Agriculture Project 2017).

Unequal Access to Employment

Over 10% of the working-age population in the municipality is unemployed. The formal sector is predominantly male-dominated, with women representing only about 30% of the available formal job opportunities. Additionally, the unemployment rate among the youth remains high.

Assessments

This section presents three assessments designed to evaluate different aspects of Municipal Spatial Data Infrastructure (MSDI) readiness: the Rapid Readiness Assessment, the Geospatial Prioritization Survey, and Deep Dive Interviews. The Rapid Readiness Assessment is performed initially to help establish a consensus of MSDI readiness across agencies and key stakeholders. The Geospatial Prioritization Survey identifies socio-economic sectors that should be prioritized for geospatial development. Finally, the Deep Dive Interviews provide a detailed analysis of the city's MSDI capacity across the four MSDI building blocks: Institutional Arrangements, People, Data, and Systems (IPDS).

These diagnostic tools offer a structured approach to assessing the municipality's current MSDI capabilities and identifying areas for improvement.

Rapid Readiness Assessment

Methodology

Objective: The MSDI rapid assessment enables decision-makers to develop a common, high-level understanding of the current status of the municipality's MSDI readiness across the Institutional Arrangements, People, Data, and Systems (IPDS) components.

What is the Rapid Readiness Assessment: It is a 14-question survey where participants rate the level of implementation for each variable in their agency or city on a 5-point scale, ranging from Very Low to Very High. A copy of the survey is available in Annex I.

Table 2. Conversion for Rapid Assessment Survey

RESPONSES	ASSOCIATED SCORE
Very Low	**0**
Low	**0.25**
Average	**0.5**
High	**0.75**

Very High	**1.0**

All responses are converted into numerical scores, as shown in Table 2. These values are then used to calculate the average score for each question and building block.
After completing the Rapid Readiness Assessment, the CAPSUS team presented the results during an in-person workshop primarily attended by Municipality and County Government staff. The workshop began with a brief overview of the MSDI readiness assessment survey methodology and an explanation of how to interpret the results. This was followed by a presentation of the municipality's initial results for each MSDI building block. Each segment included a detailed description of the variables assessed, interpretation of the findings, and key challenges and recommendations identified by participants. Between each building block presentation, participants were encouraged to share their opinions, ask questions about the assessment, and discuss which aspects of the results they agreed or disagreed with, adding any additional insights or comments.

Date conducted: The assessment was carried out in Kitengela Municipality on May 7th, 2024.

Participants: Ten participants from Kitengela Municipality completed the survey. The participants included a municipal planner, a county GIS expert, an environmental officer, a surveyor, and a board member. The full list of participants is available in Annex V.

Results

Five of the six participants who completed the Rapid Readiness Assessment held positions in the County or Municipal government that required at least a median level of familiarity with spatial data. Overall, there was no significant difference between the scores from more technical personnel except for a much higher score from the non-technical participant regarding Individual Leadership in the municipality. The quantitative results are shown in Table 3.

Table 3. Rapid MSDI Readiness Assessment quantitative results

	Institutional				People			Data			Systems			
Participant	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**
Participant 1	0.5	0.5	0.25	0.5	0.5	0.25	0.75	0.25	0.25	0.25	0.5	0.25	0.25	0
Participant 2	0.5	0.5	0.75	0.25	0.75	0.5	0.25	0	0	0.5	0.5	0	0	0.5
Participant 3	0.5	0.25	0.75	0.5	0.5	0.5	0.5	0.25	0	0.25	0.75	0.25	0.5	0.25
Participant 4	0.5	0.25	0.25	0.5	0.75	0.5	1	0.25	0.25		0.5	0.5	0.25	0.25
Participant 5	0	0	0.75	0	0.5	0.5	0.5	0.75	0.25	0.25	0.25	0.25	0	0.5
Participant 6	0.5	0.5	0.75	0.5	0.5	0.25	0.5	0.5	0.5	0.5	0.5	0.25	0.25	0.25

** Participant 4 did not respond to question 10*

The readiness score for each building block was calculated by averaging the scores of its individual questions. For example, the Institutional Arrangements readiness score was calculated by averaging the results from Q1, Q2, Q3, and Q4.
The overall MSDI Readiness Index was then determined by averaging the values from all four building blocks. The results are presented in Table 4.

Table 4. MSDI Readiness Index

Building Block	Criteria	Score	Building block score	MSDI Index
Institutional arrangements	Government central funding	0.42	0.43	**0.39**
	Data policy aimed to return on investment	0.33		
	Legal framework	0.58		
	Private sector and academia activities	0.38		
People	Human capital	0.58	0.53	
	Spatial data education	0.42		
	Individual leadership	0.58		
Data	Digital cartography availability	0.33	0.30	
	Metadata availability	0.21		
	Standards	0.35		
Systems	Web connectivity and telecommunication infrastructure	0.50	0.31	
	Access to Web Mapping	0.25		
	Geospatial software	0.21		
	Own development/Open source	0.29		

Kitengela received an MSDI index score of 0.39, indicating a low perception among municipal and county staff regarding Kitengela's capacity for MSDI implementation. However, this assessment is intended to capture only initial perceptions of the municipality's preparedness for implementing MSDI. The actual capacity was evaluated through further surveys and workshops. It is also important to mention that Kitengela is a very young municipality[11] and thus may face challenges such as establishing effective governance structures, building capacity among local officials, and formulating relevant policies to address rapid urbanization. Below are the main insights gathered from the Rapid Readiness Assessment results, and the workshop conducted to validate the results.

Institutional Arrangements

[11] It was granted municipality status in 2022.

The Institutional Arrangements building block, which focuses on a city's capacity to establish and maintain formal policies, regulations, and governance structures that support geospatial activities, received the second highest score (0.43). Participants' comments on key insights are presented in the points below.

- Participants noted that, although there is no formal data policy, operational rules are in place, and all departments adhere to professional standards, which they do not view as an area for improvement. Additionally, they mentioned that a strategy exists but has not yet been operationalized.
- Participants recognize the need for a data-sharing policy.
- It was also mentioned that Kitengela benefits from the support of a metropolitan structure. The geographical proximity to the country's capital may facilitate collaboration and communication with the national level government in terms of data acquisition.
- Participants noted that neighborhood associations have supported and complemented the municipality's functions. Kitengela collaborates with neighborhood associations on sewage issues.
- The municipality maintains a productive and close relationship with Kajiado County, aiming to enhance Kitengela's autonomy.
- Although the Legal Framework criteria received the highest score within the Institutional Arrangements block, participants identified a lack of clear data policies and regulations as a potential challenge during a brainstorming session.

People

- The people building block, which centers on creating awareness about capacity needs and identifying gaps in human resource supply obtained the highest score (0.53).
- Participants mentioned that when answering the survey, they interpreted "spatial data education" as formal training, such as a university or master's degree. However, if they understood education to include continuous training, they would have rated the municipal capacity higher. Additionally, participants remarked on the need to increase capacity for GIS and database management, as such programs are currently lacking.
- Participants mentioned that funding is a challenge and highlighted the need for adequate training for decision-makers on the benefits of data for decision-based planning.

Data

- While the data building block, which evaluates the current state of data availability, sharing, quality, and policy, received the lowest score (0.30), participants had expected a higher score, especially concerning the availability of digital cartography. Although the Kitengela area has been mapped multiple times, participants noted the need for more detailed and discrete data. Particularly, more comprehensive metadata, real-time monitoring systems,

- Participants also pointed out that the available data for Kitengela is outdated, with records ranging from 5 to 10 years old. One of the challenges in updating data is the rapid pace of change within the municipality due to urbanization. This data is mainly managed and accessed by senior physical planners at the county level.
- Participants noted that data is fragmented across various agencies, which presents a significant challenge. For instance, the state agency holds extensive water data, but the county lacks access to this information and is unaware of the data available.
- The only difficulty mentioned with data standardization was the use of different coordinate systems.
- Kajiado has increased revenue collection through the use of digital records, which also allows for monitoring land use. This platform has demonstrated how data can be a valuable investment for subnational governments.

Systems

- The Systems building block, software, hardware, and physical infrastructure of Information Technology (IT) necessary to support MSDI, received the second lowest score (0.31).
- Participants reported issues with GIS software, specifically noting that ARC licenses were expiring. They expressed a desire to continue using the ESRI product suite. This correlated with the low score on geospatial software.
- The need for investment in infrastructure was highlighted, particularly for acquiring drones.

Geospatial Prioritization Survey

Methodology

Objective: The Geospatial Prioritization Survey (GPS) is a tool designed to build a consensus on which sectors should be prioritized for geospatial development in the municipality.

What is the Geospatial Prioritization Survey: The Geospatial Prioritization Survey includes 7 questions: four questions involving ranking of prioritization and three open-ended questions.
In the questions involving ranking, participants are asked to evaluate the following for each of the 14 urban development sectors (see Annex II):

- The relative level of development
- The importance of the sector
- The importance of geospatial data in supporting development
- The current level of geospatial data use

Table 5 presents the 14 sectors included in the survey, along with a brief description of each sector. This table was provided to participants as a reference while completing the Geospatial Prioritization Survey.

Table 5. Sectors included in the Geospatial Prioritization Survey

SECTOR	DESCRIPTION
Economy	Economic health and manpower, such as employment rate, and poverty rate.
Education	Educational opportunities, such as student enrolment, student/teacher ratio, completion of primary and secondary education, and prevalence of higher education degrees.
Energy	Efficiency of electricity production and consumption, such as electrical energy use per capita, and use of renewable sources.
Environment	Environmental quality and biodiversity conservation, such as atmospheric concentrations of Particulate Matter, noise pollution, and health of native species.
Finance	Financial management, such as debt service ratio, capital spending, and own-source revenue as a percentage of total revenues.
Fire & Emergency Response	Provision of fire and emergency services, such as the prevalence of firefighters, and response time for emergency services.
Health	Provision of healthcare services and general health of the population, such as access to healthcare services, average life expectancy, and infant mortality rate.
Safety	Law enforcement, such as crime rate, the prevalence of police officers, and response time from the police department.
Shelter	Provision of housing, such as access to formal housing, and registration of legal titles for households.
Solid Waste	Solid waste collection, such as access to solid waste collection services, and recycling rate.
Telecommunication & innovation	Telecommunications services and connectivity, such as access to the Internet and cell phone connections.

Transportation	Provision of transportation services, such as rail network, car ownership, and availability of bicycle lanes.
Urban Planning	Urban planning, such as land use planning, and the prevalence of green areas.
Water & Sanitation	Wastewater collection, water supply service, and sanitation facilities such as sewer system, access to potable water, and wastewater treatment.

The open-ended questions invite participants to:

- Describe how geospatial data supports municipal development goals.
- Identify policy and resource gaps that need to be addressed for sector development.
- Outline the expected outcomes of implementing a Municipal Spatial Data Infrastructure (MSDI) across sectors.

To disseminate the results of the Geospatial Prioritization Survey (GPS), weighted scores were calculated on a scale from 1 to 14 for each assessed sector. This approach helps visualize and compare sector rankings relative to one another. The methodology was as follows:

1. For each sector, we recorded the number of participants who assigned each rank from 1 to 14.
2. We multiplied the number of responses for each rank by the rank's value. For example, one response with a rank of 1 contributes a value of 1, while three responses with a rank of 3 contribute a total value of 9. These results were then summed to determine the sector's score.
3. The sector with the lowest score was assigned a weighted score of 1, and the sector with the highest score received a weighted score of 14. The scores of the other sectors were scaled proportionally.

Based on these scores and the relative importance assigned by survey respondents, sectors are categorized into first, second, and third priority levels. This categorization helps decision-makers establish consensus on the most critical sectors and focus their attention on key areas.

After completing the Geospatial Prioritization Survey, the CAPSUS team presented the results in an online workshop primarily attended by Municipality and County Government staff.

The workshop began with a brief overview of the MSDI geospatial prioritization survey methodology and guidance on interpreting the results. This was followed by a presentation of the municipality's preliminary findings.

Throughout the session, participants were encouraged to share their opinions, ask questions about the assessment, and discuss their agreements or disagreements with the results. They also had the opportunity to provide additional insights and comments.

Date conducted: The assessment was carried out in Kitengela Municipality on May 10th, 2024.

Participants: Eight participants from Kitengela Municipality and Kitengela County completed the survey. The participants included urban specialists, physical planners and GIS officials, a municipal manager, and a county ICT officer, among others. The full list of participants is available in Annex V.

Results

This section analyzes the results of the seven questions in the survey. Each table shows how frequently participants selected each sector. For example, Table X indicates that the Economy sector was chosen 3 times as the primary sector.

Development Levels of Sectors

In evaluating the developmental status of various sectors within Kitengela, **participants identified Economy and Energy as the most advanced sectors, receiving 3 votes as the primary sector, and 2 votes as the third most important sector respectively.** The Economy and Energy sectors scored equally, with the lowest rank for Economy being 10th place and the lowest rank for Energy being 8th place. However, during the Geospatial Prioritization Survey workshop, participants emphasized that Energy should be considered a third-priority sector, as they are not directly involved in energy generation for the municipality.

Health was ranked as the third most advanced sector and received the most votes for third, fourth, and fifth place (2 votes). Following Health in terms of development were Education and Fire & Emergency Response. In contrast, Water & Sanitation, Finance, Solid Waste, and Environment were considered the least developed sectors.

Table 6. Ranking of the level of development of the sectors according to the Kitengela's participants

SECTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	No answer *	Weighted Score
Economy	3	0	2	0	0	1	0	1	0	1	0	0	0	0	0	1.0
Education	0	0	2	3	1	0	1	1	0	0	0	0	0	0	0	3.2
Energy	0	0	2	1	3	0	0	1	0	0	0	0	0	0	1	1.0
Environment	1	2	0	0	1	0	0	1	0	1	1	0	1	0	0	9.2
Finance	0	0	0	0	2	0	2	2	0	1	1	0	0	0	0	13.1

Fire & Emergency Response	0	1	1	1	3	0	1	1	0	0	0	0	0	0	0	3.6
Health	0	1	2	2	2	0	0	1	0	0	0	0	0	0	0	1.4
Safety	0	0	2	1	3	0	0	1	0	1	0	0	0	0	0	5.3
Shelter	0	0	1	1	2	1	1	0	0	0	0	1	0	0	1	4.9
Solid Waste	0	1	0	0	1	0	1	2	0	0	1	0	0	1	1	10.5
Tele-communication & innovation	0	1	1	1	1	0	2	0	1	0	0	0	1	0	0	8.4
Transportation	0	2	1	0	1	2	1	0	0	0	0	0	1	0	0	5.8
Urban Planning	0	1	1	0	0	1	2	2	0	1	0	0	0	0	0	8.8
Water & Sanitation	1	0	1	0	0	2	0	0	1	1	0	0	0	2	0	14.0

Lowest vote / weighted score — Highest vote / weighted score

* Some participants did not rank all sectors. These missing responses, or "no answers," have been identified and quantified in this and the following tables.

Relative Importance of Sectors for Kitengela's Development

In evaluating the relative importance of each sector for Kitengela's overall development, **participants identified Urban Planning and Environment as the most crucial sectors, each receiving 5 and 6 votes respectively.** Urban Planning slightly outperformed the Environment sector, with 2 votes for second place, whereas the Environment sector received one vote for third place and fourth place. Notably, Kitengela only has dedicated staff for Urban Planning and the Environment in addition to a municipal engineer which likely influenced the results. The Head of the Directorate of Physical and Land Use Planning at Kitengela Municipality also agreed with this score for the Urban Planning sector, nevertheless recognized the challenge of sensitizing the **financing** and implementing institutions on why they need to allocate resources to the urban planning sector because institutions and **political class do not understand the cost of geospatial data creation and management.**

The Economy and Water & Sanitation sectors were also ranked as important. The Economy sector received 2 votes for the highest priority but also received 2 votes for the second priority, and 3 votes for the third. The Water & Sanitation sector received 6 votes for the higher priority but also received 1 vote for the fourth and fifth priority, which affected its overall ranking.

Telecommunication & Innovation, Energy, Education, and Safety were deemed the least important sectors for achieving the municipality's development goals.

In conclusion, in the evaluation of priority sectors for Kitengela's development, Urban Planning and the Environment emerged as the most crucial sectors, with Urban Planning slightly ahead. This prioritization was likely influenced by the fact that Kitengela has dedicated staff for these sectors and a municipal engineer. The Economy and Water & Sanitation sectors were also seen as key areas, with strong support across the rankings. However, sectors such as Telecommunication & Innovation, Energy, Education, and Safety were considered less critical for achieving the municipality's development goals.

Table 7. Ranking of the relative importance of the following sectors in Kitengela's overall development

SECTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	No answer *	Weighted Score
Economy	2	2	3	0	0	0	0	0	0	0	0	0	0	0	1	2.3
Education	2	0	2	0	3	1	0	0	0	0	0	0	0	0	0	8.4
Energy	2	1	2	1	0	0	0	0	0	0	1	1	0	0	0	11.8
Environment	6	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1.4
Finance	4	0	1	0	1	1	1	0	0	0	0	0	0	0	0	6.6
Fire & Emergency Response	4	0	1	0	2	0	0	0	1	0	0	0	0	0	0	7.1
Health	4	0	0	1	1	0	0	1	0	0	0	0	0	0	1	4.9
Safety	4	0	1	1	0	0	1	0	0	0	1	0	0	0	0	8.4
Shelter	2	4	1	0	0	0	0	0	0	0	0	0	1	0	0	7.1
Solid Waste	7	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2.7
Tele-communication & innovation	1	0	3	1	1	0	0	0	0	1	0	0	1	0	0	14.0
Transportation	3	2	1	0	1	1	0	0	0	0	0	0	0	0	0	4.9
Urban Planning	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1.0
Water & Sanitation	6	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2.3

Lowest vote / weighted score — Highest vote / weighted score

* Some participants did not rank all sectors. These missing responses, or "no answers," have been identified and quantified in this and the following tables.

Importance of Geospatial Data for Sector Development

In evaluating the importance of geospatial data for each sector's development, **participants identified Solid Waste as the sector where geospatial data is most crucial, with 3 respondents ranking it in first place.**

Following the Solid Waste sector, Urban Planning and Safety sectors were also ranked highly in terms of the importance of geospatial data. Urban Planning received 5 votes for first place, while Safety received 3 votes for first place.

Telecommunication & Innovation, Fire & Emergency Response, and Economy were identified as the sectors where geospatial data is considered least important for achieving development goals.

Table 8. Ranking of the importance of geospatial data for supporting sectoral development

SECTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	No answer *	Weighted Score
Economy	3	2	1	0	0	1	0	1	0	0	0	0	0	0	0	10.3
Education	1	2	4	0	1	0	0	0	0	0	0	0	0	0	0	8.4
Energy	3	0	3	1	1	0	0	0	0	0	0	0	0	0	0	7.5
Environment	4	1	1	2	0	0	0	0	0	0	0	0	0	0	0	3.8
Finance	3	0	1	0	1	0	0	1	0	0	0	0	0	0	2	5.6
Fire & Emergency Response	3	1	1	1	1	0	0	1	0	0	0	0	0	0	0	11.2
Health	4	1	1	1	0	0	1	0	0	0	0	0	0	0	0	6.6
Safety	3	1	1	0	0	0	0	1	0	0	0	0	0	0	2	2.9
Shelter	2	1	2	2	0	0	0	0	0	0	0	0	0	0	1	4.7
Solid Waste	3	1	1	0	0	1	0	0	0	0	0	0	0	0	2	1.0
Tele-communication & innovation	1	0	4	2	0	0	1	0	0	0	0	0	0	0	0	14.0
Transportation	4	1	2	0	0	0	0	0	0	0	1	0	0	0	0	9.4
Urban Planning	5	1	1	0	0	1	0	0	0	0	0	0	0	0	0	2.9
Water & Sanitation	4	0	0	1	0	2	0	0	0	0	0	0	0	0	1	6.6

Lowest vote / weighted score — Highest vote / weighted score

* Some participants did not rank all sectors. These missing responses, or "no answers," have been identified and quantified in this and the following tables.

Use of Geospatial Data by Sector

Urban Planning and Environment were identified as the sectors where geospatial data is both most crucial and most extensively utilized.

Six out of eight participants identified Urban Planning as the sector that uses geospatial data the most. Following Urban Planning, the Environment and Transportation sectors were ranked as the second and third highest sectors with more usage of geospatial data,

Finance, Shelter, Telecommunication & Innovation, and Economy were identified as the sectors with the lowest usage of geospatial data. Even though the Solid Waste and Water Sanitation sectors are not placed in the lowest scores, the head of the Directorate of Physical and Land Use Planning at Kitengela Municipality and the municipal manager mentioned they expected these sectors to rank higher, because of their contribution to achieving county and municipal goals related to the Health sector.

Table 9. Ranking of Sectors by Geospatial Data Usage

SECTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	No answer *	Weighted Score
Economy	1	0	2	0	0	1	1	0	1	2	0	0	0	0	0	10.4
Education	1	0	0	2	2	0	0	0	1	0	0	0	0	1	1	8.6
Energy	2	1	0	0	2	1	0	0	0	0	0	0	0	1	1	6.6
Environment	3	1	1	1	0	0	1	0	0	0	0	0	0	0	1	2.8
Finance	0	1	0	1	0	0	0	2	0	0	0	0	1	2	1	14.0
Fire & Emergency Response	2	2	0	0	1	0	1	0	0	0	0	0	1	0	1	5.8
Health	3	1	0	2	0	0	2	0	0	0	0	0	0	0	0	4.8
Safety	3	1	1	0	0	0	1	0	0	0	0	0	1	0	1	5.1
Shelter	2	0	1	0	0	1	0	1	2	0	0	0	0	1	0	10.9
Solid Waste	4	0	0	0	0	1	1	1	0	0	0	1	0	0	0	7.4
Telecommunication & innovation	2	0	2	0	1	0	0	0	0	0	2	0	0	1	0	10.4
Transportation	4	2	0	0	1	0	0	0	0	0	1	0	0	0	0	4.1
Urban Planning	6	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1.0
Water & Sanitation	4	0	0	0	0	1	1	0	0	0	0	1	0	0	1	5.3

Lowest vote / weighted score — Highest vote / weighted score

* Some participants did not rank all sectors. These missing responses, or "no answers," have been identified and quantified in this and the following tables.

Use of Geospatial Data to Support Municipal and Sectoral Goals

When asked how geospatial data has been used to support sector development and municipal goals, approximately **60% of participants** reported using it for **urban and spatial planning,** this entails more **viable and sustainable solutions**. These participants mentioned that geospatial data can improve the development of policies and strategies to achieve the development goals of the city and the municipality. The head of the Directorate of Physical and Land Use Planning at Kitengela Municipality and the municipal manager agreed that urban planning is the most important usage.

Related to the above, 50% of participants indicated that geospatial data **supports evidence-based decision-making.** Spatial analysis through geospatial data allows the identification of gaps in the development of strategies for improvement.

Two participants indicated that geospatial data also has been used for the creation of revenue collection in terms of land rates and rents, up to date geospatial data can improve this revenue collection.

Table 10. Responses to GPS Question 4: How has geospatial data been used to support the development of the sectors and your city's goals?

Most repeated topics	Description
Urban planning	Planning and monitoring of development strategies, including suitability analysis to identify areas for urban infrastructure development within the city and the municipality.
Evidence-based decision-making	Evidence-based decision-making is possible starting with data collection for its further analysis, helping to identify gaps in the development of strategies for improvement.
Revenue collection and improvement	Two participants highlighted the role of geospatial data in the creation of revenue collection and the improvement of the existing revenue collection

Policies and Resources Needed to Enhance Geospatial Data Utilization

When asked about the policies and resources needed to improve the municipality's use of geospatial data, **approximately 60% of participants** highlighted the need for **data management policies and standards.** The participants emphasized that these policies need to be designed and implemented in all sectors, but mainly in the priority sectors based on the responses to the Geospatial Prioritization Survey questions.

Also, **60% of participants** highlighted the need for **financial resources destined for GIS-related activities such as data collection and maintenance.** Additionally, **60%** emphasized the **need for more software and hardware acquisition,** this includes a **GIS laboratory** or **systems for handling large amounts of geospatial data.** Following the same line, **one participant** mentioned the **need for geospatial security.**

50% of participants emphasized the importance of **capacity-building and training policies for geospatial data management,** including capacity-building opportunities for boards and staff. One participant believes as a part of the capacity building there is a need for the creation of awareness among the decision-makers on the importance of spatial data in decision-making processes.

Table 11. Responses to GPS Question 6: What policies and resources do you think are needed to improve the use of geospatial data in supporting the development of the sectors above in your city?

Most repeated topics	Description
Data management policies and standards	Participants emphasized that these policies need to be designed and implemented mainly in the priority sectors based on the responses to the Geospatial Prioritization Survey questions.
Financial resources	Financial resources destined for GIS-related activities such as data collection and maintenance.
Software and Hardware	This includes systems for handling large amounts of geospatial data. One participant mentioned the need for geospatial security, and two participants mentioned the creation of a GIS laboratory.
Capacity Building and training	Capacity-building and training policies for geospatial data management, One participant believes there is a need for the creation of awareness among the decision-makers on the importance of spatial data in decision-making processes

Anticipated Outcomes and Improvements from the Implementation of MSDI

When asked about the principal benefits and outcomes expected from implementing MSDI infrastructure, **50% of participants stated urban planning as a key improvement**, resulting from better sustainable and evidence-based decisions through greater availability of geospatial in all sectors evaluated in this survey. The Head of the Directorate of Physical and Land Use Planning and Kitengela's municipal manager agreed with this statement during the presentation of the results.

50% of participants anticipated geospatial data management improvements, this includes geospatial data collection, storage, and sharing among all sectors in the city and the

municipality. Additionally, this improvement could involve an increase in the number of datasets available and better control of these datasets translated into a dataset list or data repository.

Finally, **two participants** mentioned expected **improvements in municipal revenue collection and funds,** meanwhile, **one participant** highlighted an **increase in capacity-building** for the staff in the multiple sectors. Another participant believes that an expected outcome will be **collaborative and complementary efforts from different actors including non-governmental**.

Table 12. Responses to GPS Question 7: What specific outcomes or improvements do you anticipate across various sectors resulting from the consolidation of a Municipal Spatial Data Infrastructure?

Most repeated topics	Description
Better Urban Planning	Better urban planning entails better sustainable and evidence-based decisions through greater availability of geospatial in all sectors evaluated in this survey.
Data management	Improved GIS data collection, management, access, and dissemination across the departments at the city and municipal levels. This could involve an increase in the number of datasets.

Deep Dive Interviews

Methodology

Objective: The deep-dive interviews aim to develop a more thorough understanding of the baseline conditions of the MSDI - IPDS building blocks in the municipality.

What are the Deep Dive interviews:

The deep-dive interviews are organized around a series of questions categorized into key building blocks: institutional arrangements, people, data, and systems. Unlike previous surveys, these interviews feature more detailed and technical questions that encompass the entire data cycle process. Three distinct questionnaires were developed based on the MSDI Manual and the previous assessments and tailored to different target audiences. The interview guides are available in Annex IV. Each interview lasted approximately 30-45 minutes.

Afterward, the CAPSUS team reviewed the interview transcripts, comparing responses across different interviewees to identify common themes and divergent viewpoints.

Table 13. Questionnaires Used During Deep Dive Interviews

Questionnaire	Target Audience	Questionnaire Characteristics
Management and Strategic Staff	○ County Executive Committee Members ○ Municipal Managers ○ Assistant Directors ○ Non-technical department personnel	○ 18 main questions ○ 8 optional questions*
Technical Staff	○ GIS experts ○ Urban planners ○ Surveyors	○ 24 main questions ○ 18 optional questions* ○ It differed from the management staff questionnaire by including questions on the agency's analyses, software for geospatial data handling, and data acquisition methods.
Information and Communication	○ ICT personnel	○ 28 main questions ○ 12 optional questions*

Technology (ICT) Staff		○ It focused on systems-related aspects such as hardware maintenance, server features, web services, network characteristics, and security measures.

*Optional questions were asked at the interviewer's discretion.

Date conducted: Eight Interviews were conducted on June 10 2024 in Kitengela Municipality

Participants: Eight participants from Kitengela Municipality completed the one-on-one interview. The participants included the Kitengela Municipal Manager, County Director of Physical Planning, County Senior Physical Planner, Environmental Officers, Municipal Engineer and ICT Director. The full list of participants is available in Annex V.

Results

Planning & Identifying Data Needs

In all interviews, participants mentioned that the municipality does not have a list of Fundamental Datasets that they periodically maintain.

There is no budget allocated for geospatial information management at the municipal level. This was confirmed by both Kitengela's Municipal Manager, Kitengela's Environmental Officer, the Head of the Directorate of Physical and Land Use Planning at Kitengela Municipality, and Kajiado's Director of Physical Planning. However, Kajoado's Director of Physical Planning specified that Kajiado County does have a budget for Geospatial Information Management. The Kajiado County Integrated Development Plan 2023-2027 (KCIDP)includes a series of geospatial data policy strategies, such as developing a GIS-based County Land Information System to address issues of unapproved or outdated urban area land use and the need for updated urban area development plans (County Government of Kajiado 2023).

Additionally, the KCIDP's 2023-2027 sector priorities for Land and Physical Planning include:

- To improve the accuracy of survey data in Kajiado, a budget of 26 million Kshs has been allocated for the purchase of advanced survey equipment, including handheld GPS devices and Real-Time Kinematic (RTK) systems.
- To strengthen the accuracy and reliability of spatial data, Kajiado has allocated 150 million Kshs for the establishment of third- and fourth-order geodetic control networks.
- To establish a county land spatial data infrastructure Kajiado has allocated an 8 million Ksjs budget
- Finally, Kajiado has allocated a budget of 70 million Kshs for establishing a modern GIS lab.

This results in a total budget of 254 million Kshs over five years, averaging approximately 51 million Kshs per year. This is equivalent to 6% of the Kajiado County's Lands and Physical Planning Budget (County Government of Kajiado 2023). This is significant, as Kitengela is a very young municipality that relies on the county government for support during this transitional period. Resources allocated by the county towards spatial data management will also benefit Kitengela municipality. A direct example is Kitengela's staff's use of the county's current GIS lab.

In addition to support from Kajiado County, Kitengela funds its geospatial information management activities through donor contributions. The Head of the Directorate of Physical and Land Use Planning at Kitengela Municipality noted that donors are the primary source of funding due to a lack of central funding. This challenge in securing central funding is attributed to decision-makers' limited understanding of the importance of GIS data. Many decision-makers perceive GIS as merely a tool for producing maps and fail to recognize its critical role in informed decision-making.

Kitengela Municipality currently lacks a strategic plan for geospatial data management, as confirmed by all interviewees. However, the Head of the Directorate of Physical and Land Use Planning at Kitengela Municipality indicated that there is a data management plan at the county level. An example of this is the Land and Physical Planning sector's inclusion of a county land spatial data infrastructure in the KCIDP budget.

Although no other sector included geospatial information management in the Integrated Development Plan Budget, some sectors did mention data management activities as potential strategies. The General Economic & Commercial Affairs sector identified the lack of a legal data collection policy framework as a constraint to improving cooperatives and trade. The health sector highlighted increasing the availability, quality, demand, and utilization of data as a strategy to boost primary health services, a sector priority. Additionally, the Social Protection, Culture, and Recreation sector listed enhancing data collection and management as a strategy to improve care and support for vulnerable groups (County Government of Kajiado 2023).

None of these strategies distinguished spatial data from other types of data, but it can be inferred that the county has identified opportunities in data management and is making efforts to plan accordingly. Promoting data use for decision-making and enhancing the availability of data and county documents on the [county] website are mentioned as ways the county government would contribute towards assisting Kenya in reaching their International Council for Population Development (ICPD) 25 Kenya Commitments goal. This goal focuses on enhancing the capacity of relevant government institutions to increase the availability and accessibility of high-quality, timely, and reliable population and related data (County Government of Kajiado 2023).

Data management is also included in the KCIDP's cross-sectoral linkages as a means for sectors to contribute towards evidence-based policy formulation. The establishment of a central data repository and collection system, along with the operationalization of county statistics infrastructure, are listed as measures to mitigate the duplication of interventions, delayed reporting, and inadequate data.

Despite the numerous mentions of data in the KCIDP, the County Director of Physical Planning stated that data collection initiatives in the county are project-based. This means they only seek out data when it is needed for a specific project.

Data Acquisition

In Kitengela, much of the data used is obtained from various agencies, such as the State Department of Housing and Urban Development, the Ministry of Lands, and the Ministry of Roads. Kajiado County was also frequently mentioned as a data source. In some instances, as the creation of the integrated development plan Kitengela municipality works with both the state department and county planners.

There is no data catalog available for either Kitengela or Kajiado County. Municipal staff determine data availability by consulting with planners at the county GIS lab or the national government. If the required data is not available in the GIS lab, personnel must infer which agency possesses the data based on the relevant sector and partially available information. The lack of visibility on data availability has occasionally led to duplicate efforts. There are multiple examples of this. County Physical Planning personnel mentioned that in some cases, data is locally available, but because departments are unaware of this, they seek data from the national level. A senior physical planner noted that they collected land use data, only to later discover that the State Department of Housing and Urban Development had also collected the same data. Interviews indicate that duplication of data gathering is a common issue in Kenya, not just in Kitengela, contributing to inefficiency.

To obtain data from other government agencies, staff must submit formal data request letters via email. In some cases, data requests are denied, typically when the data is not publicly available or classified. For instance, certain forestry areas are classified due to encroachment concerns. When data is shared, it is typically sent via email or, if the data is too large, via a flash drive. If approved, participants reported receiving data from other government agencies within five working days. Interviewees cited bureaucracy and the lengthy data-sharing process as significant challenges to cooperation. During in-person workshops, all participants agreed on the necessity of both municipal and county data-sharing policies.

In addition to data from other government agencies, interviewees noted that the municipality utilizes open online sources primarily to supplement official data. The Regional Center for Mapping of Resources for Development was cited as a frequently used data source. Additionally, the municipality collaborates with neighborhood associations on sewage issues and engages with NGOs for data collection, such as e-waste data. The municipality has also partnered with professional associations, including the Surveyors of Kenya, Urban Planners, and the Council of Governors for data creation. Furthermore, there is an agreement with the Technical University of Kenya, and the municipality frequently engages with the private sector. Collaboration with the Land Governance Institute is also in place.

There was no consensus on the role of data collection within the municipality. An environmental officer and the Head of the Directorate of Physical and Land Use Planning at Kitengela

Municipality stated that some municipal data is obtained through in-house field data collection. However, another municipal environmental officer asserted that the municipality does not generate its own data. This discrepancy may stem from the close working relationship between the county and the municipality. Since the municipality relies on the county for GIS equipment, staff not directly involved in data collection may be uncertain about who is responsible for these activities.

When asked about equipment most interviewees stated that the municipality used handheld GPS devices or in some cases open source phone apps for data collection activities. Additionally, the same officer mentioned that the county uses satellite data, but that satellite imagery is not used by the municipality. In contrast, the Head of the Directorate of Physical and Land Use Planning noted the use of drones for obtaining imagery but did not mention satellite imagery. At the county level, county physical planners stated that data is generated by the county, obtained from other government agencies, and sourced from open data platforms.

Processing & Standardization

The Physical and Land Use Planning departments in both Kitengela and Kajiado are responsible for geospatial information management at the municipal and county levels, respectively. However, neither Kajiado nor Kitengela has Standard Operating Procedures (SOPs), frameworks, or guidelines related to geospatial data management. There are no data policies in place to ensure interoperability and implementation of standards, as confirmed by all interviewees.

Moreover, there are no designated personnel responsible for data quality assurance, including data cleaning and management. Metadata standards or guidelines are also absent. An environmental officer noted that it is rare for data to be shared with metadata. Of the 108 datasets shared with CAPSUS and included in Kitengela's data inventory, none contained information on temporal or spatial coverage, a description of the dataset, the source of information, or additional details. Only 40% of the data included georeferencing information.

The lack of data standardization poses challenges for collaboration among agencies regarding geospatial data sharing and use. Metadata elements help data users determine if a dataset meets their needs by understanding the quality, accuracy, spatial and temporal extent. An environmental officer mentioned that different individuals share data in various formats, leading to inconsistencies. A municipal engineer highlighted that having access to standardized metadata and data would greatly facilitate the department's work. Despite the absence of formal standards, participants in the in-person workshop noted that all departments adhere to professional standards. This suggests that, even without official regulations, the departments uphold a consistent level of professionalism and quality in their work.

Data Analysis

Only interviewees from the Physical and Land Use Planning Department reported that spatial analysis is being conducted by their municipality. Data analysis is performed using ArcGIS, R Studio, and Quantum GIS (QGIS). All analysis is conducted at the county GIS lab, funded by the FAO Digital Governance Program, and located at the county headquarters in Kajiado, about an hour's drive from Kitengela town. County personnel reported that if municipal personnel give notice, they clear a workstation in the lab for them. Municipal staff stated that they experience no issues with sharing the lab space, explaining that although they sometimes have to wait for county personnel to finish using a workstation, municipal staff often receives priority. Municipal staff reported going to the county lab around twice a week.

When asked further about the nature of the analysis, interviewees explained that the type of analysis is determined by the questions they aim to answer and their own professional expertise. However, a common use for GIS data is simply to identify the locations of various features.

Most interviewees highlighted the difficulty of renewing ArcGIS licenses since the current licenses, which had been donated, were expiring. Participants generally assessed the GIS skill level at Kitengela Municipality as intermediate, noting that only two personnel members possess GIS skills. At the county level, GIS skills in the Physical and Land Use Planning Department were rated as intermediate to advanced, with 13 personnel proficient in GIS.

The County Director of Physical Planning emphasized the crucial role of their cooperation with the FAO[12] [13]. This partnership not only facilitated the digitization of maps and data collection but also provided the county with computer equipment, software, and training for county staff. In addition to the training provided by the FAO, county physical planning personnel receive continuous GIS training, with all personnel receiving training at least once per year, and some staff pursuing their own online training. Most capacity building at the county level focuses on geospatial analysis, as they are already highly skilled in data collection.

This support has significantly enhanced the GIS skills of the physical planning department personnel, which has, in turn, benefited Kitengela Municipality. The county offers peer-to-peer learning opportunities to municipal staff whenever they use the county GIS lab.

Kitengela Municipality utilizes the county GIS lab, located at the County headquarters in Kajiado and funded by the FAO Digital Governance Program. However, Kitengela's own office is small and poorly equipped, with only individual laptops available, which participants have reported are inadequate for GIS activities.

[12] Since 2018, FAO has been instrumental in enhancing spatial data management in Kenya through a comprehensive program to digitize land records and establish a land management system. Their support includes digitizing land records, mutations, and maps; integrating textual and spatial data; updating survey records; creating original cadastral records as needed; and digitizing the registration process. FAO has also developed core Geospatial Information Systems (GIS) and provided capacity-building initiatives (Lydia 2021).

[13] In 2023, during the launch of the county's 2020-2030 Spatial Plan, FAO announced that it would provide a $30 million GIS laboratory for Kajiado County under its Land Governance program (Rayiani and Mwaniki 2023).

Table 14: Equipment Available in Kajiado County's GIS Laboratory

Equipment	Quantity
Workstations	6
Plotters/large format printers	1
Server	1
ArcGIS 10.2 concurrent licenses	6
Quantum GIS Software	Open source software
Handheld GPS hardware	Not specified

Aside from receiving assistance from the county's personnel, municipal staff report not having received any formal capacity-building and express a need for training in data collection, analysis, storage, and information dissemination. Both the municipal manager and the head of the Directorate of Physical and Land Use Planning at Kitengela Municipality emphasize the importance of providing training to municipal board members and decision-makers on the significance of GIS for informed decision-making.

In addition to training existing staff, interviewees agreed on the necessity of increasing the number of GIS-trained personnel at the municipality. This includes hiring individuals with degrees in cartography, geography, programming, or software development. It is important to note that Kitengela is a small and young municipality, which accounts for its current low staffing levels.

Data Storage

Data storage and risk management have not been prioritized at either the county or municipal levels. At the municipal level, this issue seems to stem from a reliance on county infrastructure. Interviewees from both levels reported issues with improperly stored data, leading to corrupt data files. Although data at the county GIS lab is backed up on a physical server every month, most data is stored on individual computers at both the county and municipal levels. Personnel from the municipal environmental department were unaware of the county server's existence. However, they reported sharing their geospatial data with the municipal GIS officer from the Department of Physical and Land Use Planning for storage. Municipal physical planners indicated that they store data on the County GIS lab computers. Given that the county director reported data being backed up on the server, and the ICT director confirmed monthly backups, it can be inferred that as long as personnel save data on the county GIS lab computers, it is backed up—even if municipal staff are unaware of this. The County Director of Physical

Planning expressed concerns about relying solely on an individual physical server for data storage and emphasized the need for a backup option. Some, but not all, interviewees reported backing up data on external drives.

There are no protection systems or protocols in place, and reliance is placed on personal responsibility, such as having personnel use passwords on their individual computers and avoiding the use of unknown external flash drives. Interviewees also reported the absence of a data inventory or catalog at both the municipal and county levels. The County Director of Physical Planning believes that the current process is insufficient and suggests that the ICT department should develop a data security policy.

Currently, neither the county nor the municipality has an ICT policy or any regulations that determine where servers should be stored and managed. Most server and workstation maintenance activities are conducted by county ICT personnel. Due to its small size and recent establishment, Kitengela Municipality does not have an ICT department and is supported by Kajiado County. Kajiado County has seven IT staff who provide regular support, although the municipality contracts an internet provider.

Some interviewees believe that investing in technology to enable data sharing among agencies and personnel at the municipality and county levels is essential. However, when discussing the possibility of creating a geoportal, they noted that improvements in storage space, hardware, and capacity building are necessary first. It was particularly mentioned that before creating a geoportal, the municipality must increase its current capacity, as "you cannot give people something they will not know how to use." This includes establishing policies and regulations to govern the geoportal's use and management.

Data Access & Dissemination

Kitengela's small municipal staff, along with the clear role of the Directorate of Physical and Land Use Planning in managing geospatial data, ensures that most municipal geospatial information is given to the municipal planners and stored in the county GIS lab. This arrangement allows county personnel from the Department of Physical Planning access to this information. However, there is no evidence of additional efforts to disseminate data. Physical planners reported sharing data with other agencies only after receiving a formal written request via letter, which aligns with the procedure for acquiring data from other government agencies at both the county and national levels. Kitengela and Kajiado maintain websites managed with support from the ICT department. The ICT department contacts other departments to obtain summarized information for updates. While data itself is not published on either Kitengela Municipality or Kajiado’s websites, Kitengela Municipality's website does publish county reports that impact the municipality.

All interviewees indicated that their agency does not apply a usage license to the data and maps they produce. Furthermore, there was no indication that departments charge other government agencies for sharing digital records. However, the head of the Directorate of Physical and Land Use Planning at Kitengela Municipality mentioned that they do charge for

sharing physical data. Kenya's 2010 Constitution guarantees citizens the right to access information held by the State and requires the State to publish important information. The County Governments Act highlights that citizen participation relies on timely access to information and data, reinforcing the right to obtain county government information. County legislation may charge reasonable fees for accessing this information. Additionally, the Urban Areas and Cities Act mandates that municipal boards maintain a comprehensive database and provide public access, potentially subject to a nominal fee. If providing information incurs expenses, a citizen's request for information may also be subject to a reasonable fee.

Key Takeaways

Institutional Arrangements Capacity Assessment

Data governance policies and protocols

Currently, there are no policies related to open data, data management, or data sharing at the county or municipal levels. Additionally, there are no standard operating procedures (SOPs), frameworks, guidelines, or strategic plans for geospatial data management.

Neither Kitengela nor Kajiado County have an established data governance policy. Kitengela, being a small and relatively new municipality with a recently formed board (established in 2023), has limited personnel. Spatial data management is handled by the Directorate of Physical and Land Use Planning at Kitengela Municipality, with additional support from physical planners at Kajiado County's Department of Physical Planning.

Currently, there are no planned spatial data activities; instead, departments determine their data needs on a project-by-project basis. The lack of data catalogs or dissemination activities at both the municipal and county levels means that personnel must identify data availability by consulting with planners at the county GIS lab or the national government. They often need to request specific datasets from other county departments or agencies, which can lead to redundant data acquisition efforts. A senior physical planner noted that it is common for communities to collect data for local plans but fail to share it with the County.

The lack of formal policies and coordination in data management at both county and municipal levels has led to inefficiencies and redundant data acquisition efforts in Kitengela and Kajiado County. Without clear guidelines, spatial data management remains fragmented, hindering effective planning and decision-making. A comprehensive data governance policy could resolve these issues by improving processes, data sharing, and overall efficiency.

Data Sharing

Internal data sharing

Participants report collaborating with other agencies to facilitate data collection and planning. However, the lack of standardized procedures hampers these efforts. Accessing data requires a formal request via email, and data is mainly shared with Kajiado County personnel through email or local drives. Although data is generally shared freely, it must first be requested officially. Challenges in internal data sharing include the use of inconsistent data formats.

External data sharing

The municipality typically does not share data with government agencies (county or national) unless a formal request is received or collaboration is required. For instance, the municipal environmental officer shares internal Environmental Impact Assessment Reports with the National Environmental Management Authority (NEMA) for approval. Additionally, municipal GIS-based planning, such as the Integrated Development Plan, is coordinated with both county and national levels by working together with county planners and the state department. Due to the close relationship with county planners and the use of the county's GIS lab, Kitengela Municipality staff benefit from access to county data.

No specific restrictions on data sharing with government agencies were mentioned, and interviewees did not reference any data-sharing laws or regulations. Municipal personnel reported requesting information from county and national agencies, such as the State Department for Housing and Urban Development (SDHUD), with whom they have a formal data-sharing arrangement. Despite this, data is still provided upon request via formal emails. Data received from national agencies typically takes about five working days. However, due to Kitengela's proximity to Nairobi, officials have occasionally visited state department offices in person with a flash drive to collect data after the request had been sent. It was noted that not all institutions share data, especially if it has not been made public. The lack of formal arrangements and communication procedures between the municipality and national agencies was identified as a challenge to effective data sharing.

The municipality has engaged with local universities and organizations for data collection. For example, the FAO has assisted Kajiado County with map digitalization, and the environmental officer has contacted the Digital Center for Southern and Eastern Africa for data acquisition. Kajiado County also has an agreement with the Technical University of Kenya (TUK), where students conduct research for the county. Additionally, the county collaborates with professional associations, such as surveyors and urban planners, as well as the Council of Governors to obtain and share data.
In Kitengela, collaborations include working with neighborhood associations on sewage issues and NGOs for e-waste data collection. Most of these collaborations are formalized through Memorandums of Understanding (MoUs). Participants noted that Kitengela benefits from strong and capable neighborhood associations that support and complement the municipality's functions.
Kajiado County has hired external consultants for technical data collection, including operating drones for aerial photography to gather information on informal settlements and built-up areas. The county also partnered with a national consultancy, Geomaps, to develop its spatial plan due to the extensive scope of the work required. Kajiado County's use of external consultants and technical partnerships underscores the need for specialized expertise in managing complex spatial data, enhancing the county's planning capabilities.

Strengths, Gaps, and Challenges

Strengths

- Centralized Information: Spatial data management is primarily handled by the Directorate of Physical and Land Use Planning at Kitengela Municipality. This structure

largely prevents overlap in roles and responsibilities related to municipal geospatial information.

- Support from County: Kitengela benefits from support provided by physical planners at Kajiado County's Department of Physical Planning, enhancing expertise and resources at the municipal level.
- Formalized Collaborations: Most collaborations with external organizations are formalized through Memorandums of Understanding (MoUs), ensuring clear agreements and expectations.
- Community Engagement: Kitengela benefits from strong neighborhood associations that actively support municipal functions and contribute to data collection efforts.

Gaps:

- No Data Governance, guidelines Policies, SOPs, or Guidelines: There are no established data governance policies or protocols for open data, data management, or data sharing at the municipal or county levels. The lack of standard operating procedures (SOPs), frameworks, and strategic plans for geospatial data management creates inconsistencies and inefficiencies.
- Reactive Data Management: Spatial data activities are not planned but rather addressed on a project-by-project basis, leading to a reactive approach.
- Lack of Data Catalogs: The absence of data catalogs or dissemination activities complicates the process of identifying and accessing available data.
- Inconsistent Data Formats: Challenges in internal data sharing include the use of inconsistent data formats, which complicates data integration and use.
- Limited External Data Sharing: The municipality typically does not share data with government agencies unless a formal request is received, hindering data accessibility and collaboration.
- Unclear Data-Sharing Procedures: The lack of formal arrangements and communication procedures between the municipality and national agencies affects effective data sharing and coordination.

People Capacity Assessment

Awareness of the value of geospatial data infrastructure and the use of geospatial data

Kitengela municipal personnel, including the municipal manager, show a strong appreciation for the value of geospatial data. However, the technical capacity to fully leverage this data is still developing, with only the physical planners possessing average to advanced GIS skills. Decision-makers, particularly board members, have a limited understanding of the importance of GIS data. Many perceive GIS merely as a tool for producing maps, overlooking its critical role in informed decision-making. This misconception often leads to inadequate funding for spatial data acquisition and management. While there is recognition of the value of geospatial data within

the municipality, the lack of technical skills and understanding among key decision-makers hinders the effective utilization and proper funding of GIS resources.

Availability of sustained and skilled workforce

Kitengela Municipality has a lean staff consisting of an urban planner, a planner/GIS expert, a surveyor, three environmental officers, an engineer, a public participation officer, a municipal manager, procurement, human resources, administrative work, fire officers, accountant,s and support staff. Of these, only the urban planner and the GIS expert are considered GIS specialists, while the environmental expert has some basic GIS experience. Kajiado County's Department of Physical Planning employs 13 staff members with GIS knowledge. According to the county director of physical planning, all county departments use GIS, and each department has at least one staff member with spatial data management skills and working knowledge of GIS.

While Kitengela Municipality receives support from Kajiado County staff, particularly from the Department of Physical Planning, it was reported that the current staff is insufficient. There is a need for additional personnel with skills in cartography, geography, or data analysis. Although Kitengela Municipality benefits from support from Kajiado County, the limited number of GIS specialists and overall staff capacity remain challenges. Expanding the team with personnel skilled in cartography, geography, and data analysis is crucial to address the growing demands of spatial data management and enhance the municipality's operational effectiveness.

Relevant GIS knowledge and skills among Kitengela’s human resources

The physical planners are perceived to have intermediate to advanced GIS skills, and the GIS expert is currently pursuing a master’s degree in GIS and remote sensing. Both have formal training in GIS.

Participants have identified several technical skill gaps and believe that the municipality would benefit from additional training. Specifically, urban planners need deeper technical training on GIS software, while the rest of the staff would benefit from basic GIS training, including data collection, analysis, and storage. There is also a need for capacity building on the importance of spatial data for board members. Given that the municipality is still relatively new, there have been no formal capacity-building initiatives for data or GIS analysis thus far. However, physical planners gain some benefit from peer-to-peer learning from county planners at the county GIS lab.

Kajiado County staff participate in yearly training programs, which focus primarily on data analysis, as county personnel are already skilled in data collection. There is a desire for additional capacity-building in drone use. County staff has also benefited from the training provided by the FAO, which helped enhance their GIS skills. Additionally, some Kajiado staff have taken the initiative to pursue additional training in remote sensing independently. Kitengela Municipality has staff with GIS skills, but technical gaps remain, particularly among urban planners and other personnel. While peer-to-peer learning with Kajiado County offers some support, formal training programs are needed to enhance GIS proficiency and improve spatial data management.

Strengths and Gaps

Strengths:

- Strong Appreciation for Geospatial Data: Kitengela municipal technical personnel, and the municipal manager, demonstrate a strong understanding of the value of geospatial data.
- GIS Expertise in Key Roles: The urban planner and GIS expert are considered GIS specialists with formal GIS training. Their skills include data collection, and the use of GIS software such as ArcPro and Rstudio.
- Support from County Staff: Kitengela benefits from support and expertise provided by Kajiado County staff, particularly from the Department of Physical Planning through peer-to-peer learning.
- Recognition of Skill Gaps: There is awareness among participants of the need for additional training and skills development in GIS
- Collaborations with Educational Institutions: Kajiado's partnership with the Technical University of Kenya (TUK) and Kitengela's relationship with the African University can be leveraged for training and capacity building.

Gaps:

- Limited Technical Capacity: The technical capacity to fully leverage geospatial data is still developing, with only average GIS skills among physical planners.
- Limited GIS Awareness Among Decision-Makers: Decision-makers, particularly board members, have a limited understanding of the importance of GIS data, The misconception that GIS is merely a tool for producing maps results in inadequate funding for spatial data acquisition and management.
- Insufficient Staffing: Kitengela Municipality's lean staff, with limited GIS expertise, is insufficient to meet all spatial data management needs. There is a need for additional personnel with skills in cartography, geography, or data analysis.
- No Formal Capacity Building: The municipality has not yet implemented formal capacity-building initiatives for data or GIS analysis.

Data Capacity Assessment

Data management and standards

Kitengela Municipality and Kajiado County currently lack standard operating procedures (SOPs), frameworks, guidelines, or strategic plans for managing geospatial data. Although Kajiado County personnel have operational rules in place, they do not view the absence of a formal data policy or the lack of standardized procedures as a significant issue. This absence affects all aspects of data management, including data sharing, collection, and storage.

Data management practices are inconsistent. Data is often stored on individual computers or county GIS lab workstations, and some participants report backing up their data on external drives, albeit without formal policies or procedures. Issues with data corruption have arisen due to improper storage practices. Although GIS workstations are backed up on the lab server, and the ICT department performs monthly server backups, there are concerns about the reliability of

relying solely on a single physical server for data storage. The absence of formal policies and standardized procedures for geospatial data management in Kitengela Municipality and Kajiado County leads to inconsistencies and risks in data handling.

Availability of spatial datasets and Fundamental data

The municipality does not maintain a comprehensive list of fundamental datasets. Instead, needed spatial data, such as land use data, is identified based on specific project requirements such as the Integrated Urban Development Plan.

Data collection is managed through various channels: by different departments, external consultants, partnerships with organizations, or through requests to county and state agencies based on project needs. There are no established procedures for updating data, leading to issues such as outdated information; for instance, the road map used is five years old.

Of the 108 data files shared with CAPSUS consultants, none included metadata such as publish date, modification date, or update frequency (see Annex III which includes a sample of the Available Municipal Dataset). While all files were in a spatial format and could be accessed by consultants, key datasets like topographic data (Digital Elevation Models), population distribution, hazard risk zones, temperature, and precipitation information were notably absent. However, the draft report for Kitengela's Integrated Strategic Urban Development Plan, prepared by Vision R consultants, indicates that some of these datasets, including elevation maps, precipitation distribution, and soil typology, may exist. It is unclear whether the municipality can access this data or if it was transferred to Kajiado County after the project's completion.

Participants highlighted a critical need for updated data on land use, a complete cadaster, updated road networks, and satellite imagery—datasets currently unavailable to them. Additionally, there is a need for an integrated service delivery system for automated municipal revenue collection. Kitengela Municipality's fragmented data collection process and lack of formalized procedures for updating datasets have resulted in outdated and incomplete spatial information. Addressing these gaps by formalizing data management practices and ensuring access to key datasets will be essential for improving planning and municipal functions.

Strengths and Opportunities

Strengths:

- GIS Workstation Backups: GIS workstations are backed up to a server located in the county lab
- Existing Data Collection Efforts: Various departments and external consultants are actively involved in data collection, showing an ongoing effort to gather spatial information.
- Existing Data on File: Despite issues, there is a repository of spatial data files available for use and analysis in the county GIS lab workstations.

Gaps:

- Lack of SOPs and Guidelines: There are no standard operating procedures (SOPs), frameworks, or guidelines for managing geospatial data.
- Inconsistent Data Management Practices: Data management practices are inconsistent, with data often stored on individual computers or external drives without formal policies.
- No Established Data Update Procedures: There are no established procedures for updating data, leading to issues like outdated information.
- Absence of Metadata: None of the 108 data files shared with CAPSUS consultants included metadata, such as publish date or update frequency.
- Missing Key Datasets: Essential datasets, such as topographic data, population distribution, and hazard risk zones, are notably absent.
- Concerns About Data Storage Reliability: There are concerns about the reliability of relying solely on a single physical server for data storage.
- Lack of Comprehensive Dataset List: The municipality does not maintain a comprehensive list of fundamental datasets, relying instead on project-specific data identification, such as land use data for development plans.

Systems Capacity Assessment

Availability of spatial software and hardware

GIS software assessment

The municipality does not have its own GIS software and instead relies on the software available at Kajiado County's GIS Lab, which includes ArcGIS 10.2. In addition to ArcGIS, both physical planners use QGIS and R Studio for spatial data analysis tasks. One physical planner has learned to program in R through online courses. The municipal engineer primarily uses AutoCAD software but reports that the current computers are not powerful enough to run AutoCAD without frequent crashes.

Participants noted that challenges with ArcGIS include a lack of access to additional features, such as 3D analysis, which are only available with an ArcGIS Pro license. Budget constraints for software remain a significant issue for both Kitengela Municipality and Kajiado County. The current ArcGIS licenses, provided by the FAO, do not include budget provisions for renewal or upgrades.

Municipal personnel use unspecified GPS software and phone applications for data collection, likely relying on popular open-source platforms such as ODK or KoboCollect. Challenges reported include the cost of licenses, poor network connectivity, outdated professional equipment, and the need to use specific workstations to access GPS software. Kitengela Municipality's dependence on Kajiado County's GIS software and budget constraints restrict access to advanced features and impede effective spatial data analysis. Promoting the use of open-source software and providing enhanced training are essential steps to advance geospatial data management and analysis.

GIS hardware assessment

Kitengela Municipality operates from a small, inadequately equipped office. Personnel use individual laptops, which are maintained by the county ICT department. When needed,

Kitengela's physical planners access Kajiado County's GIS Lab, which features six workstations, a large-format printer, and a local server for data storage. The server is backed up to local drives monthly by the county ICT department. Kajiado County lacks a fixed budget for hardware, and workstations and personal laptops are updated approximately every three years, contingent on available funding.

Both municipal and county personnel use GPS handheld devices and mobile phones for data collection. Kajiado County benefits from a 100 Mbps internet connection, while Kitengela Municipality has a secure connection provided by an internet service provider that also offers network maintenance. However, most participants reported unreliable internet access and slow network speeds, with issues attributed to delayed payments for services. Kitengela Municipality's reliance on Kajiado County's GIS Lab and limited resources reveal a critical need for improved infrastructure. Challenges with outdated facilities, infrequent hardware updates, and unreliable internet highlight the necessity for better funding, regular equipment upgrades, and dependable service contracts to improve data management and municipal efficiency.

Availability of supporting ICT services

Kitengela Municipality lacks a dedicated ICT administrator or staff. Instead, it relies on support from Kajiado County's ICT department, which is staffed by seven technicians. This support includes hardware and software maintenance, troubleshooting, and monthly maintenance of the county's GIS lab server, including server data backups to an external hard disk. The county ICT staff are also responsible for maintaining and updating the county webpage, which, while not offering data, publishes municipal planning documents and policies from various departments.

Kitengela Municipality has contracted an external vendor to develop its webpage where they publish reports and publications. Given Kitengela's current limited hardware and software, it is understandable that the municipality does not have a dedicated ICT department. However, as the municipality's systems and capacity grow, establishing an internal ICT department will become essential.

Strengths and Gaps

Strength

- Access to Kajiado County's GIS Lab: Kitengela Municipality benefits from access to ArcGIS 10.2, QGIS, and R Studio through Kajiado County's GIS Lab, enabling a range of spatial data analysis tasks.
- External ICT Support: Kitengela Municipality receives comprehensive ICT support from Kajiado County's ICT department, including hardware and software maintenance, troubleshooting, and web page management.
- Data Collection Tools: Both municipal and county personnel use GPS handheld devices and mobile phones for data collection, which enhances field data gathering capabilities.
- Webpage Development: Kitengela has contracted an external vendor to develop its webpage, potentially improving the accessibility of municipal information. Currently, the website publishes municipal news, acts, and regulations, and provides service application forms, including those for development permissions.

Gaps:

- Inadequate Hardware: Kitengela's small office is inadequately equipped, with individual laptops that are not suitable for demanding GIS tasks and AutoCAD software.
- Budget Constraints: Both Kitengela Municipality and Kajiado County face budget constraints for software and hardware, with no provision for renewing or upgrading ArcGIS licenses.
- Unreliable Internet Access: Kitengela Municipality experiences unreliable internet access and slow network speeds due to delayed payments for services, impacting data collection and communication.
- No Dedicated ICT Personnel: Kitengela lacks a dedicated ICT administrator or staff, relying entirely on support from Kajiado County's ICT department for all ICT needs.

The assessment of Kitengela Municipality's key areas of intervention reveals several critical strengths and gaps across the four pillars of institutional arrangements, data governance, people capacity, and systems capacity.

Institutional Arrangements: Kitengela Municipality and Kajiado County currently lack comprehensive data governance policies and protocols, which results in fragmented and inefficient data management. The municipality's reliance on informal data sharing and inconsistent internal practices further exacerbates these challenges. The need for a formalized data governance policy is crucial to address inefficiencies and promote effective data sharing and management.

People: Kitengela Municipality benefits from a strong appreciation for geospatial data among its personnel and support from Kajiado County. However, technical capacity remains limited, with a need for additional GIS training and a better understanding of GIS's strategic importance among decision-makers. The current staff levels are insufficient to meet the growing demands for spatial data management.

Data: The assessment of data management in Kitengela Municipality reveals key gaps and opportunities, including a lack of standardized procedures, formal policies, and consistent data updates. Current issues like inconsistent storage and missing metadata exacerbate these problems. However, existing GIS backups, ongoing data collection, and a spatial data repository offer a foundation for improvement. To address these gaps, it's crucial to implement SOPs, formalize data updating processes, and include metadata in datasets while expanding the dataset repository and enhancing data storage solutions. These steps will improve data reliability, support better planning, and enhance municipal operations.

Systems Capacity: The municipality's dependence on Kajiado County's GIS Lab and limited office resources highlight the need for improved infrastructure. Challenges include outdated hardware, budget constraints, and unreliable internet access. To optimize data management

and enhance municipal operations, Kitengela Municipality must invest in better infrastructure, and regular equipment upgrades, and potentially establish its own ICT department.

In summary, addressing these gaps through enhanced data governance, investment in infrastructure and training, and improving internal systems will be essential for Kitengela Municipality to effectively manage and utilize spatial data, leading to better planning and decision-making.

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Annex I: Rapid MSDI Readiness Assessment format

Rapid MSDI Readiness Assessment

Name: _____

Agency: _____

Email: _____ Phone: _____

Please rate the level of implementation of each variable in your agency, by ticking ✔ the relevant box for each variable.

FACTOR	VARIABLE	VERY LOW	LOW	AVERAGE	HIGH	VERY HIGH
INSTITUTIONAL ARRANGEMENTS	Government central funding					
	Data policy aimed to return on investment					
	Private sector and academia involvement					
	Legal framework from SDI strategy and access to information					
PEOPLE	Human capital					
	Spatial data education					
	Individual leadership					
DATA	Digital cartography availability					
	Metadata availability					
	Data standards					
SYSTEMS	Web connectivity and telecommunication infrastructure					
	Access to web mapping					
	Geospatial software					
	Own development / open source					

Annex II: Geospatial Prioritization Survey format

Geospatial Prioritization Survey

The survey aims to measure current performance of city services and quality of life. Indicators cover broad sectors of urban services and are underpinned by an integrated approach to sustainable development and resilience. They aim to help city senior management and urban planners track progress on city performance and set appropriate targets. The sectors used in the survey are described here.

SECTOR	DESCRIPTION
Economy	Economic health and manpower, such as employment rate, poverty rate.
Education	Educational opportunities, such as student enrolment, student/teacher ratio, completion of primary and secondary education, prevalence of higher education degrees.
Energy	Efficiency of electricity production and consumption, such as electrical energy use per capita, use of renewable sources.
Environment	Environmental quality and biodiversity conservation, such as atmospheric concentrations of Particulate Matter, noise pollution, health of native species.
Finance	Financial management, such as debt service ratio, capital spending, own-source revenue as a percentage of total revenues.
Fire & Emergency Response	Provision of fire and emergency services, such as prevalence of firefighters, response time for emergency services.
Health	Provision of healthcare services and general health of the population, such as access to healthcare services, average life expectancy, infant mortality rate.
Safety	Law enforcement, such as crime rate, prevalence of police officers, response time from police department.
Shelter	Provision of housing, such as access to formal housing, registration of legal titles for households.
Solid Waste	Solid waste collection, such as access to solid waste collection services, recycling rate.
Telecommunication & innovation	Telecommunications services and connectivity, such as access to Internet and cell-phone connections.
Transportation	Provision of transportation services, such as rail network, car ownership, availability of bicycle lanes.
Urban Planning	Urban planning, such as land use planning, prevalence of green areas.
Water & Sanitation	Wastewater collection, water supply service and sanitation facilities such as sewer system, access to potable water, wastewater treatment.

Geospatial Prioritization Survey

Name: _____ Agency: _____

Email: _____ Phone: _____

1 Please rank the **level of development** of the following sectors for your city with "1" representing the highest level of development.

[For example, if Economy has the highest level of development in your city, and Water and Sanitation has the lowest, they shall be ranked "1" and "14" respectively. Please tick the box of the respective rank of each sector.]

SECTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Economy														
Education														
Energy														
Environment														
Finance														
Fire & Emergency Response														
Health														
Safety														
Shelter														
Solid Waste														
Telecommunication & innovation														
Transportation														
Urban Planning														
Water & Sanitation														

Geospatial Prioritization Survey

(2) Please rank the following sectors in terms of their **relative importance to your city's overall development goals,** with "1" representing the highest level of importance.

[For example, if Economy has the highest level of importance in your city, and Water and Sanitation has the lowest, they shall be ranked "1" and "14" respectively. Please tick the box of the respective rank of each sector.]

SECTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Economy														
Education														
Energy														
Environment														
Finance														
Fire & Emergency Response														
Health														
Safety														
Shelter														
Solid Waste														
Telecommunication & innovation														
Transportation														
Urban Planning														
Water & Sanitation														

Geospatial Prioritization Survey

3 Please rank the **importance of geospatial data for supporting the development** of the following sectors, relative to one another, with "1" representing the highest level of importance.

[For example, if geospatial data is most important for supporting Economy, and least important for supporting Water and sanitation, they shall be ranked "1" and "14" respectively. Please tick the box of the respective rank of each sector.]

SECTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Economy														
Education														
Energy														
Environment														
Finance														
Fire & Emergency Response														
Health														
Safety														
Shelter														
Solid Waste														
Telecommunication & innovation														
Transportation														
Urban Planning														
Water & Sanitation														

Geospatial Prioritization Survey

4 How has geospatial data been used to support the development of the sectors above and your city's goals?

5 Please rank the **level of use of geospatial data in the following sectors** within your city, relative to one another, with "1" representing the highest level of use.

[For example, if Economy has the highest level of use of geospatial data in your city, and Water and Sanitation has the lowest, they shall be ranked "1" and "14" respectively. Please tick the box of the respective rank of each sector.]

SECTOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Economy														
Education														
Energy														
Environment														
Finance														
Fire & Emergency Response														
Health														
Safety														
Shelter														
Solid Waste														
Telecommunication & innovation														
Transportation														
Urban Planning														
Water & Sanitation														

Geospatial Prioritization Survey

6 What policies and resources do you think are needed to improve the use of geospatial data in supporting the development of the sectors above in your city?

7 What specific outcomes or improvements do you anticipate across various sectors resulting from the consolidation of a Municipal Spatial Data Infrastructure?

Annex III:Sample of Available Municipal Dataset

Recommended Fundamental Spatial Datasets for Urban Development Planning and Their Availability (Based on the National Spatial Plan, County Spatial Planning Guidelines, and Example County Spatial Plan Format).

Suggested Fundamental Dataset	Datasets Available in the Municipality	Included in Kitengela's data inventory	Year	Alternative Third-Party Information Sources
Administrative boundaries	Administrative boundaries	Yes	Not specified	Humanitarian Data Exchange
Digital Elevation Model	Not available			
Population distribution	Not available			GHSL - Global Human Settlement Layer
Population density	Not available			WorldPop
Land Cover classification	Land use classification	Yes	Not specified	Copernicus
Cadaster	Cadastre	Yes	Not specified	
Employment areas	Not available			
Agriculture land	Included in the land use file	Yes	Not specified	
Tourism attraction sites	Not available			
Mining sites	Not available			
Industrial zones	Not available			Open Street Maps
Markets location	Not available			
Roads network	Roads network	Yes	Not specified	
Transport lines	Railway line	Yes	Not specified	Open Street Maps
Transport stations	Not available			Open Street Maps

Airports location	Not available			Open Street Maps
Traffic and parking	Not available			Open Street Maps
Street lighting	Street lights location	Yes	Not specified	Open Street Maps
Energy sources	Power plants location	Yes	Not specified	
Education facilities	Schools location	Yes	Not specified	
Health facilities	Health facilities location	Yes	Not specified	
Cultural facilities	Not available			Open Street Maps
Religious facilities	Not available			Open Street Maps
Security facilities, courts, prisons	Not available			Open Street Maps
Recreation facilities (Social halls, stadia, theatres, community playgrounds, etc.)	Playing fields location	Yes	Not specified	Open Street Maps
Public spaces (parks, picnic sites)	Not available			Open Street Maps
Community facilities	Culvert location, water points locations, powerline location,	Yes	Not specified	Open Street Maps
Built-up surface	Not available			Open Street Maps
Urban footprint	Buildings under construction location, semi-permanent buildings location, and permanent buildings location	Yes	Not specified	Open Street Maps
Rural settlements	Not available			GHSL - Global Human Settlement Layer
Informal settlements	Not available			WorldPop
House typologies	Not available			
Natural resources distribution	Not available			
Water bodies	Tributary rivers, ponds location	Yes	Not specified	
Forestry	Not available			
Soils	Not available			Open Street Maps
Vegetation	Thicket, hedges, treeline location	Yes	Not specified	Open Street Maps
Average Annual Rainfall	Not available			

Average Annual Land Surface Temperature	Not available			Open Street Maps
Climate Zones	Not available			ArcGIS Hub
Air pollution concentration	Not available			Google Earth Engine Data Catalog
Conservation zones	Not available			
Hazards prone areas	Not available			
Location of solid waste management infrastructure	Not available			
Location of liquid waste management infrastructure	Not available			Global Facility for Disaster Reduction and Recovery
Sanitation services location	Not available			

Annex IV: Deep Dive Interviews format

Interview For Technical Staff

Institutional Arrangements

1. At the municipal level, who is in charge of Geospatial information management?

2. Is there a standard operating procedure, framework, guidelines, or strategic plan for geospatial data management? This could include data collection, data analysis, data processing, etc. If yes, who is responsible for quality assurance, and what metadata schema is used?
3. Do you have a working relationship with National level government agencies, local universities, other agencies within the municipality, and/ or private sector organizations to obtain or share data with? If yes, please give the agency names, a description of the cooperation (extent of data sharing), and how data is shared. Is there a formal cooperation protocol?
4. What are the challenges for achieving collaboration among agencies for data sharing and use of geospatial data? (e.g. lack of knowledge of available data or information, access to information, files, or databases)
5. What are the key investments needed/made in technological infrastructure and data and is central funding available to support these investments?
6. How could your organization better support the utilization of spatial data?

People

7. Describe the level of GIS skills and experience possessed by your personnel in general (basic/intermediate/advanced).
8. How many permanent data / GIS specialists do you have in your department and do they have a formal education background in Geography / Surveying / GIS / Cartography / Urban Planning?
9. Do you have in-house developers? If yes, what are their skills (software, database, scripting)?
10. Are there any capacity-building initiatives for data and/or GIS analysis in the municipality?
11. Please identify any additional skills that municipal personnel may require to aid in data management.
12. Is there a designated person who curates data and maps?

Data

13. Give a brief description of the data that your agency possesses, this includes how the data and metadata are stored (cloud, server, workstation, external hard drive, CD, DVD, paper, etc.), and if the data is shared with other agencies or published.
14. What geodata does your department produce or maintain? Are there any other imagery datasets (similar to yours) collected and maintained by different agencies in the municipality that could be considered a duplication of effort?
15. How do you obtain data? Is any of it produced by your agency, obtained from other agencies, or obtained through secondary sources? If it is produced by the agency, is data collected in the field? Does the agency use external data/layer web services for GIS work?
16. How do you find out what kind of GIS data is available in your municipality, or from county and national governments?
17. What data does the agency not have access to that could make its work easier or better?
18. What datasets would benefit the agency most in completing its tasks?
19. Please describe the spatial analyses that your agency currently uses.

Systems

20. Please list the software used for spatial data collection, maintenance, dissemination, processing, and analysis and the difficulties associated with each task.

Task	Software(s)	Challenges[14]
Spatial Data Collection		
Spatial Data Processing		
Spatial Data Analysis		
Spatial Data Dissemination		

21. Do you use web services (e.g. WMS, WFS)?
22. Are there any customized software/applications that are used for processes in the agency?

Hardware

23. Do the workstations currently used in your agency meet your needs? Please provide details on the amount and characteristics of current and needed workstations

[14] Examples include lack of licenses, poor/slow internet connection, lack of hard disk space, lack of memory, and antiquated computers

24. What hardware is available that allows for the geo-tagging of data? Does your agency have access to, or own, GPS equipment?

Network

25. Are you able to access the internet when needed? Is the connection fast enough? Is the connection reliable? If not, please describe the problem (speed, reliability, etc.

Geoportal

26. What needs to be in place for the municipality to develop a Geoportal?

Optional questions (People)

- What is the level of awareness of and support for geospatial implementation in your agency?

Optional questions (Data)

- Is the spatial information/data needed for your work easily accessible? How do you access the data?
- How do agencies request data from each other? Can you access the data through a network from a server / another workstation or do you need to approach someone to get a paper map / copy on USB?
- Are there policies to ensure interoperability and implementation of standards?
- Is satellite imagery available for your city, if yes from which satellite was the imagery acquired and when (year)?
- What data exists in other forms (tabular, paper maps, AutoCAD, etc.) that could be converted to GIS data?
- What data/information that the agency produces would benefit other agencies the most?
- In your opinion, how could data infrastructure in the city be improved?

Optional questions (Systems: Software)

- Does your agency have its own web services? If yes, please list the services.

Optional questions (Systems: Hardware)

- Are all workstations used for similar tasks, or are certain workstations used for unique processes?
- Does your agency have access to additional government or city servers?
- Are there power outages at the office? How does this impact your daily tasks?

Optional questions (Systems: Geoportal)

- Which geospatial datasets would you like to add to a geoportal first? Why?
- How do you think a geoportal can provide geospatial information to the public? What tools and functions are needed?
- How can we integrate crowd-sourced data from the public or private sector data? How can we control data quality?

Interview For Management/ Strategic Staff

Institutional Arrangements

1. At the municipal level, who is in charge of Geospatial information management?
2. Do municipal agencies cooperate with each other in data sharing and geospatial data management? If so, please give the agency names and a short description of the nature of cooperation for each agency (e.g. extent of data sharing, etc.)
3. Do you have a working relationship with National level government agencies, local universities, and/ or private sector organizations to obtain or share data with? If yes, how is data shared, is there a formal cooperation protocol?
4. Is there a budget allocated for municipal geospatial information management? This includes data collection, capacity building, hardware acquisition, software acquisition, IT maintenance, and acquisition.
5. What are the challenges of achieving collaboration among agencies for data sharing and innovative use of geospatial data? (e.g. lack of knowledge of available data or information, access to information, files, or databases).

People

6. What are the data-related positions in the agency? This could be exclusively data-based or just personnel that use GIS data and software in their everyday work.
7. Describe the level of GIS skills and experience possessed by your personnel in general (basic/intermediate/advanced).
8. Do you have in-house developers? If yes, what are their skills (software, database, scripting)?
9. Does the agency hire external contractors to perform internal IT or data analysis tasks? If yes, what tasks are they typically hired to do?
10. Are there any capacity-building initiatives for data and/or GIS analysis in the agency?
11. Please identify any additional skills that agency personnel may require to aid in data management.

Data

12. Is there a list of Fundamental Data Sets identified in your city, and if yes, how are they identified?
13. Is the agency recognized as the custodian of imagery data?

14. Does the agency apply a usage license to the data and maps that it produces?
15. What datasets would benefit the agency most in completing its tasks?

Systems

16. Who maintains the intranet/internet connections (internal IT vs. consultant/outside provider)?
17. What needs to be in place for the municipality to develop a Geoportal?
18. Are all workstations used for similar tasks, or are certain workstations used for unique processes?

Optional questions (Data)

- How does the agency ensure the security and safety of data?
- How do you find out what kind of GIS data is available in your municipality?
- Does the agency produce or manage sensitive data?
- What data/information that the agency produces would benefit other agencies the most?
- In your opinion, how could data infrastructure in the city be improved?

Optional questions (Systems)

- Which GIS data sets would you like to add to a geoportal first? Why?
- How do you think a geoportal can provide geospatial information to the public? What tools and functions are needed?
- How can we integrate crowd-sourced data from the public or private sector data? How can we control data quality?

Interview For Information and Communication Technology (ICT)Staff

Institutional Arrangements

1. Do you have a working relationship with National level government agencies to obtain or share data with? If yes, how is data shared?
2. What are the key investments needed/made in technological infrastructure and data and is central funding available to support these investments?

People

3. How many personnel can operate and maintain the geospatial server in your agency?
4. How many IT administrators does Kitengela Municipality have?
5. Do you have in-house developers? If yes, what are their skills (software, database, scripting)?

6. Please identify any additional skills that agency personnel may require to aid in data management.

Data

7. Are there data policies to ensure interoperability and implementation of standards?
8. How does the agency ensure the security and safety of data?
9. Does the agency apply a usage license to the data and maps that it produces?
10. Does the agency use external data/layer web services for GIS work?
11. In your opinion, how could data infrastructure in the city be improved?

Systems: Software

12. List the geospatial servers (open source / commercial) for geospatial information management.
13. Does Katwana municipality have an official website that is frequently updated?
14. Do you use web services (e.g. Web Map Service, Web Feature Service, etc) or does Kitengela have its own web service? If yes, please list the services.
15. Are there any customized software/applications that are used for processes in the agency?
16. Does the agency have any software agreements with vendors?

Systems: Hardware

17. How much does your agency typically budget for new workstations or workstation upgrades per year? If there is no fixed budget, how often are workstations upgraded?
18. Who conducts maintenance/repairs on workstations (in-house IT vs. contractor)?
19. Describe the server infrastructure setup of your municipality and/ or agency. If possible, please attach a network diagram.
20. Please list all servers owned or used by Kitengela, including the manufacturer, model, processor speed, amount of memory, storage space, network connection speed, and age of each server. Indicate if Kitengela has enough storage capacity on its server(s). If servers are cloud-based, who provides the service?

Server	Owner	Local or cloud-base	Model	Processor speed/ Network connection speed	Storage space	Age	Is capacity sufficient?	If CB who provides service

21. Are there any regulations that determine where servers are to be housed and managed? Does the Tharaka Nithi County Government ICT Policy apply to municipal servers and ICT systems?

22. Who conducts maintenance on servers?
23. Is data backed up? If so, how frequently and where is the backup stored? How often is data synchronized?
24. Does Kitengela have access to additional government or city servers?

Systems: Network

25. What is the available bandwidth and speed of the internet connection that you are using?
26. Who maintains the intranet/internet connections (internal IT vs. consultant/outside provider)?
27. What network security measures are in place? Do they prevent users from performing certain tasks?

Systems: Geoportal

1. What needs to be in place for the municipality to develop a Geoportal?

Optional questions (People)

- How many personnel have a formal educational background in ICT/Computer Science?

Optional questions (Data)

- How do you find out what kind of GIS data is available in your municipality?
- How do agencies request data from each other? Can you access the data through a network from a server / another workstation or do you need to approach someone to get a paper map / copy on CD / DVD?

Optional questions (Systems: Software)

- What operating system(s) do workstations in the agency use?

Optional questions (Systems: Hardware)

- Please list all the workstations within the agency. This information should include the manufacturer, model, processor brand and speed, amount of memory, hard disk space, desktop or laptop, and age of each workstation.
- Are there any workstations that are currently under warranty? If so, when does the warranty expire?

- Are all workstations used for similar tasks, or are certain workstations used for unique processes?
- Does another entity own the server used by the agency?
- What hardware is available that allows for the geo-tagging of data?

Optional questions (Systems: Network)

- Are you able to access the internet when needed? Is the connection fast enough? Is the connection reliable? If not, please describe the problem (speed, reliability, etc.). Is the internet connection reliable enough to use web-based services?

Optional questions (Systems: Geoportal)

- How do you think a geoportal can provide geospatial information to the public? What tools and functions are needed?
- How can we integrate crowd-sourced data from the public or private sector data? How can we control data quality?

Annex V: List of participants per survey

The table below presents each participant's designation and identifies their involvement in the following surveys: Rapid Readiness Assessment (RRA), Global Prioritization Survey (GPS), and Deep Dive Interviews (DDI).

	PARTICIPANT'S DESIGNATION	RRA	GPS	DDI
Benson Nkele	Municipal Senior Physical Planner and GIS Expert	✅	✅	✅
Collins Masiea	ICT Director		✅	✅
Elizabeth Mutisya	Head of the Directorate of Physical and Land Use Planning and municipal planner	✅	✅	✅
Ezekiel Lemarpe	Municipal Environmental Officer	✅	✅	✅
Fred Swalah	County Director of Physical Planning		✅	✅
Josephine Nashipae S.	Municipal Manager		✅	✅
Josphat Kamau	Municipal Environmental Officer		✅	✅
Michael Abande	Municipal Engineer	✅	✅	✅
Evaline Ndecha	Municipal Surveyor	✅		
Felix Muneria	Board Member	✅		

Annex VI: Project for Strengthening Survey of Kenya for GIS Promotion in The Republic of Kenya

KNSDI activities began in 2001 when the Survey of Kenya (SoK) conducted an inventory survey to assess the demand for geographical information. The survey identified the need for a centralized system for managing and accessing spatial data. Between 2002 and 2006, five stakeholder workshops were held to emphasize the importance of geographical data, encourage resource pooling, and foster collaboration. In 2005, the Kenyan government sought technical assistance from Japan to enhance SoK's GIS capabilities, leading to a three-phase project. This project, initiated in 2006, focused on building SoK's capacity, promoting GIS use in Kenya, and developing KNSDI.

Key outcomes included the creation of KNSDI standards and the improvement of map digitization processes. Six KSISO standards were adopted to fit the Kenyan context, including:

KSISO 19101.GI – Reference model
KSISO 19109.GI – Rules for schema
KSISO 19111.GI – Spatial referencing by coordinates
KSISO 19113.GI – Quality principles
KSISO 19114.GI – Quality evaluation procedures
KSISO 19115.GI – Metadata

In addition, a **Manual for Product Specification** was developed to provide basic standards for processing digital geographical data, focusing on five elements of data quality:

- Completeness
- Logical consistency
- Positional accuracy
- Temporal accuracy
- Thematic accuracy

Digitization manuals for thematic map databases and topographic-cadastral map databases were also created. To facilitate data dissemination, a **Clearing House (GIS Portal)** was developed using the ESRI GIS Portal Toolkit. Though an **NSDI policy** covering data and metadata standards, software and hardware guidelines, and governance arrangements was drafted, it was not approved. The SoK also established **guidelines for geographical data supply and sharing.** Finally, **GIS training courses** were offered to 80 participants, introducing them to open-source software like QGIS and ILWIS, as well as basic GIS skills. Advanced users received training on optimizing the software's functionalities (Murage, Gitimu, and Sato 2008).