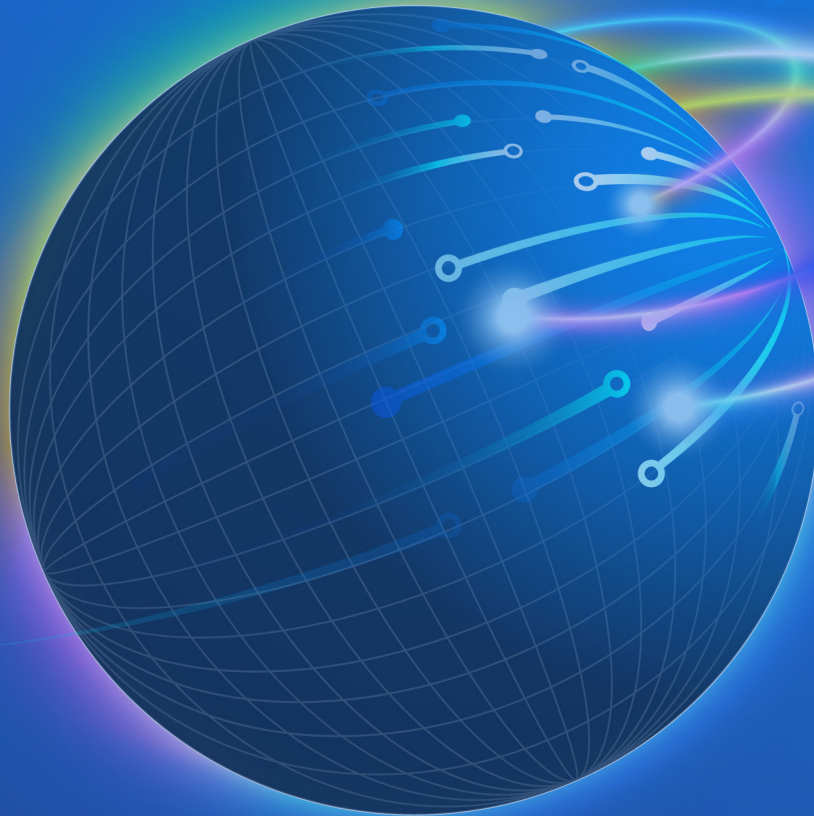




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Geospatial Technology and Building permits Issuance and Management of Informal Settlements: Kigamboni, Tanzania

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ABSTRACT

This research investigates the application of Geo-spatial technology in enhancing the management of building permit allocation and addressing the proliferation of unplanned settlements. The study sought to evaluate the existing procedures for issuing building permits, identify the key challenges affecting applicants, and propose a geospatial framework to improve operational efficiency and regulatory compliance. Adopting a descriptive research design, the study combined both qualitative and quantitative approaches to gather comprehensive data. Field measurements using GPS, analysis of scanned cadastral maps, Landsat satellite imagery, document reviews, structured questionnaires, and interviews with key informants constituted the primary data collection methods. Spatial data analysis was performed using ArcGIS and QGIS software, incorporating overlay techniques and reduction mapping to understand patterns and trends, while qualitative responses were analyzed through content analysis and summarized using basic statistical tools. The results indicate that a significant proportion of respondents, over 75% of the 159 surveyed, encountered delays in permit processing exceeding two months. The primary factors contributing to these delays were identified as bureaucratic inefficiencies (48.43%), insufficient public awareness of permit procedures (14.46%), and the high costs associated with application processing (12%). Additionally, the study highlighted that the continued dependence on manual record-keeping and paper-based systems exacerbates the occurrence of unplanned settlements, with notable cases observed in areas like Rancheria. These findings emphasize the need for modernization in permit management to address both administrative bottlenecks and uncontrolled urban expansion. The study concludes that the integration of geospatial technology can substantially enhance the transparency, efficiency, and responsiveness of urban planning authorities. By maintaining regularly updated spatial databases, local authorities can monitor settlement growth, streamline permit issuance, and enforce compliance more effectively. Such systems would provide urban planners with real-time spatial intelligence, facilitating evidence-based decision-making, timely intervention, and sustainable settlement management. Ultimately, adopting Geo-spatial technology in building permit administration can reduce delays, minimize unauthorized construction, and support systematic urban development, ensuring that growth aligns with strategic planning objectives and community needs.

INTRODUCTION.

The persistent growth of informal settlements in urban areas underscores significant administrative inefficiencies and highlights the disconnect between urban governance structures and the lived realities of low-income populations. In many developing countries, including Tanzania, the continued reliance on outdated, manual processes for issuing building permits characterized by physical documentation, in-person interactions, and poorly maintained archives has perpetuated delays, escalated costs, and contributed to widespread unauthorized construction. This system disadvantages both applicants, who face procedural and financial burdens, and urban authorities, who struggle to maintain accurate records and enforce planning regulations (Alnkiza, 2024; Omar, 2018). The informal subdivision of land often emerges as a response to increasing urbanization pressures and growing housing demand, particularly among low-income earners. However, the absence of municipal oversight and strategic planning in these developments leads to uncoordinated urban

expansion. As a result, such areas often lack access to essential services, including water, sanitation, electricity, waste management, and transportation infrastructure. Moreover, the lack of a clear land tenure framework exacerbates legal uncertainties, deters private investment, and limits residents' ability to leverage their property as collateral for financial services (Olsson, 2018; Ernest & Kyengya, 2025). While initiatives like Tanzania's Integrated Land Management Information System (ILMIS) aim to modernize urban planning through digital platforms, their full potential remains unrealized. The system is frequently underutilized due to limited institutional capacity, inadequate training, insufficient funding, and a lack of integration with other urban planning and construction approval mechanisms. Consequently, planning efforts remain reactive rather than proactive, and urban authorities continue to operate without reliable, up-to-date data to support informed decision-making (Lionardo, 2020; Kyengya et al., 2025). The solution lies in establishing a comprehensive Geo-spatial framework that integrates land-use planning with the building permit

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application and approval processes. Such a system would centralize data, eliminate administrative bottlenecks, and enhance transparency. By adopting digital tools such as Geographic Information Systems (GIS) and remote sensing technologies, urban planners and municipal officials can monitor land-use changes in real time, process permit applications efficiently, and enforce compliance with zoning and building codes (Oldenhuizing, 2004; Kyengya et al., 2025). Furthermore, implementing a centralized and accessible online platform would enable applicants to submit documentation remotely, track the status of their applications, and receive timely feedback electronically. This reduces the need for physical visits, minimizes opportunities for corruption, and promotes a fair, accountable permitting process. In the long term, such a system would also enhance urban resilience by enabling data-driven planning, targeted infrastructure development, and more effective service delivery tailored to the needs of growing populations. Addressing the rise of informal settlements requires not only technical innovation but also strong political will and institutional reforms. Strengthening inter-agency coordination, building local capacity, and fostering

community participation are essential to ensure that urban development is inclusive, sustainable, and responsive to the needs of all residents. By leveraging geospatial technologies and streamlining administrative processes, cities can transition toward more orderly and equitable growth, curb the expansion of informal settlements, and improve the quality of life for their urban populations.

MATERIAL AND METHODS

The area of Study

Kigamboni is located in the southeaster portion of Dar es Salaam, falling within the geographical coordinates of approximately -7.230° to -6.780° latitude and 39.270° to 40.350° longitude. It is bordered to the east and north by the Indian Ocean, which also hosts the Dar es Salaam harbour (refer to Figure 1). The district shares its southern and south-western boundaries with Mkuranga District, while its western edge borders Temeke District. Key administrative wards within Kigamboni—such as Kigamboni, Vijibweni, Tungi, Mjimwema, Kibada, and Somangila—are interconnected by major coastal roads, facilitating transport and communication. Other wards in the district are linked through a network of secondary

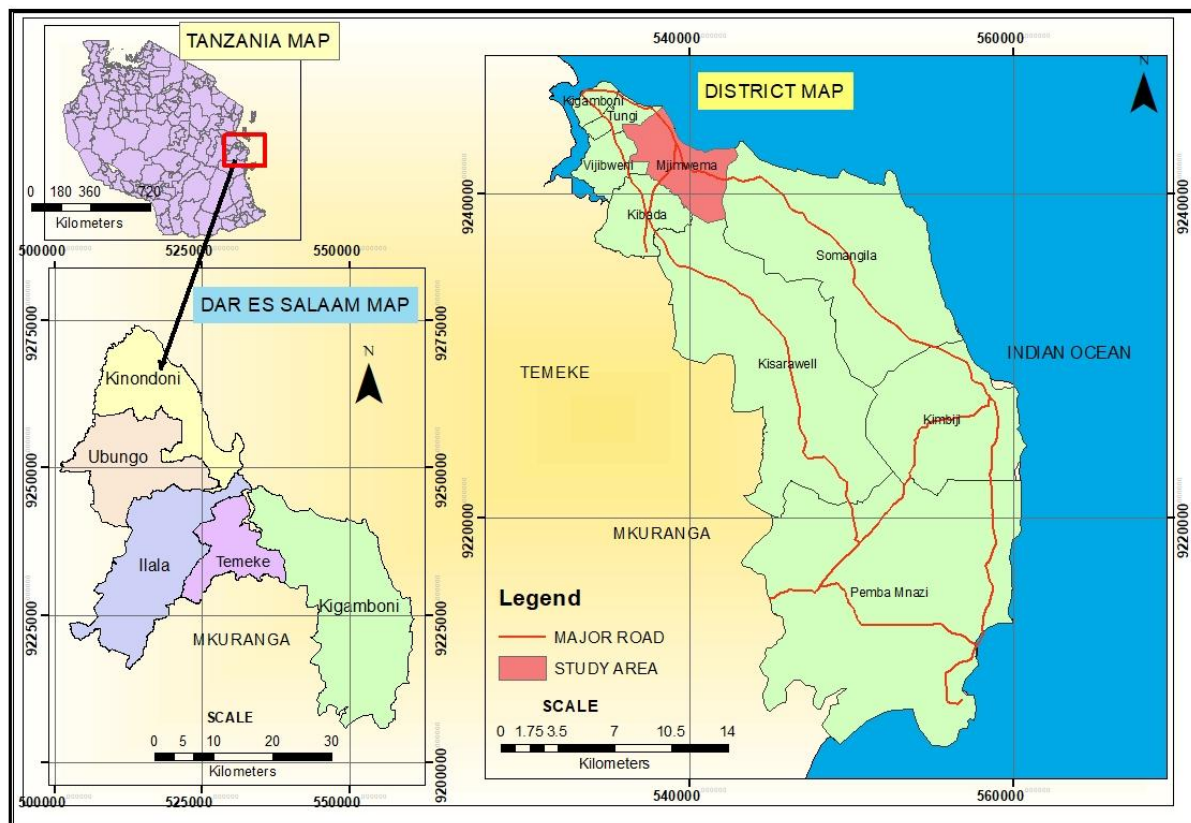


Figure 1: Kigambon municipality

and feeder roads, ensuring accessibility across the region.

MATERIALS AND METHODS

This study adopts a structured exploratory framework that integrates both qualitative and quantitative research methods to deliver a comprehensive and multidimensional analysis. By employing a mixed-methods approach, the research seeks to gain a holistic understanding of the

procedures and challenges involved in issuing building permits within informal settlements, while also exploring the applicability of geospatial technologies as a potential solution to improve these processes. The qualitative component is used to investigate and contextualize existing permit issuance systems, uncovering procedural inefficiencies, institutional barriers, and their broader

implications for urban planning and regulatory compliance. In parallel, the quantitative dimension—primarily leveraging geospatial tools and techniques—is aimed at enhancing the efficiency, transparency, and accuracy of permit allocation as part of a modern development control framework.

The overarching objectives of the study are fourfold: (1) to systematically document the current building permit

issuance practices, (2) to identify and analyze key challenges that hinder effective permit management, (3) to assess the outcomes and limitations of current approaches, and (4) to develop and recommend a geospatially model enabled permit issuance model that can serve as a robust tool for reinforcing planning regulations and fostering orderly urban development.

The study concentrated on analyzing the process of

Table 1: Collected Data along with its results

Data	Data Type	Data Source	Purpose
Building permit forms Master plan -Detail plans Surveys image	Structured questionnaires	Government documents open source (Google Earth, open street map)	-Process, procedures
Questionnaires	Questionnaires	-on-site Surveys and Key respondents	identify the type of obstacles faced in the process
-geospatial vector file, feature properties -space based imagery visual representation	-Master plan Town drawings -Surveys, physical infrastructures	Online government services, geospatial imagery (Google Earth, open street map), public sector network as well as public services providers	-designing the digital permit approval system

building permit issuance and identifying the underlying challenges associated with granting construction licenses, particularly in informal settlements. To achieve this, both spatial (geographical) and non-spatial data were utilized, enabling a multidimensional understanding of the permit system and its spatial implications. Spatial data processing began with the collection of diverse source materials, including high-resolution satellite imagery, detailed town planning drawings, existing master plans, and topographic survey maps. These resources were initially available in varying digital formats, such as JPEG and PDF. In order to standardize these inputs for integration into ArcGIS, all documents were converted into JPEG format using a simple image editing tool, ensuring compatibility with GIS software for further processing. Subsequently, the images and cartographic documents were imported into ArcGIS for spatial referencing. This was accomplished by assigning four dereferencing control points—based on known Easting and Northing coordinates—to align the scanned materials accurately with real-world coordinates. Once spatially aligned, these geo-referenced images served as the foundation for the digitization process, during which key physical features such as roads, buildings, and plot boundaries were traced and transformed into vector data formats (lines and polygons).

In parallel, GPS coordinate data derived from building permit application forms was compiled and initially organized using Microsoft Excel. These coordinates were then exported in CSV format and imported into ArcGIS as discrete point data. Each point corresponded to a specific construction site or issued permit within the informal settlement areas. Through spatial analysis, these points were connected to form polygons, representing the spatial footprint of each permitted structure or parcel. This step

allowed for the creation of a geospatially accurate map of issued building permits, offering valuable insights into spatial patterns, permit coverage, and potential regulatory gaps within unplanned urban areas. By integrating spatial and attribute data in a GIS environment, the study not only documented the physical extent and distribution of issued permits but also highlighted procedural inefficiencies and potential areas for intervention. The outcome provides a foundation for proposing a more streamlined, geospatially enabled permit issuance framework to support urban planning and development control in rapidly growing informal settlements.

The Non-Spatial Data Analysis

Data from structured surveys and key informant interviews were analyzed using descriptive statistical methods. The challenges reported by permit applicants were categorized to identify recurring trends, and these trends were then represented in various visual formats, including tables, charts, and other statistical presentations, for greater clarity and ease of understanding. Figure 2 provides a visual summary of the data analysis workflow. Several key improvements were implemented to enhance the overall process: redundancy was minimized (for example, the phrase “saved as JPEG” replaced the previous wording “spared into JPEG designs”), and the overall structure was improved by clearly separating the sections dealing with spatial data from those focusing on non-spatial data. This adjustment made the methodology more reader-friendly and intuitive.

Furthermore, technical terminology was simplified for clarity. For instance, the phrase “extracted from the application form” was replaced with the more straightforward “extracted from permit applications,”

and the overly complex “The GPS coordinates extricated from the permit forms were handled” was revised to the clearer “The GPS coordinates were processed.” These

adjustments helped streamline the explanation without compromising technical accuracy.

RESULTS AND DISCUSSION

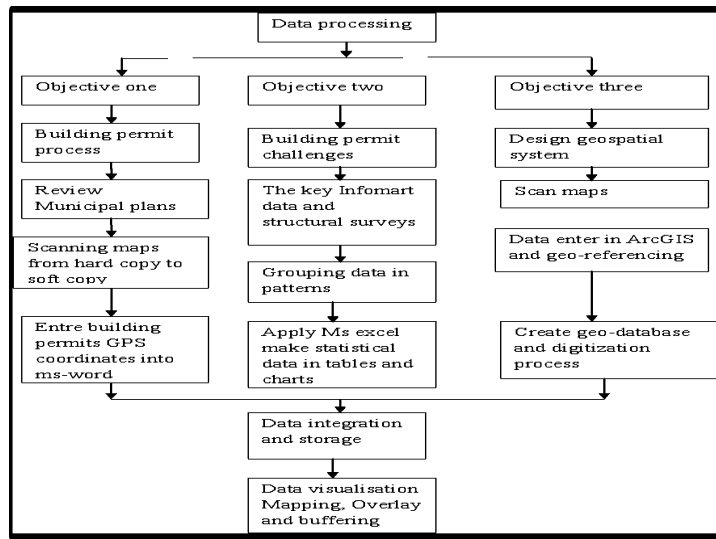


Figure 2: process and procedure of data analysis

The data collected in the study—including GPS coordinates, site images, and sketches—was evaluated by municipal technical officers in accordance with Kigamboni’s development plans. This evaluation was crucial step, as the permit process can only proceed once the assessment confirms that the proposed construction aligns with the municipality’s planning guidelines. To ensure a thorough understanding of the permit issuance process, the study also involved conducting in-depth interviews with key stakeholders who are directly responsible for the approval of building permits within the Kigamboni Municipality. The data obtained from these interviews was analyzed in a structured manner. Each research objective was independently assessed using a variety of analytical methods, including tables, charts, bar graphs, maps, and photographs, alongside descriptive techniques. These visual and statistical tools enabled a clearer representation of the key findings, offering

valuable insights into the complexities and obstacles that stakeholders face in the building permit process.

A core objective of this research was to explore the procedures and criteria involved in granting building permits in informal settlements. The study found that three primary stakeholder groups play significant roles in the process: applicants who seek permits, local government officials who oversee the approval process, and municipal technical officers who assess the compliance of proposed projects with urban planning standards. Each group holds distinct responsibilities when it comes to reviewing and processing applications. To provide a comprehensive understanding of the roles of these stakeholders, Table 2 outlines their specific duties and functions in detail. It highlights how each group contributes to the overall permit approval system and the challenges they face while ensuring that development complies with local regulations and planning frameworks.

From the study the findings revealed that building permit

Table 2: Roles of Key Actors in Building Permit Processing

No	Actors	Roles And Responsibilities
1	Applicant	
		Dully fill the building permit application form and attach all documents mentioned.
2	At the Local Government Office	
	a)Sub-ward Officers/ Sub-ward Chairman	Checking if the applicant is within administrative boundaries also proof of land sale ownership
	b) Ward-Officer	Checking the proof of land sells ownership
3	At the Municipality Level	
	a)Land Surveyor	Assess the encroachments of the building permit against existing surveys
	b) Town Planners	Responsible for examining the conformity of building permits to existing land-use plans
	c) Land Officer	Assess all attached documents of the applicants including national identity, land sale agreements, and applicant neighbouring form

d) Head of Department	Overall, in charge of making decisions after reading the comments of the technical officers
e) Municipal Engineer	Assess the architectural drawings
f) Building permits Register	Prepare building permit bills and custodian of building permits at Municipal
g) Municipal Accountant	Generates control numbers for building permit payment of bills
h) Urban Planning Committee	Discuss and approve building permits

process in Kigamboni Municipality starts with applicants seeking approval at the sub-ward level. In accordance with regulations, applicants—whether individuals, businesses, or institutions—must first obtain and complete a specific application form from the District Office. As noted by Omar (2018), this process is entirely manual and requires in-person submission, reflecting the traditional practices still in place in Kigamboni District. The application form requests detailed personal information, such as the applicant’s name, contact information, the property’s location, and the proposed use of the building (whether residential or commercial). Applicants must also indicate whether the building will be a single-store or multi-store structure. This data allows local authorities to assess the application before moving forward with the permit process.

Also, Applicants are required to carefully fill out the form and submit various supporting documents, including a passport-sized photograph, a national ID to verify citizenship, land ownership documentation, and approved architectural plans. These requirements are consistent with broader procedural practices in similar permit systems, as highlighted by Elizabeth and Africa (2005), who emphasize the role of the applicant in ensuring that all necessary documentation is provided.

Submission and Verification Stage

Once the application is completed, it is submitted to ward and district authorities for review. This stage serves to verify the land’s ownership and ensure that the proposed construction is within the correct jurisdiction. Applicants must provide the site’s name and geographic coordinates, helping to clarify which administrative boundaries apply. However, the manual nature of this process often causes delays. According to a Kibugumo sub-ward officer, the lack of a digital verification system leads to the risk of issuing multiple permits for the same plot of land.

Local officials cross-reference applications with municipal development plans to ensure compliance with planning regulations (Ponnewitz & Bargstaedt, 2019). The responsibilities are divided among several specialists: Municipal Land Officers are tasked with receiving applications, verifying coordinates, and initiating the review process. Land Surveyors conduct site visits to evaluate the current conditions of the applicant’s land and nearby properties. Using GPS devices (configured to the WGS 84 Zone 37 coordinate system) or smartphone applications, surveyors gather coordinates, create sketches of the site, and photograph the location to support the permit review. Figure 3 illustrates the workflow used to assess land

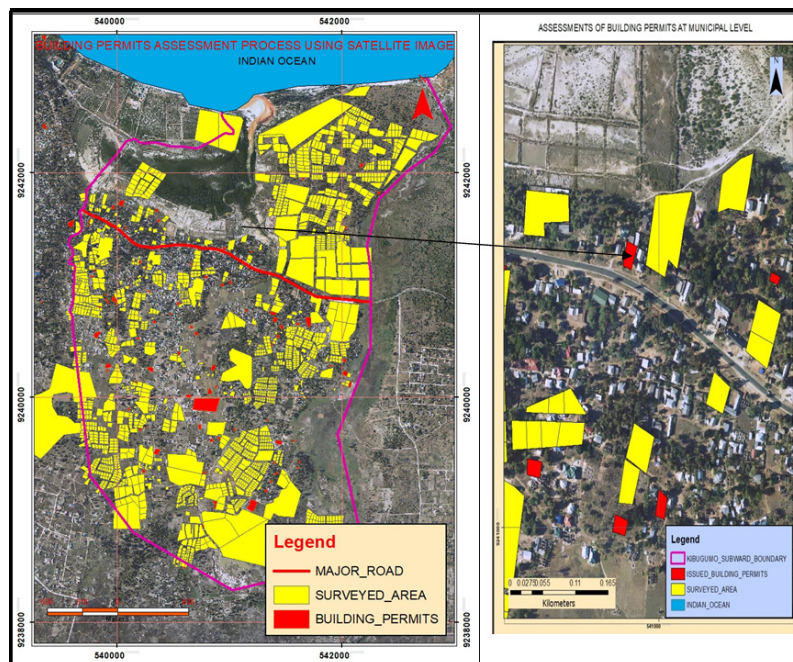


Figure 3: Process of Land Parcels by Land Surveyors

parcels applying for building permits in Kigamboni Municipality, with a particular focus on reviewing spatial data, mapped zones, and physical infrastructure. In the figure, land parcels being evaluated are highlighted in yellow, while previously surveyed plots are marked in red. Once an application is submitted, it undergoes an initial review by a land surveyor, who is responsible for identifying any discrepancies such as encroachments, overlaps, or deviations from the approved boundaries. The surveyor achieves this by comparing the application against established survey records. As noted by the surveyor, “Applications are rejected if the land divisions violate the predefined boundaries.” If no violations are identified during this stage, the application is cleared to proceed to the next phase, where a town planner conducts a more detailed review of the proposal.

Town Planner’s Role

The study revealed that a town planner plays a critical role in evaluating building proposals by ensuring they comply with the municipality’s overarching development plans. This includes aligning the proposals with the area’s master plan, which sets the long-term vision for urban development, as well as detailed zoning schemes, urban design blueprints, and the existing infrastructure—such as roads, utilities, and public services. The master plan acts as a guiding framework, dictating zoning classifications that designate land for specific uses, including residential, commercial, industrial, or mixed-use areas. This zoning system is designed to optimize land allocation, streamline urban growth, and promote efficient land use, all while maintaining a balance between development and sustainability. By carefully reviewing each application, the town planner ensures that proposed developments do not

disrupt the intended land-use patterns, as outlined in the development plans. This evaluation process serves as a safeguard against the misuse of land that has been reserved for specific functions, such as green spaces, public facilities, or conservation areas. In this way, the town planner helps maintain the integrity of the municipality’s urban fabric, supporting organized, well-planned growth that is in line with the community’s needs and long-term vision.

Challenges in Compliance

Omar (2018) observes that nearly 80% of building permit applications do not fully comply with approved planning schemes, with non-compliance being the primary reason for delays or rejections. This high rate of non-conformity points to significant challenges in the permit approval process. Town planners stress that deviations from established zoning regulations or infrastructure requirements—such as road access, utilities, or other public services—are the most common causes for stalled applications. These violations create obstacles that prevent applications from moving forward, ultimately delaying the progress of development projects. The recurring issue of non-compliance highlights the critical need for applicants to strictly follow municipal guidelines and planning frameworks. Town planners argue that a more rigorous adherence to zoning regulations and infrastructure standards is necessary to streamline the approval process. When developments are aligned with these plans, it not only facilitates smoother permit issuance but also supports organized and sustainable urban growth, ensuring that the development process is efficient, predictable, and in line with the broader goals of the municipality.

Figure 4 demonstrates an example of the building permit

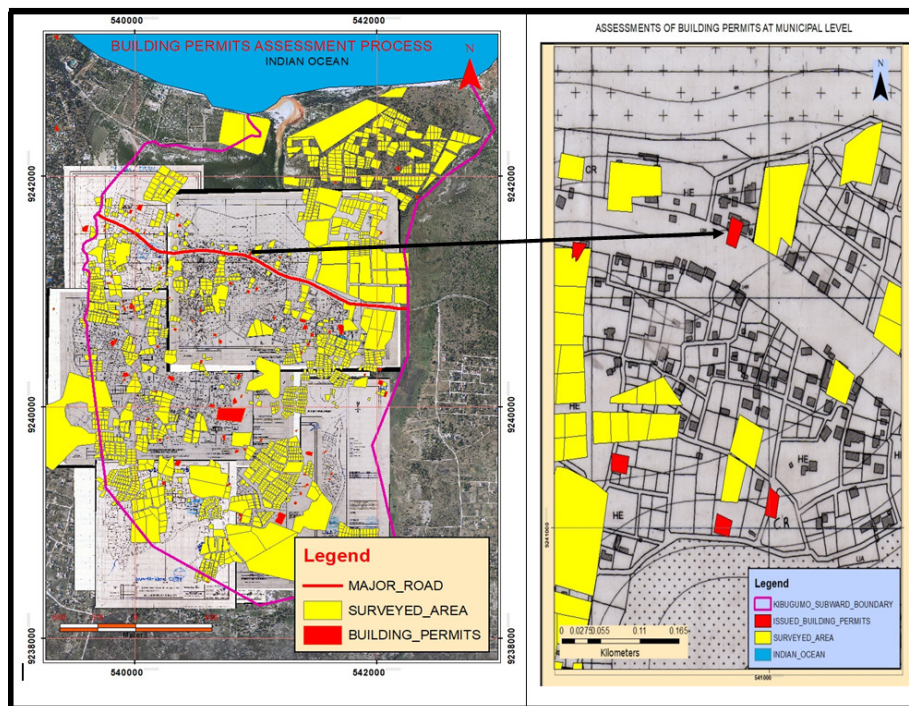


Figure 4: Land Parcel Utilization Assessment by Town Planners

evaluation process carried out by town planners. The diagram uses zoning map overlays to assess land use for a specific plot. In the illustration, red parcels represent building permit applications that are pending approval in informal settlements, while yellow areas denote surveyed and approved zones. A town planner clarified the evaluation process, stating, “If the application aligns with the designated land use (indicated by the arrow), the officer endorses the form with comments, instructing both the applicant and permit reviewer to comply with the 60-meter right-of-way (ROW) requirement for TANROAD infrastructure during construction. The application is then forwarded to land officers for further review. However, proposals that fall within reserved road corridors are automatically rejected.”

Verification and Approval Workflow

Upon receipt of the building permit application, the land officers are responsible for thoroughly reviewing and verifying the submitted documents. These include the applicant’s national ID card, signed neighborhood boundary agreements, and land sale contracts. The land officer’s first task is to ensure that the documents are authentic and complete, as any missing or fraudulent documents could result in delays or the rejection of the application. The officer also ensures that the submitted documents align with local regulations, confirming that the applicant has proper legal standing and authorization to apply for the permit. Once the land officer has validated the documents, the application is either approved or rejected. If the documents are complete and valid, the land officer will approve the application and forward it to the department head for further review. If there are issues, such as discrepancies in the documentation or failure to meet initial requirements, the officer will reject the application, providing a detailed explanation and justification for the decision. This rejection may include recommendations for the applicant to rectify any errors before reapplying.

After the application is submitted to the department head, it undergoes a thorough review of all technical assessments, comments, and feedback provided by the land officer and other relevant stakeholders. The department head evaluates the overall compliance of the application with municipal regulations, development plans, and zoning requirements. In particular, the department head focuses on whether the proposed project meets the broader urban planning objectives, such as ensuring proper land use, preserving environmental integrity, and maintaining public safety. Based on this evaluation, the department head makes the final decision regarding the application. If approved, the application moves to the next stage; if rejected, the applicant is informed with a clear justification. If the application is approved by the department head, it is then forwarded to the municipal engineer for a detailed architectural and structural review. The municipal engineer ensures that the architectural plans conform to the established municipal

guidelines, which include assessing the design’s structural integrity, compliance with zoning laws, alignment with the city’s infrastructure capacity (e.g., roads, utilities, drainage), and adherence to safety and environmental standards. The engineer also evaluates the impact of the proposed building on the surrounding infrastructure and its compatibility with neighboring developments. This stage of review is crucial, as the engineer’s approval ensures that the construction project can be safely integrated into the existing urban environment. If the plans *meet all* technical and regulatory requirements, the municipal engineer signs off on the application, which then proceeds to final approval?

Building Standards Review and Fee Payment

The municipal engineer plays a central role in the building permit approval process by thoroughly reviewing site plans, construction guidelines, and technical specifications provided with the application. In addition to evaluating the proposed project’s design and compliance with zoning regulations, the engineer also establishes specific conditions for site inspections, ensuring that the construction meets the safety, environmental, and infrastructure standards set by the municipality. The engineer further determines the appropriate permit fees, which are calculated based on factors such as the size of the construction, the complexity of the project, and its impact on surrounding infrastructure. These fees help cover the costs of administering the permit process and conducting necessary inspections throughout the construction phase.

Once the municipal engineer completes their review and sets the inspection conditions, the process moves to the municipal accountant, who assigns a payment reference number for the permit fees. The applicant is required to pay the fees, and once payment is received and confirmed, the accountant issues a receipt. This payment confirmation is a necessary step in finalizing the application. The receipt, along with the completed permit application, technical documents, and any other required paperwork, is then submitted to the building permit committee for final evaluation and decision-making. The building permit committee is composed of professionals from various departments who assess the application in greater detail. The committee reviews the application based on technical input from the municipal engineer, land officers, urban planners, and other relevant experts. These professionals examine the application for compliance with municipal development plans, environmental standards, zoning regulations, and infrastructure compatibility. The committee’s primary objective is to ensure that the proposed development will contribute positively to urban growth while adhering to the municipality’s planning framework.

After reviewing the application, the committee can approve, reject, or defer the decision. In instances where there are unresolved issues—such as discrepancies in the application, insufficient supporting documentation,

unclear boundaries, or the need for additional site inspections—the committee may decide to defer its decision until the next meeting. During this period, further clarifications are sought, additional site visits may be conducted, or the applicant may be asked to provide further information or revised plans. As the committee chair explained, “Unresolved issues may delay approval until the next meeting, after which the permits will be processed.” This reflects the committee’s commitment to ensuring that all necessary aspects of the application are thoroughly examined and any concerns are addressed before final approval is given. Once the committee resolves any outstanding issues and clarifications have been made, the application is either approved or rejected. If approved, the permit is officially issued, and the applicant is notified.

The approval also triggers the necessary preparations for inspections during the construction phase to ensure compliance with the original permit conditions. If rejected, the applicant is provided with a detailed explanation outlining the reasons for the rejection, and recommendations for resubmission, if applicable.

Processing Timeline

According to the urban planning office, permits typically take 2–5 days to issue, pending plan reviews, fee processing, and committee meetings held weekly. Delays often arise from manual document handling and multi-stage reviews. Figure 5 summarizes the timeframes applicants face during permit processing.

According to interviews with applicants, among 159

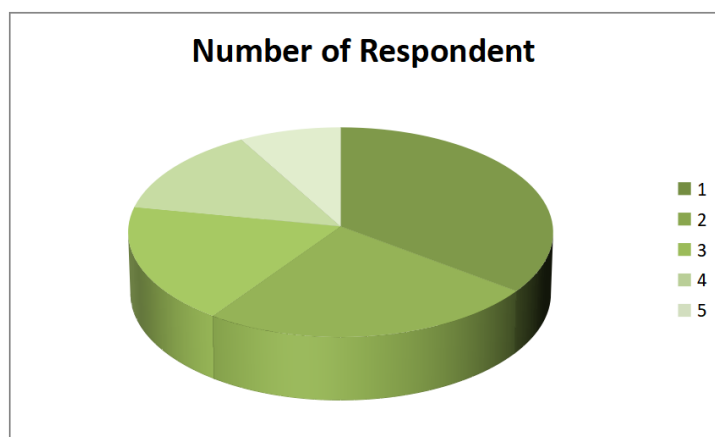


Figure 5: Building Permit Processing Duration

respondents asked about the time required to obtain building permits, 56 (35.23%) reported a processing period of two weeks. Additionally, 39 respondents (24.51%) stated the process took one week, while 29 (18.24%) experienced a three-week wait. A further 22 respondents (13.82%) noted completion within four weeks, and the remaining 13 (8.17%) faced delays exceeding one month at Kigamboni Municipality. Processing times varied due to challenges such as bureaucratic hurdles, limited public awareness, high fees, corruption, ambiguous sub-ward

regulations, and land-use conflicts.

Challenges in Building Permit Issuance

The permit approval process faces obstacles impacting three key groups: applicants, local government leaders, and municipal technical staff. Challenges reported by applicants include inefficiencies outlined in Table 4 (not shown here), which categorizes difficulties encountered during permit processing.

Challenges in issuing time

Table 4: Challenges Faced by Applicants

No:	Challenges	Sub-Total	Percentage
1	Bureaucracy	77	48.42
2	No Challenges	28	17.60
3	Awareness	23	14.45
4	High Fees	19	11.93
5	Corruption	5	3.13
6	Boundary	4	2.52
7	Land Use	3	1
Total	159	100	

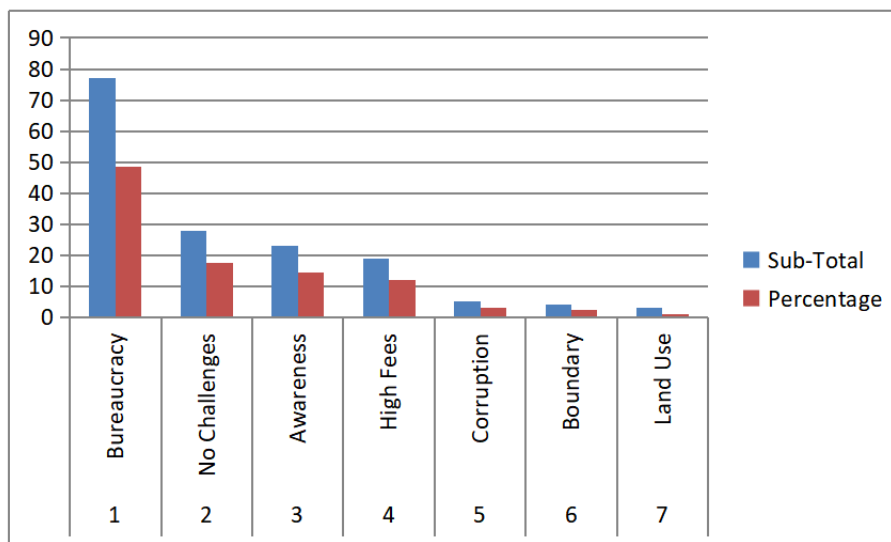


Figure 6: Challenges Faced by Applicants

Figure 6, highlights responses from 159 participants regarding challenges in obtaining building permits. Among these, 77 respondents (48.42%) identified excessive bureaucratic hurdles, particularly due to mandatory in-person interactions, which prolong the process. This aligns with findings from Kumasi, Ghana, where 80% of permits went unissued between 1990 and 2000 because of inefficiencies like redundant approvals, superficial design reviews, and inflated costs (Botchway *et al.*, 2014). A key issue is the sheer number of stakeholders required to sign off on permits including sub-ward officers, town planners, surveyors, and accounting departments leading to delays and resource strain. In contrast, countries like the UK and the Netherlands streamline approvals through digital platforms and geospatial tools, significantly reducing processing times (Noardo *et al.*, 2022).

Limited Public Awareness of Permit Procedures

A smaller group (23 respondents, 14.46%) cited inadequate public knowledge of permit processes. Many applicants

were unfamiliar with where to apply, which offices oversee permits, or the roles of surveyors and architects. This lack of clarity contributes to delays, as uninformed applicants often approach incorrect departments or submit incomplete documentation. Improved outreach and guidance could mitigate these inefficiencies.

Financial Barriers to Permit Acquisition

Nineteen respondents (11.94%) raised concerns about high permit costs in Kigamboni District. Fees range from Tshs. 50,000/= for residential buildings (0–50 m²) to Tshs. 100,000/= for commercial properties, with commercial fees doubling in some cases. Critics argue that these charges prioritize municipal revenue over equitable urban planning, a trend also observed by Fauth & Soibelman (2022) and Lionardo *et al.* (2020). Such financial burdens disproportionately affect smaller projects and undermine the permit system’s role as a tool for sustainable development.

The fee system demonstrates that costs increase

Table 5: Building Permit Charges in Kigamboni Municipality

No.	Area (Sq.m)	Charges in Tshs.		
		Residential	Commercial	Public Buildings
1	Area 0--50	50,000/=	100,000/=	40,000/=
2	Area 51--100	100,000/=	200,000/=	80,000/=
3	Area 101-150	150,000/=	300,000/=	120,000/=
4	Area 151--200	200,000/=	400,000/=	160,000/=

proportionally with the size of the buildable area, prioritizing income generation over regulating development. Similar observations were noted in a Kibungo-based study, which revealed that municipal building permits were primarily used as revenue-generating mechanisms rather than tools to manage urban growth. Additionally, a small fraction of respondents (3.14%) raised concerns about corrupt practices by municipal officers during site inspections.

They highlighted that the absence of standardized fees for site visits created opportunities for unethical officials to solicit bribes from applicants.

Unclear Administrative Boundaries

Issues related to administrative jurisdiction were also raised during interviews. Four respondents (2.51%) reported challenges when applying for building permits in

areas bordering sub-wards. This ambiguity in boundaries sparked disputes with inspectors and even accusations of falsified permit documents, as residents struggled with poorly defined sub-ward demarcations. Moreover, there are other challenges that follow under

This situation leads to several inefficiencies in the process. The officer's time, which could be spent on actual application processing, is diverted to educating applicants and managing incomplete submissions. This, in turn, results in delays as applicants must make multiple visits to the office, each time with different documents or incomplete paperwork. The cycle of repeated visits not only slows down the application process but also leads to an increase in administrative costs. The local government must allocate more time and resources to assist each applicant individually, further stretching limited manpower and resources.

Moreover, this inefficiency also has broader implications for the overall permit approval timeline. The repeated back-and-forth and delays in document submission contribute to a longer wait time for applicants, which can frustrate the public and discourage compliance with formal permit processes. Additionally, the delays may disrupt project timelines for construction and development, further exacerbating the challenges faced by both applicants and government officers.

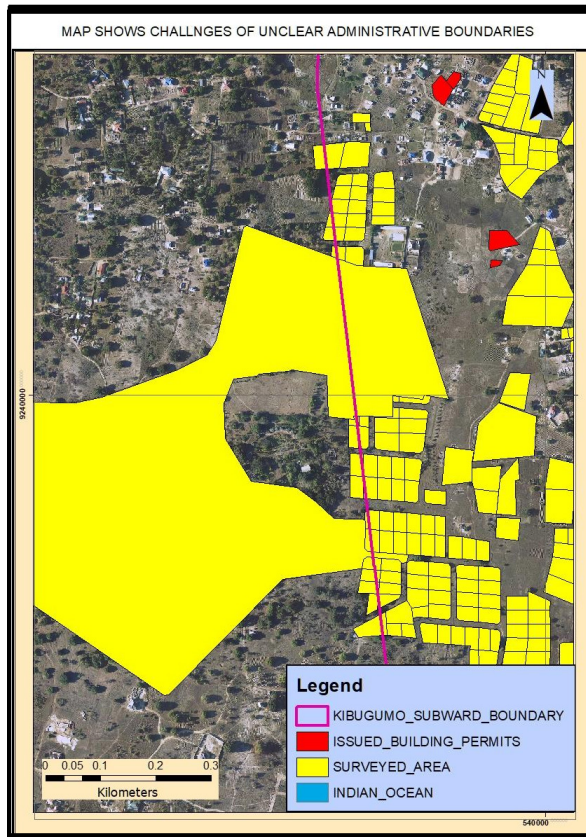


Figure 7: Challenges Arising by Unclear Administrative Boundaries

local government category such as

Low public awareness

At the sub-ward level, key actors responsible for processing building licenses face a number of challenges, primarily because this is the initial stage of the application process. One of the most significant issues is the general lack of awareness among applicants regarding the required procedures for obtaining a building permit. Many applicants arrive at the local government offices with little understanding of the necessary documentation or the steps involved in securing a permit.

As the sub-ward officer explained, applicants frequently come to the office seeking information about the permit process but fail to bring the required documents, such as photographs, sale contracts, and national identification cards. This lack of preparedness forces the local government officer to spend a considerable amount of time explaining the procedure and educating the applicants about the essential documents needed for a successful application. In many cases, applicants are instructed to return at a later date once they have gathered the necessary materials.

Verification of the applicant documents

Local government leaders face significant challenges when it comes to verifying the endorsement of ownership based on land sale agreements submitted with building permit applications. These leaders are often compelled to approve building permit applications without being fully confident in the authenticity of the documents provided. One of the main obstacles is the lack of digital record-keeping systems to store information related to land sale transactions within their respective wards. Without a centralized database or computerized system, local government leaders are unable to easily verify the details of land ownership, leading to potential issues with the documentation submitted by applicants.

In addition to this, local government leaders often find themselves in a position where they must sign the permit application on behalf of neighboring property owners if the applicant fails to obtain the required signatures from the neighbors themselves. According to the sub-ward officer, this practice creates several challenges, particularly when multiple individuals claim ownership of a single plot of land. The absence of clear and accurate documentation can result in confusion about land ownership, with one parcel of land potentially being attributed to several different owners.

This situation can lead to a variety of complications, including land disputes, conflicts among neighbors, and questions about the legitimacy of property ownership. In some cases, local government officers may be unfairly accused of corruption or misconduct, even though the issues are often the result of poor record-keeping practices rather than any malicious intent. The lack of proper documentation and the reliance on manual, outdated systems exacerbate these issues, leading to confusion and mistrust among both the public and local government officials.

Challenges due to proximity administration boundaries
Local government leaders face a significant challenge in dealing with unclear administrative boundaries near land parcels, which are often vague due to the absence of an integrated geospatial system (Figure 6). This lack of geospatial data creates confusion when determining land ownership and jurisdictional boundaries between wards. Without a reliable, digital mapping system, local authorities struggle to accurately identify the exact location of land parcels and verify the authenticity of transactions, particularly in areas where boundaries are not well defined.

This situation is further complicated when an applicant unknowingly purchases a plot of land that belongs to someone else. Due to the administrative ambiguities, the applicant may be advised to visit a neighboring ward to have their land sale documents signed and to submit a building permit application. In such cases, the leaders of the neighboring ward may not have access to or may be unaware of the land transactions that took place in another ward. As a result, they may unknowingly approve the building permit application based on incomplete or inaccurate information, which leads to the issuance of a permit for land that is not rightfully owned by the applicant.

When the permit is issued in this manner, it creates a ripple effect that puts local government officials at risk. If it is later discovered that the applicant received the permit for a plot of land that was not legally theirs, the official who

signed off on the permit may face allegations of abuse of office or corruption. These accusations can damage the official's reputation and career, leading to disciplinary action or legal consequences. The lack of accurate land records, combined with unclear jurisdictional boundaries, makes it difficult for local government leaders to prevent such issues from arising.

As explained by a local government officer from Kibugumo Ward, this situation often results in unnecessary land disputes and confusion. Applicants may unknowingly build on land that is under dispute, leading to legal conflicts between neighboring landowners. The official noted that these disputes frequently escalate due to the lack of a comprehensive geospatial system to track land ownership and boundary data. Without such a system, local government officers are left to rely on outdated or incomplete records, which increase the likelihood of errors in land transactions and building permit approvals.

The absence of a robust geospatial system not only increases the administrative burden on local government leaders but also undermines the integrity of the permit approval process. It leads to inefficiencies, delays, and potential conflicts, further straining local governance and creating mistrust among the public. Ultimately, the lack of reliable land data and clear boundaries makes it difficult to ensure fair and transparent land transactions, putting both applicants and local government officials at risk.

Challenges due to instruments errors

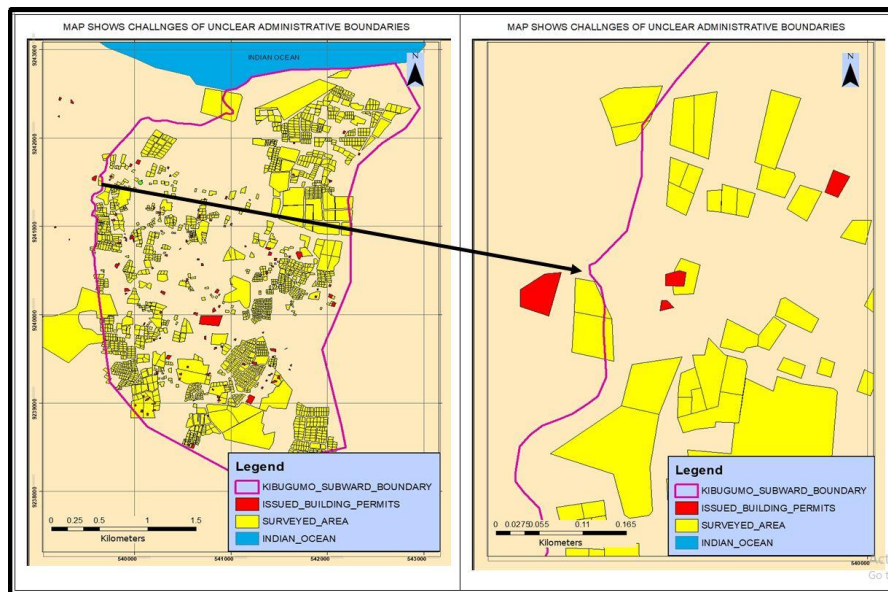


Figure 8: Challenges due to reside nearby administrative boundaries

This process entails a detailed examination of building permit records and on-site land surveys to identify discrepancies such as encroachments, boundary overlaps, and mismatches between surveyed plots and approved permit plans. A key challenge arises from positional inaccuracies in land parcel geometry caused by GPS measurement errors. Land authorities highlight

that GPS deviations can displace plotted boundaries by 10 to 15 meters from their true locations. A second issue stems from improperly calibrated control points used in cadastral mapping (Figure 7). These geospatial inaccuracies often interrupt the building permit approval workflow, requiring intervention by surveying experts to resolve the errors before proceedings can

resume.

Land uses premises and out-dated plans

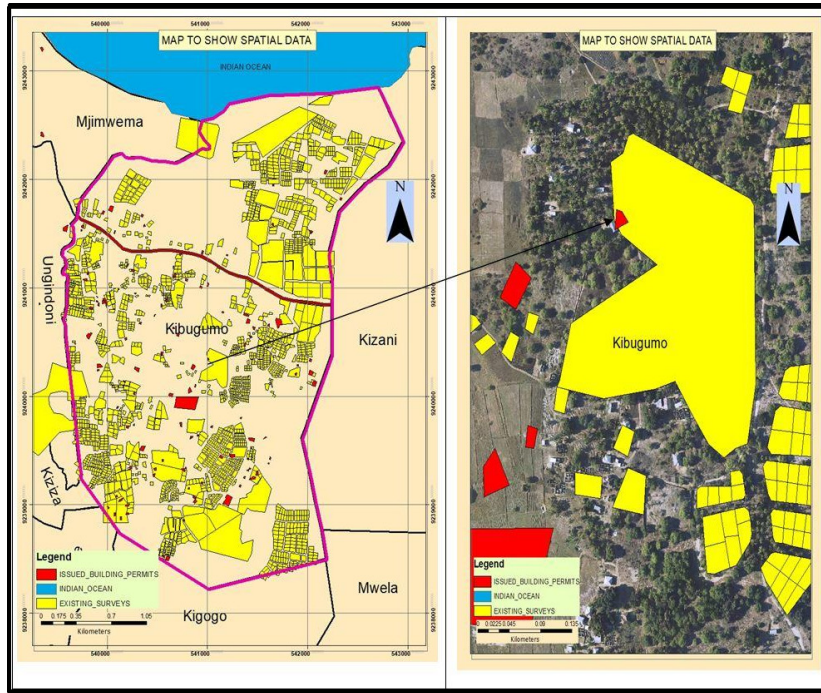


Figure 9: Challenges of Encroachment and Shifting of Surveys

Municipal planners are tasked with assessing development proposals by comparing current site conditions with existing zoning plans to ensure conformity. However, discrepancies often arise when building permits designate land for residential development, while official town planning maps allocate the same areas for public infrastructure such as schools or clinics (figure 10). During site inspections, planners frequently come across privately developed properties that do not align with municipal plans, creating challenges in granting permits due to outdated or inconsistent land use designations. A notable

example can be seen in Greece, where nearly 25% of housing is located in informal settlements. This situation stems from outdated zoning laws, inefficient territorial controls, and an overly complex legal system (Fauth & Soibelman, 2022). These challenges highlight the pressing need to modernize urban planning frameworks, ensuring regulations are in sync with the evolving needs of urban development, reducing conflicts between formal planning and actual on-the-ground practices.

Submission of Application Forms without Essential

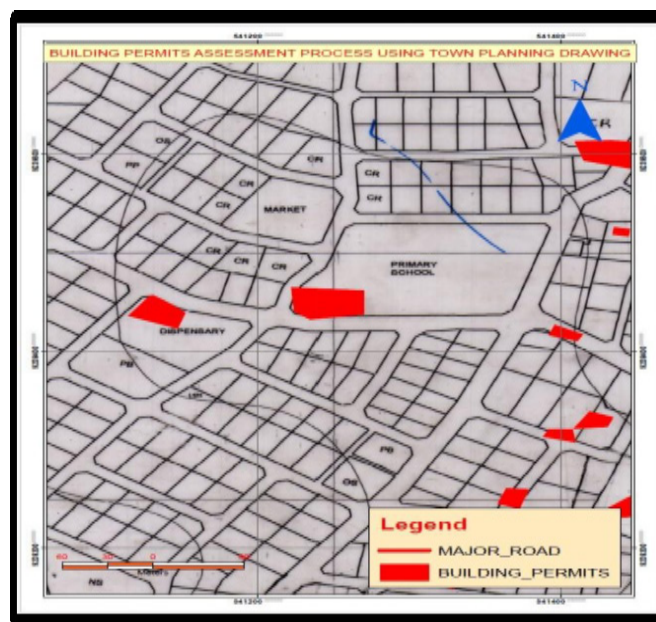


Figure 10: Challenges Due to Land Use Premises

Attachments

Land officers assess property ownership by verifying documents such as birth certificates, national IDs, and signed boundary agreements. Missing documents halt evaluations, leading to incomplete assessments. Inaccurate permit evaluations due to insufficient documentation may result in flawed decisions by town planning authorities.

Adherence to Building Planning Standards

Civil engineers review structural drawings to ensure compliance with regulations. Challenges arise when applicants submit generic, low-cost plans that mismatch actual plot dimensions (e.g., oversized designs). This forces applicants to hire architects for redesigns, increasing costs and discouraging permit applications. Delays occur while waiting for corrected plans, prolonging permit processing times, as noted by municipal engineers.

Obstacles Related to Operational Equipment

- **Manual Billing and Documentation:** The processing of bills and permits remains a manual task, with no digital infrastructure in place to improve efficiency. This outdated approach slows down the overall system, causing delays in processing and a higher risk of errors in records.

- **Resource Deficiencies:** There is a critical shortage of office resources such as adequate shelving for file storage, as well as essential equipment like computers, printers, and office phones. These limitations affect the ability to manage documentation properly and to maintain effective communication with applicants, leading to inefficiencies in day-to-day operations.

- **Payment System Delays:** Instability in the network disrupts the generation of control numbers needed for fee payments through mobile or bank systems, causing significant delays. This disrupts the payment process for applicants, while accounting officers face difficulties in tracking payments, creating a sense of frustration and confusion on both sides.

To overcome these challenges, it is strongly recommended that the government prioritize investments in modernizing infrastructure. Upgrading office equipment, transitioning to digital systems, and improving network stability will streamline operations, reduce bottlenecks, and ensure a smoother, more efficient service for both applicants and officials.

Database Challenges and Use of Geospatial Systems

Local government offices in Kigamboni District are hindered by structural and technological limitations that significantly affect their efficiency and service delivery. One major issue is the lack of dedicated registry spaces and absence of a digital database system. Approved permits, though authorized at the local level, are archived physically in register books and file shelves at higher-tier administrative offices. This decentralized and paper-based storage system not only slows down information retrieval but also increases the risk of misplacement, duplication, or loss of critical documents.

The lack of geospatial technologies—such as GIS (Geographic Information Systems)—further limits the ability of planners to monitor and enforce land use compliance. Without these tools, it becomes difficult to detect illegal developments or assess whether approved projects align with zoning regulations, increasing the risk of unregulated construction and land mismanagement.

Moreover, several recurring operational challenges compound these issues: incomplete application submissions from developers, non-compliant or poorly prepared building plans, and the use of outdated equipment, including malfunctioning printers, insufficient computers, and limited communication tools. These bottlenecks are further exacerbated by weak record-keeping practices, which lead to delays in processing permits and increase administrative burdens on staff.

To improve the situation, there is an urgent need for comprehensive reforms, including the digitization of records, the integration of geospatial tools for land monitoring, and substantial investment in office infrastructure and staff training. Upgrading the technological and institutional capacity of local planning offices would not only streamline permit issuance but also enhance accountability, transparency, and compliance with urban development standards in Kigamboni District (Kahi, 2015).

The reliance on manual storage strategy complicates



Figure 11: Building Permits File Storage in Shelves

efforts for specialized personnel to retrieve historical building license data for evaluation. Implementing a geospatial system in municipal offices would enhance data retrieval and analysis, contrasting with traditional methods that hinder efficiency (Abdel Wahed *et al.*, 2012). Without such a system, gaps in permit management lead to haphazard issuance and potential duplication, exemplified by 96 land conflicts due to overlapping permits in informal settlements. Adopting a geospatial system would streamline data management, improve accessibility, and reduce duplicate permits, mitigating applicant confusion and land disputes.

Addressing Permit Processing Challenges

To overcome the operational inefficiencies inherent in the traditional permit handling process within Kigamboni Municipality. To achieve this, a preliminary assessment was conducted by mapping out the existing permit workflow using flowcharts, which served as a foundational step for designing a more effective, technology-driven system. This mapping exercise helped identify critical bottlenecks, redundant tasks, and potential areas for automation.

The introduction of a geospatial system represents a transformative approach to resolving these challenges. By enabling automated detection of inconsistencies or non-compliant aspects of permit applications, the system enhances both the accuracy and speed of decision-making. It reduces reliance on manual procedures, which are not only time-consuming but also susceptible to human error, document misplacement, and procedural delays (Abdel Wahed *et al.*, 2012). This digital solution also addresses long-standing issues such as unclear land boundaries, overlapping claims, and inefficient file tracking—factors that frequently contribute to project stagnation and legal disputes.

Additionally, the system supports anti-corruption efforts by minimizing direct human interference in permit approvals, thereby reducing opportunities for bribery and favoritism. It fosters transparency by allowing real-

time tracking of application status and clearly outlining procedural steps and timelines. Moreover, coupling this technology with proactive public engagement—through awareness campaigns, user training, and accessible digital platforms—can close the information gap that often leaves applicants unaware of procedures, timelines, or required documentation.

Transparent and standardized fee structures are also essential, as they help demystify payment expectations and prevent arbitrary charges. Altogether, these integrated measures not only streamline permit processing but also enhance public trust, accountability, and sustainable land governance in Kigamboni.

Geo-spatial system development structure

The system integrates spatial data (town plans, surveys, permits, road networks) and non-spatial attributes (applicant details), processed using ArcGIS/QGIS, geo-referencing, and digitization. Unlike Omar (2018), it incorporates spatial elements. Design hinges on understanding roles of permit actors to determine data needs. Components include mobile data collection via smartphones, office-based analysis on computers, and centralized server storage, facilitating efficient operations for applicants, officials, and local governments

Building Permit Application Process for Applicants

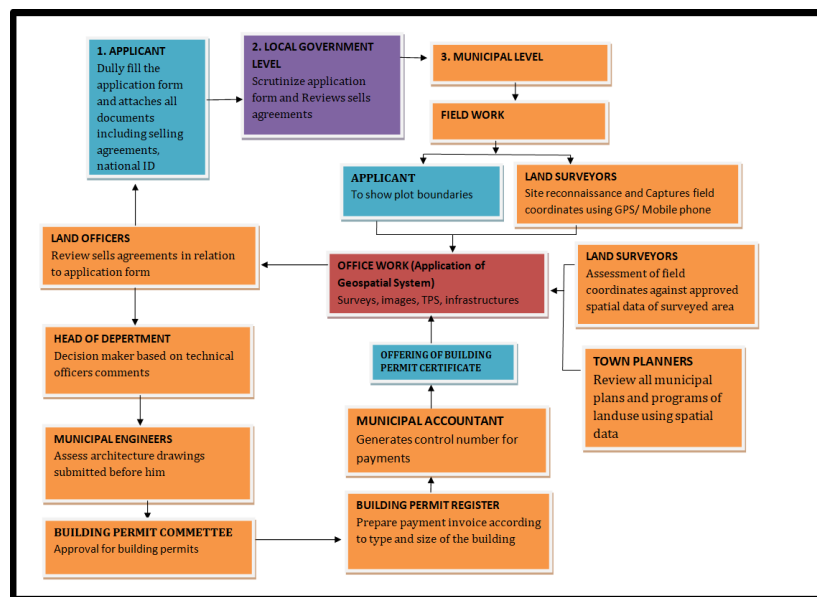


Figure 10: Workflow for Building Permit Issuance.

The building permit system operates through an online portal where applicants submit their requests digitally. To initiate the process, individuals must complete an online form, specify the project location, upload essential documents—such as property titles and architectural plans—and submit the application to the local municipality for evaluation. Users must first register on the platform by creating a username, typically using their email or a combination of their legal names, and setting a password. This account allows them to track the status of their application.

International examples from countries like Sweden and the Netherlands show that digital permit applications reduce processing times (Elizabeth & Africa, 2005; Olsson *et al.*, 2018). Applicants are advised to securely store their login credentials to receive regular updates. If additional documents are requested, these should be promptly uploaded to avoid delays. Registration requires valid national identification information, and applicants must link their contact number and email to receive real-time notifications.

Once logged in, users must enter personal information—

including full name, ID number, and address—to verify their identity and project site. They can then upload all required attachments, such as sales agreements, identification documents, technical drawings, site photographs, and other relevant files. The portal also supports editing of uploaded plans and enables users to overlay infrastructure maps, like roads, to assess site accessibility. GPS functionality allows applicants to pinpoint their land boundaries via smartphones, generating polygonal coordinates for the plot. After submission, the application is forwarded to local authorities for review.

Local Government Handling of Building Permits

Municipal authorities leverage advanced geospatial technologies to evaluate applications, ensuring that proposed projects align with urban development plans, verifying the legitimacy of land ownership, and assessing compliance with zoning laws. Officials then have the authority to either approve or reject the permit applications, providing a reasoned explanation for their decisions. If the application meets all necessary criteria, it is forwarded to the appropriate urban planning department for further review. The integration of geospatial tools streamlines the decision-making process by combining both spatial and descriptive data (Meijer, 2005), making assessments more efficient and accurate. Once the initial document review is completed, on-site inspections are scheduled, where officials use GPS technology to mark precise locations. Even applications from informal settlements are subject to the same standardized processes, but they benefit from the enhanced monitoring capabilities provided by geospatial data repositories, ensuring greater oversight.

The online platform offers real-time updates on the status of applications, allowing for better coordination between applicants, local authorities, and other stakeholders. By overlaying spatial data on zoning maps, surveyors can identify any potential conflicts between the proposed land use and existing infrastructure, helping to prevent encroachments. Applications that do not align with regulations or land-use policies are rejected, while those that meet the requirements continue through the approval process.

Land Use and Document Authentication

Urban planners use zoning maps to overlay permit boundaries, ensuring the proposed projects align with established land-use policies. In informal settlements, outdated or incomplete plans can lead to delays (Omary, 2018). The system also employs buffering techniques to identify and assess potential infrastructure conflicts, preventing issues that might arise from project overlaps. During the document verification process, officials confirm identities, validate property rights, and collect consent forms from neighboring property owners to reduce the risk of disputes. Once the permits are authorized, they are forwarded to department leaders for final approval. These officials track the progress of each application, working to resolve any obstacles or delays, ensuring the timely processing of requests. This system

helps streamline the entire approval process and ensures that any issues are swiftly addressed, facilitating smoother urban development.

Architectural Evaluation and Payment

Once permits are approved, they undergo a technical review to ensure design compliance. Fees are calculated based on the size and type of the building using geospatial tools. An automatic payment reference code is generated and sent to the applicant via text message. After the payment is made, the permits are forwarded to municipal panels for final approval. The system stores approved permits in a geospatial database (Oldenhuizing & Hoogwout, 2004), providing a resource for oversight and assessment in areas like Kigamboni. This facilitates informed policymaking by offering clear and accessible data for evaluation.

Conclusion

Permit approval delays often result from manual procedures; transitioning to geospatial systems can help eliminate inefficiencies and reduce corruption, while improving overall transparency. Efforts to educate communities and modify pricing structures are essential in fostering greater compliance. Future studies should focus on the role of geospatial databases in managing land in informal settlements, with an emphasis on planning road networks and properly documenting properties, in order to strengthen urban management practices.

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