

Research Article

The Challenges of Integrated Infrastructure Planning Between the Metropolitan Cities of Ethiopia, the Case of Addis Ababa and Sheger

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Abstract

Rapid urbanization in developing countries necessitates enhanced infrastructure provision, management, and integration but often faces challenges like inadequate provision, inefficient governance, poor maintenance, and lack of integrated planning. As a result, the aim of this study is to identify and analyze the key challenges that are associated with the effective planning and implementation of integrated infrastructure planning in the study area. The study used a mixed-methods approach and descriptive and explanatory research designs, convenient sampling and empirical data collection from questionnaires, surveys, interviews, and FGDs are analyzed using Microsoft Excel, ArcGIS, and SPSS. The finding of the study highlights critical challenges in urban infrastructure development, including poor stakeholder coordination, resource constraints, and inadequate governance. Rapid urbanization, outdated infrastructure, and weak planning exacerbate key issues such as insufficient urban drainage, sewerage, solid waste management, and transportation systems. Global comparisons underline the need for integrated planning, advanced technology, and strong institutional frameworks to enhance efficiency and sustainability in addressing these problems. Therefore, the study recommends that to solve problems with urban infrastructure, it is important to encourage stakeholders to work together and use comprehensive planning strategies to improve resource allocation, capacity-building programs, and meaningful community engagement.

Keywords

Challenges, Integrated Infrastructures Planning, Metropolitan Region, Coordination

1. Introduction

Nowadays, a global trend of rapid urbanization demands better provision, management, and integration of infrastructure through sound planning and delivery [1, 2]. According to [3, 4], institutions and structures that emerged in the late nineteenth and early twentieth centuries, along with incremental, ad hoc, and largely path-dependent changes in technology, markets,

and regulatory processes, manage and organize nearly all infrastructures in the developed world. Evidence indicates that developed countries have improved integration among institutions and infrastructure. As a result of this rapid urbanization and urban growth inevitably expands beyond cities' original boundaries to neighboring jurisdictions [5, 6]. There is a

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growing discussion today that various forms of 'infrastructure integration' could enable networks to become smarter, more cost-effective, and more environmentally friendly [7-10]. Urbanization creates metropolitan areas or city regions, consisting of a densely populated urban core and its sparsely populated surrounding territories that share industry, infrastructure, and housing [11]. The general populace perceives metropolitan areas as generators of regional development in a globalizing world [12-15].

Integrated infrastructure is a cornerstone of sustainable urban development, ensuring efficient service delivery, resource optimization, and enhanced quality of life for residents [16, 17]. In Ethiopia, the growing urbanization and rapid expansion of metropolitan cities, in Addis Ababa and Sheger, have amplified the need for coordinated infrastructure planning. Effective integration of infrastructure systems spanning transportation, utilities, housing, and public services is essential for fostering economic growth and environmental sustainability [7]. However, achieving this level of integration poses significant challenges in the Ethiopian context.

One of the primary obstacles is the lack of collaboration among key stakeholders, including municipal authorities, urban planners, developers, and local communities. This disjointed approach often results in fragmented planning efforts, inefficiencies, and delays in project implementation. Additionally, resource constraints financial and technical further exacerbate the challenges, leaving critical infrastructure projects underfunded and under-resourced. The shortage of skilled personnel, lack of technology and limited access to modern machinery also hinder the effective design and execution of integrated infrastructure systems in the study area.

Existing literature highlights the importance of addressing these barriers to achieving sustainable urban development. However, there is a notable gap in research exploring the specific challenges faced by Ethiopian metropolitan cities in planning and implementing integrated infrastructure [18, 19]. This study seeks to fill this gap by identifying and analyzing the key obstacles to integrated municipal infrastructure planning between Addis Ababa and Sheger, offering insights that can inform policy and practice. For this as a rationale, we chose these cities because they are the economic hubs of the Ethiopia and Oromia regions, are actively expanding their gray infrastructure to support the economy, and are experiencing rapid population growth, which is exerting substantial pressure on green spaces.

Furthermore, a significant number of government and private employees work in Addis Ababa while residing in Sheger City, and vice versa. However, a lack of integrated infrastructure planning, financial planning, and institutional collaboration between the two cities could significantly impact the smooth operation of transportation infrastructure systems, thereby reducing the efficiency and quality of life of the employees. Furthermore, the upstream wastewater production has a significant potential impact on the downstream environment. Consequently, a lack of integrated development intervention

between the two metropolitan cities is likely to perpetuate such circumstances.

As a result, the aim of this study is to identify and critically analyze the key challenges hindering the effective planning and implementation of integrated infrastructure between the cities of Addis Ababa and Sheger. The other subsidiary objectives are: 1) The study aims to identify and categorize the main institutional, financial, and technical challenges affecting integrated municipal infrastructure planning in the study area. 2) The study aims to evaluate the efficacy of current policies, frameworks, and coordination mechanisms in municipal infrastructure planning in the study area. 3) Formulate evidence-based recommendations for the enhancement of coordination, resource allocation, and implementation of integrated infrastructure planning.

The study's results will provide a comprehensive understanding of these challenges. It will serve as a valuable resource, offering essential insights to policymakers, development administrators, urban planners, and government decision-makers to facilitate the implementation of policies and strategies. Additionally, we anticipate a more comprehensive understanding of the obstacles associated with the planning of integrated infrastructure, which will clarify the policy-making process for urban development in Ethiopia and other comparable contexts in developing countries.

2. Materials, Methods and the Study Area

2.1. Study Area

Ethiopia's capital city, Addis Ababa, functions as its political, economic, and cultural epicenter [20] and [21]. The most recent data [22] estimates the population of Addis Ababa, Ethiopia's capital metropolis, at approximately 5,704,000. Urbanization, economic development, and migration from rural areas have all contributed to the city's accelerated growth in recent years [23, 24]. Nevertheless, the accuracy of population estimates may differ depending on the source, as official censuses may not accurately reflect real-time development. The developing world has experienced economic development opportunities as a result of rapid population growth. However, this growth has also brought about social, environmental, and cultural challenges, leading to a discrepancy between the demand and supply of services [20]. It is imperative to comprehend the dynamics of urbanization and infrastructure development in Addis Ababa in order to evaluate the efficacy of integrated planning initiatives.

In recent decades, there has been a substantial increase in the quantity of social and physical infrastructure; however, there is still a significant need for enhancement in terms of quality and distribution [21]. The government's strategies for its extensive urban investments, which combine the enhancement of the urban environment with the creation of economic opportunities, particularly for urban youth, have yielded some promising results [21]. Nevertheless, it is imperative that we assess, ad-

just, or supplant the policies and strategies in accordance with their effectiveness in addressing the city's chronic issues [21].

The Addis Ababa metropolitan area, as well as Sheger, is currently experiencing substantial population growth and urban expansion, which is resulting in heightened pressure on infrastructure and services. Analyzing the integration of planning processes and infrastructure investments throughout the Sheger Metropolitan Area provides insights into regional development dynamics and interdependencies. A number of satellite cities and villages surround the capital.

Sheger City, a late-established city in the Oromia National Regional State, consists of 12 subcities and villages. Out of this, we deliberately selected three of these sub cities as case study sites: Burayu, Sebeta/Furi, and Galan (Figure 1). For this as a rational, we chose these cities because they are the economic hubs of the Ethiopia and Oromia regions, are actively expanding their gray infrastructure to support the economy, and are experiencing rapid population growth, which is exerting substantial pressure on green spaces. The following Figure 1 shows the location map of the study area.

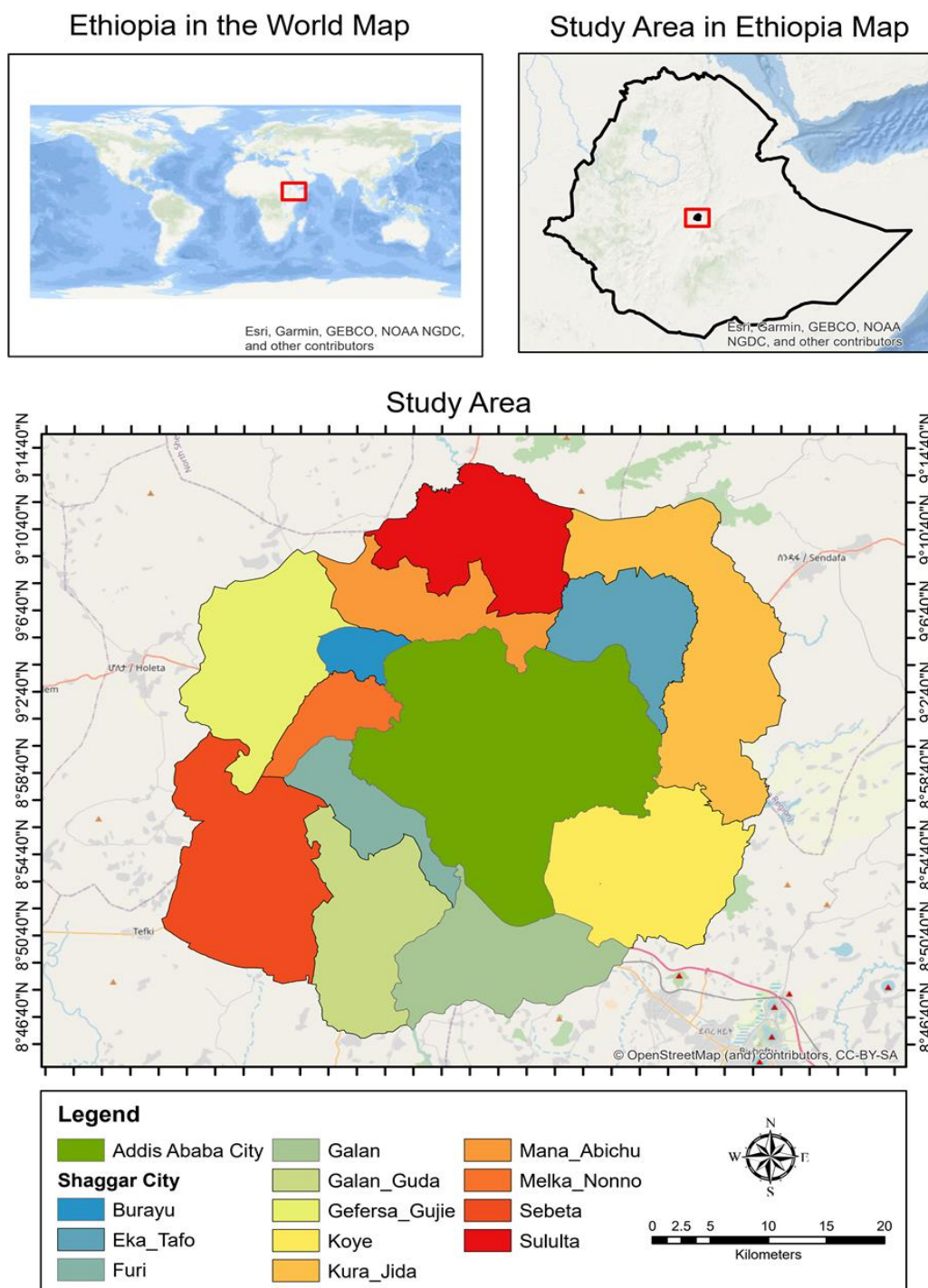


Figure 1. Location map of the study area.

2.2. Research Methodology

This study uses descriptive and explanatory research designs to investigate the challenges of integrated municipal infrastructure planning among Ethiopian metropolitan cities. Descriptive analysis highlights key issues, while explanatory analysis examines causal relationships and contributing factors [25]. We apply a mixed-methods approach, combining quantitative and qualitative research to ensure a comprehensive understanding. Quantitative data offers measurable insights, while qualitative data provides contextual and stakeholder perspectives [26]. The study sites encompass metropolitan areas like Addis Ababa and Sheger city, as well as selected sub cities such as Burayu, Gelan, and Sebeta/Furi, chosen for their unique urban development characteristics. These locations reflect diverse urbanization and infrastructure integration contexts.

We employ a convenient sampling strategy to select towns and participants, with a focus on municipal officials, urban planners, and community representatives. Infrastructure categories include transport and road networks, sewerage and drainage systems, and solid waste management systems. Data collection involves structured surveys for quantitative insights, in-depth interviews, focus group discussions, and field observations for qualitative analysis. Secondary data from government reports and plans supplement primary data collection. Data analysis combines statistical techniques for quantitative findings and thematic analysis for qualitative narratives. Triangulation ensures the reliability of results and highlights any inconsistencies between data sources. The study adheres to ethical guidelines, including informed consent, data confidentiality, and cultural considerations, ensuring a responsible and inclusive research process.

2.3. Data Types and Sources

This study has extensively used both primary and secondary data, including both quantitative and qualitative from Addis Ababa and Sheger city (Burayu subcity, Galan subcity, and Furi subcity), which were the sources of the data. We collected the primary data through various methods and tools such as questionnaires, Focal group discussions (FGDs), and structured and semi-structured interviews with city officials, professionals, and community representatives. We also conducted field observations to enhance the quality of the data and gather additional insights.

We extracted secondary data from research findings, books,

review articles, and both published and unpublished reports to compare and bolster the primary sources.

2.4. Sampling Techniques and Sample Size Determination

The study employed a non-probability sampling method to collect data from 257 experts working across five critical urban infrastructure sectors in Addis Ababa and three selected sub-cities (Burayu subcity, Galan subcity, and Furi subcity) of Sheger City, as shown in Table 2 below. The human resource report of Addis Ababa and the subcities of Burayu, Galan, and Furi in Sheger city indicate that 980 experts or professionals are relevant to the research topic. This approach allowed the researchers to focus on individuals with specialized knowledge and expertise in transport and road networks, waste management systems, and drainage and sewerage systems. The sampling frame consisted of the entire population of experts in the selected sectors, ensuring the inclusion of only qualified individuals with relevant educational backgrounds and professional experience.

We used a convenient sampling technique to select participants from each sector, highlighting their professional relevance and contributions to integrated infrastructure planning. This deliberate selection process ensured the inclusion of those most capable of providing comprehensive and reliable data [27, 28]. Furthermore, the targeted selection allowed for efficient data collection, avoiding the unnecessary sampling of individuals with limited knowledge of the subject matter.

We conducted focus group discussions (FGDs) and interviews with selected respondents to capture diverse perspectives for qualitative data. Following the recommendation that FGD sessions should not exceed 10 participants [29], the study organized FGDs with a total of 90 participants from various population segments. The selection process aimed to ensure fair representation across different sub cities, with participants drawn from community representatives, technical experts, and local authorities. Table 1 and Figure 2 summarizing the number of FGDs and respondents across the Addis Ababa and Sheger sub cities reflect a balanced and structured sampling framework. The study makes sure that problems with integrated infrastructure planning are looked at in a strong and critical way by using purposeful sampling and a clear process for choosing participants. This strategic approach maximizes the reliability of insights while maintaining methodological rigor [30, 31].

Table 1. Number of FGDs conducted in Addis Ababa and each sub city.

| No | Sub city | No. of FGD | Participant per FGD | Total number of participants |
|----|-------------|------------|---------------------|------------------------------|
| 1 | Addis Ababa | 3 | 10 | 30 |

| No | Sub city | No. of FGD | Participant per FGD | Total number of participants |
|----|-------------|------------|---------------------|------------------------------|
| 2 | Sabata/Furi | 2 | 10 | 20 |
| 3 | Gelan | 2 | 10 | 20 |
| 4 | Burayu | 2 | 10 | 20 |
| | Total | 9 | 10 | 90 |

Source(s): FGDs survey, 2023

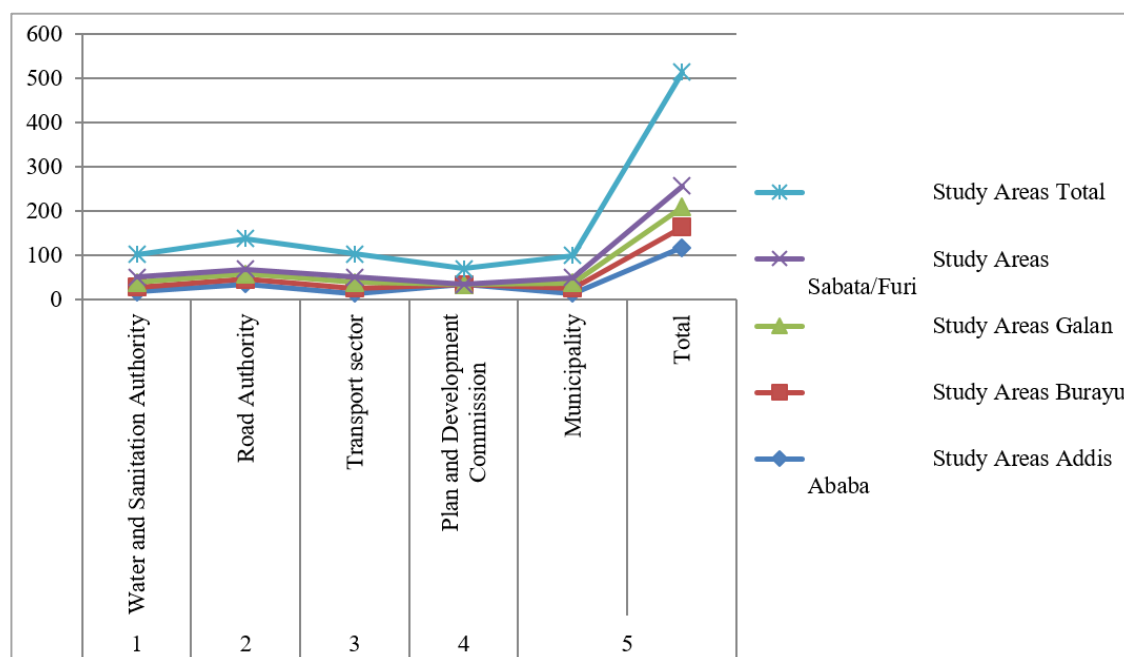


Figure 2. The number of respondents from different sectors answered the questionnaires.

2.5. Data Collection Methods

In order to accomplish the research objectives, we implemented a blend of quantitative and qualitative data collection methodologies. This investigation employed both primary and secondary data. To supplement these methodologies and collect primary data, we developed both closed-ended and open-ended questionnaires. We disseminated these to experts in a variety of infrastructure sectors, addressing a variety of topics, including planning, integration, challenges, and proposed solutions. The questionnaires also inquired about the existence or absence of infrastructure management and collaborative or integrated planning. We acquire secondary data from a variety of sources, including periodicals, books, journals, and reports. It is imperative to possess a comprehensive understanding of the survey area and its inhabitants prior to employing any formal questionnaire procedure [32]. Subsequently, we devised a variety of inquiries for expert perspectives, focus group discussions, and key informant interviews, following a comprehensive examination of the study area and

adherence to the objectives. We have sufficiently devised the questions to ensure that the research focuses on the pertinent aspects required to provide responses to the research topics. Twenty graduate students from a variety of university backgrounds, well-versed in research ethics, conducted the data collection over a two-month period. We conducted the investigation in two phases. The initial stage consisted of the preliminary data collection and pre-survey preparation. Before the full-scale administration, we verified that the queries were substantively significant, logical, and appropriate. In conclusion, in total, we disseminated questionnaires to 257 experts, and we were able to collect 100% of them.

2.5.1. Expert Perspectives

In order to acquire primary and secondary data for both quantitative and qualitative analysis, we elected to implement a field survey. The questionnaire surveys were the most critical component of the fieldwork that occurred during the summer of 2023. This study implemented the "formal standardized questionnaire method" in conjunction with other data collection methodologies. The primary objective of the

expert survey was to acquire a deeper understanding of the planning of integrated infrastructure. We distributed survey questionnaires to 257 purposefully selected and pertinent professionals in the five sectors of the study area. With the help of the data collectors, we made significant efforts to ensure accurate completion and return of all questionnaires. The questionnaires consist of both open-ended and closed-ended queries in order to collect additional information regarding the knowledge gap. As part of a retrospective data-gathering strategy, we were collecting current information. Selected professionals with expertise in urban infrastructure planning comprised the cohort. In order to expedite the process of contacting respondents, researchers implemented convenience and snowballing sampling methods after determining the total number of respondents.

2.5.2. Focal Group Discussions

The study also utilized focus group discussions (FGDs). We utilized 9 groups, each with 10 participants, as seen in Table 1 to foster an open exchange of ideas, which is particularly beneficial for exploring complex issues related to infrastructure development and integration. Additionally,

2.5.3. Key Informant Interviews

This study utilized structured and semi-structured interviews to gather data on integrated infrastructure planning. We conducted the interviews on-site and in office, with permission, recorded them using an audio recorder to ensure accuracy and detail [33, 34]. We conducted interviews with key informant stakeholders, officials, and community representatives to understand the challenges of integrated infrastructure planning in the study area. We conducted the interviews in the study area, each lasting an average of 35 minutes. The interviews were focused on the city's policies, strategies, legal frameworks, challenges, and coping mechanisms.

2.5.4. Field Observations

We utilized a methodology similar to, which involved extensive participant observation. We conducted these observations using a camera and short notes to investigate and assess existing integrated infrastructure planning problems arising from poor integration, planning, and management, thereby providing a visual representation of the identified challenges.

2.5.5. Documents

This study used secondary data to develop information on legal and policy frameworks, reports, infrastructure development trends, and other critical data. Consequently, we collected secondary data from a diverse range of sources, including academic journals, books, published and unpublished documents, government policy documents, proclamations, and statistical data. We collected secondary data from sources such as Addis Ababa structural plan, the federal urban planning

institute, Addis Ababa transport policy document, the Addis Ababa draft sanitation plan, Addis Ababa draft drainage plan, Shegere draft structural plan, and urban planning implementation manual.

2.6. Data Analysis and Presentation

Data gathered using interview, questionnaires, observation and focus group discussion were analyzed in two ways. Quantitative data collected through closed-ended questionnaire were edited, coded, classified, and then encoded into a computer and analyzed using Microsoft excel, AutoCAD and ArcGIS software, Statistical Package for Social Science (SPSS), Version 24 software. We employed a methodical approach to analyze data from focus group discussions (FGD) and observations. Initially, we transcribed the FGD recordings and categorized the responses into thematic areas, with a particular emphasis on recurring patterns, critical insights, and differences in perspectives. We compiled field notes to collect observation data, emphasizing specific behaviors, interactions, and environmental contexts. To validate or contrast the findings, we then triangulated both data sets by comparing the FGD insights with observed actions. The analyzed data is presented in tables, graphs, charts, and percentages.

3. Results and Discussion

Regional infrastructure development is a critical mechanism for promoting sustainable development [35-37]. The region's socio-economic system generally views infrastructure as a component that fosters economic growth. Integration necessitates both coordination and cooperation, as it involves the unification of individuals into a single system. It also advocates for the establishment of a unified, formalized decision-making system and the procedures that enable its operation [38]. The precinct is of significant importance to national economic drivers, and it is imperative that we implement integrated infrastructure planning to mitigate potential future constraints that could limit its productivity and efficiency [39, 40]. We address the following topics in the context of these circumstances:

3.1. Urban Drainage System

3.1.1. Challenges of Integrated Drainage System Development

Table 2. Challenges of integrated drainage system development.

| No | Issues | Frequency | Percentage |
|----|---|-----------|------------|
| 1 | Lack of collaboration among multiple stakeholders | 114 | 44.5 |

| No | Issues | Frequency | Percentage |
|----|--------------------------------|-----------|------------|
| 2 | Inadequate financial resources | 73 | 28.3 |
| 3 | Inadequate skilled man power | 49 | 19 |
| 4 | Insufficient machinery | 21 | 8.2 |
| | Total | 257 | 100 |

Source(s): Expertise survey, 2023

The findings in Table 2 highlighted the critical need for enhanced collaboration among stakeholders in addressing integrated infrastructure challenges. The respondents cited the absence of collaboration, highlighting how disjointed efforts between users, designers, developers, and other parties hinder progress. This lack of coordination underscored the importance of fostering stakeholder engagement and joint planning to streamline efforts and maximize impact. Additionally, resource-related issues, including insufficient funding, skilled manpower, and machinery, further exacerbate the situation. These limitations indicate that a comprehensive strategy to allocate resources effectively and build local capacity is essential.

The results align well with the study's objectives of identifying key obstacles to integrated municipal infrastructure planning. The prioritization of challenges confirms that stakeholder collaboration is a critical factor, directly impacting resource allocation and capacity building. This suggests that the development of an integrated urban drainage system in the study area necessitates the coordination and collaboration of a variety of stakeholders [41, 42]. However, a lack of effective coordination mechanisms can lead to resource inefficiency, conflicting priorities, and duplication of efforts, as confirmed during focus group discussions and key informant interviews.

For example, there is no agreement between the two cities regarding the location of a solid waste disposal site or the construction of a dam for drinking water. Hence, effective infrastructure development and maintenance necessitate sufficient financial, human, and technological resources [7, 35, 43, 44]. As document analysis indicates, there were no common financial sources for the development of integrated urban infrastructure like roads, dams, flood protections, and others. A lack of adequate resources can impede the implementation of integrated urban infrastructure projects and the resolution of urgent issues, such as flooding [45, 46].

Other developing countries facing rapid urbanization have documented similar challenges. Studies from sub-Saharan Africa, South Asia, and Latin America consistently highlight the importance of stakeholder coordination and resource mobilization in infrastructure planning [47, 48]. For instance, research in Kenya and India emphasizes that collaborative frameworks significantly improve project efficiency and sustainability. These parallels validate the relevance of the findings within a broader global context, demonstrating that the

issues faced by Ethiopian metropolitan cities are part of a larger pattern in comparable regions.

The study contributes to the theoretical advancement of urban infrastructure planning by emphasizing the interplay between collaboration, resource availability, and technical capacity. Conceptually, it underscored the necessity of adopting a systems-based approach, where multiple stakeholders work cohesively to address shared challenges. Methodologically, the study provides a framework for identifying and prioritizing barriers, which can guide future research and policy formulation in similar urban contexts.

3.1.2. Perspectives and Challenges in the Adequacy of Urban Drainage System

The study's findings highlight a critical issue regarding the inadequacy of drainage systems in the study area. The significant disparity in perceptions, with only 21.7% of respondents considering the system sufficient and 78.9% deeming it inadequate, underscores the urgent need for improved drainage infrastructure. Field observations corroborate this perception, revealing the absence or scarcity of both open and closed drainage systems, particularly in older road networks. These results suggest systemic neglect in urban infrastructure maintenance and planning, which poses risks of flooding, road degradation, and public health concerns. Such areas lack drainage facilities, indicating inadequate upgrades or maintenance to meet contemporary needs. This phenomenon is frequently observed in rapidly urbanizing regions, where drainage system development is unable to keep pace with population growth and urban expansion [49-51]. The findings align with the study's objectives of assessing infrastructure challenges and highlight drainage as a critical bottleneck in urban planning.

The overwhelming perception of insufficient drainage systems highlights a potential gap in urban infrastructure planning and investment. The absence of proper drainage system, particularly on older roads, points to a need for systematic retrofitting and upgrading of outdated infrastructure [52, 53]. Urban planners and local governments must prioritize drainage in their planning agendas to ensure that both new and old parts of the cities are resilient to environmental stresses. Additionally, the study suggests that the focus on building flood drains only along newly built highways is an example of an approach to development that puts more emphasis on building new infrastructure than on installing new systems and making them better. The mismatch between infrastructure provision and community requirements underscored the significance of meaningful community engagement and participation in infrastructure planning and decision-making processes [54, 55]. Inadequate consideration of local knowledge and preferences can result in a disconnection between infrastructure solutions and the realities and priorities of residents [56, 57]. The results mirror challenges observed in other rapidly urbanizing regions in developing countries. For instance, studies in cities like Nairobi and Dhaka have similarly identified insufficient

drainage infrastructure as a significant urban challenge. These cases linked poor drainage systems to increased flooding, erosion, and public health risks. The parallels between these findings and the current study indicate that the challenges faced in Ethiopian metropolitan cities are not unique but part of a broader trend in under-resourced urban environments. This study underscores the significance of drainage systems in older road networks for urban infrastructure planning, emphasizing the necessity for a thorough assessment and prioritization of infrastructure upgrades in rapidly expanding urban areas.

3.2. Major Challenges of Sewerage Management System

Table 3. Major challenges of Sewerage management system.

| No | Issues | Frequency | Percentage |
|----|--|-----------|------------|
| 1 | lack of financial resources | 131 | 50.9 |
| 2 | lack of coordination among stakeholders | 84 | 32.7 |
| 3 | lack of skilled human power and geographical landscape | 42 | 16.4 |
| 4 | Total | 257 | 100 |

Source(s): Expertise survey, 2023

The data in [Table 3](#) reveals significant challenges in infrastructure development, with (50.9%) of respondents citing a lack of financial resources as the most pressing issue. This indicates that financial constraints significantly hinder the ability to implement and maintain essential sewerage treatment plant projects. The lack of coordination among stakeholders, cited by (32.7%) of respondents, suggests that even when resources are available, inefficiencies and misalignment between municipalities, private sectors, and local communities, as also observed from FGDs, prevent effective project execution. Additionally, (16.4%) of respondents point to a lack of skilled human power, and geographical landscape means terrain such as mountains, hills, and uneven surfaces found in the study areas can complicate construction efforts and increase costs. The slope in the study areas is gentle, and the flow line from the sewerage to the treatment plant is from the upper area to the bottom, in contrast to the present literature, as indicated by the respondents' responses. Additionally, some specific areas prone to flooding or with unstable soil conditions require specialized engineering solutions to ensure structural stability and long-term functionality.

The results align with the study's objectives of identifying and analyzing challenges in sewerage management. The prioritization of financial resources as the primary issue validates the hypothesis that resource constraints are a fundamental

barrier to sustainable sewerage systems [58, 59]. For example, in India, inadequate funding for sewage treatment plants has contributed to widespread water pollution issues. Furthermore, the inclusion of stakeholder coordination and technical capacity issues supports the study's premise that these challenges are interrelated and require a holistic approach to address them effectively. Effective liquid waste management requires collaboration and coordination among various stakeholders, including government agencies, private sector entities, and community organizations [60]. For instance, in Kenya, fragmented governance structures have hindered efforts to improve sanitation services in urban areas [61, 62]. Insufficient human resources and terrain significantly influence the design and functionality of sewerage systems, which primarily rely on gravity flow to transport wastewater. Gravity can effectively transport effluent in regions with a consistent, moderate slope, thereby minimizing the necessity for mechanical pumps. However, level terrains pose challenges [63], as an inadequate slope hinders the natural flow, often requiring the installation of costly pumping stations and increasing the risk of stagnation. In countries like Nepal, the rugged terrain and shortage of trained personnel have hampered efforts to provide adequate sanitation services in remote areas [64]. The absence of established formal structures for coordinating urban development and infrastructure provision exacerbates the challenges associated with sewerage systems [65, 66] highlight the importance of multi-stakeholder collaboration and partnerships in urban infrastructure development. Integrated urban planning approaches that consider multiple sectors and stakeholders are essential for addressing complex urban challenges holistically. Examples from cities like Curitiba, Brazil, highlight the benefits of integrated planning in improving urban infrastructure and quality of life [67-69].

The findings suggest a pressing need for a multi-faceted approach to address the identified challenges, involving increased investment, improved coordination among stakeholders, capacity building, technological innovation, and coherent policy frameworks. Addressing these challenges requires a comprehensive strategy that acknowledges the interconnectedness of urban development and waste management issues. The difficulties in managing sewerage systems in the study areas are indicative of broader patterns observed in urban areas globally, highlighting the need for a holistic approach to tackle wastewater management challenges. The challenges identified are consistent with findings from similar studies in other developing countries. Research from regions such as South Asia and sub-Saharan Africa has highlighted financial limitations as a primary obstacle to effective sewerage management [70, 71]. For example, studies in India and Kenya have shown that inadequate funding leads to poorly maintained sewerage systems, exacerbating public health risks. Similarly, the lack of stakeholder coordination has been recognized as a global challenge, emphasizing the need for integrated planning and governance frameworks [72]. The alignment of these findings with the current study underscores the universality of these

challenges in under-resourced urban contexts. The study highlights the need for a systems-based approach to address financial, organizational, and technical barriers in sewerage management. It provides a model for analyzing issues, highlighting targeted investments and collaborative governance.

3.2.1. Impact of Rapid Urbanization on Sewerage Systems and the Need for Innovative Solutions

The findings emphasize the significant impact of rapid urbanization (85.7%) on the sewerage system. As urban areas expand, the volume of wastewater increases, necessitating advanced technology and innovative solutions to manage the growing complexity effectively. This underlines the strain urbanization places on existing sewerage infrastructure, making it clear that traditional methods are insufficient to handle the rising demands. The key informant interviews conducted further validate these findings, highlighting the substantial financial investments required to construct and maintain modern sewerage systems and lines in urban regions. This result indicates a strong correlation between urban growth and the increasing complexity of infrastructure challenges, particularly in sewerage management. The results directly align with the study's goals of understanding the effects of urbanization on sewerage systems [73, 74]. The confirmation by respondents and interviewees reinforces the validity of the data, showing consistency across different sources. Additionally, the identification of technological needs and financial constraints supports the study's premise that urbanization not only increases system demands but also necessitates comprehensive planning and resource allocation to address these challenges effectively.

The findings highlighted the urgent need to address the impact of rapid urbanization on sewerage systems and the importance of investing in innovative solutions to effectively manage increased wastewater volumes in the study areas [75, 76]. These challenges highlighted the necessity for coordinated efforts among various stakeholders to develop and implement sustainable solutions for urban wastewater management. The challenges in managing sewerage systems in the study areas are representative of broader urbanization-related issues seen globally. Both developed and developing countries design contemporary integrated sewerage management systems in city regions to tackle the challenges of urbanization, environmental protection, and public health [77, 78]. Integrated urban planning techniques that consider various sectors and stakeholders are crucial for enhancing urban infrastructure and quality of life, as evidenced by successful examples such as Curitiba, Brazil [79, 80]. The challenges identified in this study are consistent with global trends observed in other rapidly urbanizing cities. For example, studies in cities like Lagos and Mumbai have shown that rapid urbanization exacerbates the strain on sewerage systems, leading to higher volumes of wastewater and requiring significant technological innovation and financial

investment [81, 82]. The findings also align with research highlighting the complexity of urban sewerage systems in developing regions, where outdated infrastructure struggles to cope with rapid growth. These similarities confirm that the issues faced in the study area are part of a broader global phenomenon. This study explores the relationship between urbanization and sewerage system challenges, emphasizing the need for innovative technology and adaptive solutions, using quantitative survey data and qualitative insights for future research.

3.2.2. Institutional Gaps in Sewerage Service Coordination

The results reveal a critical gap in sewerage service management, with 86% of respondents indicating the absence of formal or informal institutions dedicated to organizing sewerage services in the study area. This indicates a lack of institutional frameworks for planning, coordinating, and managing essential sewerage infrastructure. The absence of such structures can lead to uncoordinated efforts, inefficiencies, and the inability to address growing urban sewerage challenges effectively. These findings underscored the fundamental role of governance and institutional mechanisms in ensuring the functionality and sustainability of urban sewerage systems. The identified challenges in sewerage management highlight the necessity for comprehensive interventions that encompass institutional reforms, legal frameworks, financial investments, government attention, awareness-raising efforts, and institutional cooperation.

The absence of formal institutions and legal frameworks to coordinate sewerage management reflects broader challenges in urban governance and infrastructure development, particularly in developing countries [83-85]. The observation of comparable challenges in urban sanitation in other countries, such as Nigeria and Bangladesh, underscored the significance of robust institutional capacity and coordination mechanisms [86, 87]

The results are consistent with similar findings in other rapidly urbanizing regions of developing countries. Studies in cities like Dar es Salaam, and Dhaka, have highlighted the absence or inefficiency of formal institutions as a major impediment to effective sewerage management [88]. These cases have linked weak governance to inadequate planning, underfunded infrastructure, and public health risks. The alignment of these findings with global patterns reinforces the broader relevance of the current study, situating its conclusions within the context of international urban infrastructure challenges. The study underscores the importance of institutional frameworks in urban infrastructure management, emphasizing the need for robust governance structures to address complex infrastructure challenges and establish or strengthen institutions for sustainable sewerage management in rapidly growing urban areas.

3.3. Urban Solid Waste Management

3.3.1. Challenges in Multi-stakeholder Collaboration: Addressing Barriers in Resources, Manpower, and Infrastructure

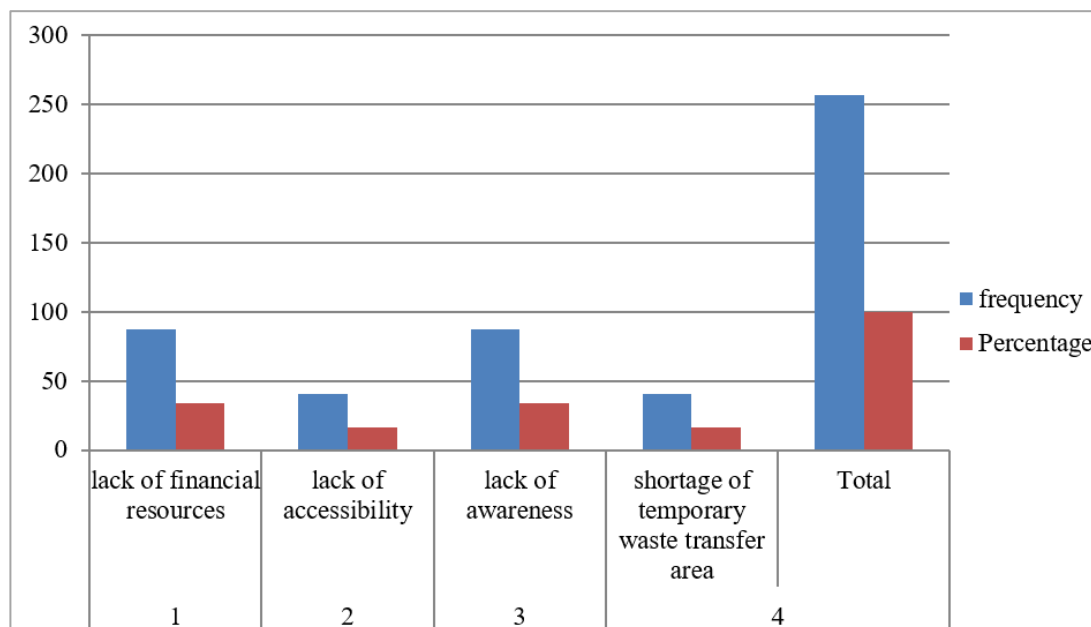


Figure 3. Challenges in Multi-Stakeholder Collaboration.

The responses of the respondent summarize on [Figure 3](#) reveals four key challenges faced solid waste collection stations. The two most frequently cited issues lack of financial resources and lack of public awareness each account for (34%) of the responses. Accessibility issues and a shortage of temporary waste transfer areas, affecting (16%) of respondents each, were also noted. Site observations further support these findings, showing poor solid waste management practices in Burayu, Gelan, and Sebata sub-cities, where solid waste is scattered throughout the area. Additionally, the Raphi solid waste dumping site in Addis Ababa was found to be incompatible with other land uses.

The lack of financial resources, noted by (34%) of respondents, is a significant obstacle to effective solid waste management. This insufficient funding limits investments in infrastructure, staff, and proper collection of the waste. Similarly, a lack of public awareness, also affecting (34%) of respondents, suggests that many individuals may not understand proper waste disposal methods. This lack of awareness was observed during field observations, where scattered solid waste was prevalent in several sub-cities. Accessibility challenges, cited by (16%) of respondents, imply that certain areas may have poor infrastructure or difficult-to-reach locations, which can hinder the efficiency of waste collection. Additionally, 16% of respondents pointed to a shortage of temporary waste transfer areas, indicating logistical issues in the flow of waste from collection points to final disposal sites. The Raphi

solid waste dumping site's incompatibility with surrounding land uses, as seen in Addis Ababa, further complicates the situation.

The lack of financial resources suggests that the waste collection system is severely underfunded, affecting the overall efficiency and effectiveness of solid waste management in the areas. Without sufficient funding, it becomes challenging to improve infrastructure, hire adequate staff, or implement proper waste management practices. This underfunding likely contributes to the poor solid waste management practices observed in Burayu, Gelan, and Sebata sub-cities, where waste is scattered and poorly managed. Public awareness also plays a crucial role. The scattered waste in the observed areas indicates that residents may not be fully informed about proper solid waste disposal practices. This lack of awareness, compounded by the lack of financial resources, exacerbates environmental and public health risks. Additionally, accessibility issues and the shortage of temporary transfer stations further slowdown the waste management process, contributing to the accumulation of waste in certain areas. The incompatibility of the Raphi dumping site with other land uses in Addis Ababa suggests poor urban planning. The lack of integration between waste management facilities and surrounding land uses creates conflicts and inefficiencies in the broader urban environment, further complicating waste management efforts.

The challenges outlined and supported by site observations

reveal a waste management system that faces both financial and logistical constraints. The top two challenges lack of financial resources and lack of public awareness are deeply intertwined. Without adequate funding, authorities cannot improve infrastructure or run effective public awareness campaigns, leading to a cycle of poor waste management and scattered waste, as seen in Burayu, Gelan, and Sebata sub-cities.

Accessibility issues and the shortage of temporary transfer areas further complicate the situation, pointing to weaknesses in urban planning and logistics. When solid waste collection sites are difficult to access or there are insufficient places to temporarily store waste, the entire system becomes inefficient, leading to the accumulation of waste in neighborhoods [89, 90]. The incompatibility of the Raphi dumping site with residential land use type highlights the need for better integration of waste management within broader urban planning efforts to prevent conflicts and improve sustainability.

3.3.2. Key Challenges in Integrated Solid Waste Management: The Role of Urban Planning and Household Awareness

The study highlights several key challenges in integrated solid waste management. The most significant issue, as indicated by (48%) of respondents, is weak urban planning and a lack of understanding of waste management at the household level. When households are unaware of how to sort, handle, and dispose of waste correctly, it leads to improper segregation, increased littering, and reliance on unsanitary methods like open dumping or burning. This behavior not only overwhelms waste collection systems but also contributes to environmental pollution, public health hazards, and inefficient recycling processes. Ultimately, without proper education and awareness, household-level waste management becomes a critical bottleneck in the overall waste disposal system. This suggests that both infrastructure planning and public awareness regarding proper waste disposal practices are insufficient.

Additionally, (34%) of respondents identified the lack of financial support for waste management agencies, while (18%) cited poor coordination and the absence of a legal framework. Insights from interviews and focus group discussions reinforce these findings, with weak planning, insufficient public awareness, and inadequate funding emerging as primary obstacles to effective waste management. Governance issues, including the absence of appropriate legal frameworks and federal structures, hinder the progress of integrated solid waste management initiatives. Financial constraints, institutional aspects, political factors, lack of integration among stakeholders, and outdated policies contribute to the challenges faced in solid waste management in the areas as identified during focus group discussion. Also, inadequate logistics, such as storage, collection, and transportation of solid waste, are significant reasons for inadequate waste management in many

third-world countries.

The results align with the study's objectives that waste management challenges stem from a combination of governance, planning, and resource-related issues. The high prevalence of weak urban planning and inadequate household waste management understanding emphasizes the importance of integrating community-based and systemic approaches [91, 92]. The identification of financial and legal barriers reinforces the study's framework by validating its focus on structural challenges as key areas of concern.

These findings indicate that without strong urban planning and public engagement, waste management systems will continue to be ineffective. Weak urban planning contributes to poorly design waste collection systems, while a lack of awareness at the household level leads to improper waste disposal, complicating management efforts [89]. The lack of financial support for agencies also impedes their ability to invest in necessary resources, further weakening the system. The absence of coordination and legal frameworks suggests that regulatory oversight and stakeholder cooperation are inadequate, which hinders the development of a cohesive and efficient waste management strategy [93]. The combination of weak urban planning and lack of public awareness highlights the need for more holistic and integrated approaches to solid waste management. Local governments must prioritize better urban planning, including robust waste disposal systems, while also launching educational campaigns to raise public awareness about responsible waste management at the household level. The lack of financial support for waste management agencies suggests that a more sustainable funding model is required, possibly through public-private partnerships or government subsidies [94, 95]. Moreover, the lack of coordination and legal frameworks indicates a governance gap, necessitating stronger laws, policies, and inter-agency cooperation to align all stakeholders and streamline waste management processes. Strengthening both regulatory and financial structures will be key to improving waste management outcomes in the study areas.

These findings align with challenges identified in other urban contexts, particularly in developing nations. For instance, studies in Nairobi and Dhaka have similarly reported weak urban planning, insufficient funding, and lack of legal frameworks as major obstacles to waste management [96, 97]. The lack of coordination among stakeholders is a recurring theme globally, often cited as a significant impediment to implementing sustainable waste systems. This alignment situates the study within a broader body of literature, emphasizing the universal relevance of the identified challenges. The study emphasizes the importance of financial, governance, and social factors in urban waste management, emphasizing the need for community education and systemic planning. It provides a framework for future research and practical insights.

3.3.3. Barriers to Establishing Common Solid Waste Disposal Areas: Policy, Communication, and Accessibility Issues

Table 4. Barriers to Establishing Common Solid Waste Disposal Areas.

| No | Issues | Frequency | Percentage |
|----|--|-----------|------------|
| 1 | lack of confidence in administrative boundaries | 26 | 10 |
| 2 | lack of policy direction | 72 | 28 |
| 3 | lack of communication on the distribution system | 87 | 34 |
| 4 | lack of accessibility | 72 | 28 |
| | Total | 257 | 100 |

Source(s): Expertise survey, 2023

The results of the study in Table 4: highlight key challenges faced in establishing common solid waste disposal areas. These findings emphasize the critical role that governance, policy, and communication play in managing urban waste. Lack of confidence in administrative boundaries reflects the challenges of jurisdictional overlaps and unclear responsibilities, which hinder coordinated efforts to establish waste disposal systems. The lack of policy direction points to the absence of a comprehensive waste management framework, while inadequate communication complicates the proper allocation of resources. Finally, accessibility issues, which affect both waste collection and transportation, underline the logistical difficulties in creating efficient waste disposal infrastructure. These findings underscored the need for better governance, clearer policy frameworks, and improved communication strategies to overcome barriers to solid waste management.

The findings align with the study's objectives to identify and assess the challenges in setting up common solid waste disposal areas. The prominence of communication and policy-related challenges validates the objectives that waste management systems are often impeded by systemic governance issues. These results support the idea that a lack of coordination and clear policy direction at both local and regional levels complicates waste management efforts, confirming the study's focus on administrative and planning challenges [98].

Gaps in communication, lack of policy direction, and lack of accessibility are the main negative effects on the management of common solid waste disposal sites [92]. The un-integrated solid waste management planning is widely observed in the study area, reflecting a need for comprehensive strategies to address the identified challenges. Addressing the challenges of

setting up common solid waste disposal areas requires integrated strategies that encompass policy direction, governance mechanisms, communication and coordination efforts, resource allocation, and institutional capacities [99, 100]. Striking the right balance between policy, governance, institutional mechanisms, and resource provision and allocation is crucial, especially in low-income countries; to effectively manage solid waste.

The challenges identified in this study are consistent with waste management issues reported in other urban regions globally. Studies in cities like Dhaka and Jakarta have similarly found that lack of coordination between governmental bodies, insufficient policy frameworks, and accessibility challenges are common barriers to effective waste management [101, 102]. In these cities, fragmented administrative boundaries and policy inconsistency have been identified as key constraints in implementing unified waste management strategies. The alignment with international case studies underscores the universality of these challenges in urban settings worldwide and provides external validation for the current study's findings. The research emphasizes the importance of integrated waste management systems, focusing on governance, communication, and accessibility [103, 104]. It explores barriers to common disposal areas and uses expert surveys to identify challenges. The findings highlight policy coherence, administrative clarity, and effective communication among stakeholders.

3.4. Urban Transport System and Road Network Work

3.4.1. Challenges in Intercity Commuting: Accessibility, Congestion, and Transportation Planning

The study conducted on Figure 4 reveals that the transportation system between the two metropolitan cities is inefficient in meeting the basic needs of commuters, particularly in terms of ease of access and overall service quality. The study areas manifest a systemic shortfall in designing a cohesive, commuter-friendly transport network, as evidenced by the prevalence of issues related to transportation planning. It involves developing policies and infrastructure to create an efficient, integrated, and sustainable transportation network that meets both current and future demands [105, 106]. It involves the design of infrastructure, the forecasting of needs, and the coordination of various modes of transport, all of which can lead to inefficiencies and inadequate infrastructure, as field observations have shown. Poor infrastructure challenges often create physical and logistical barriers that hinder people's ability to reach their destinations, resulting in extended travel times and decreased mobility. A lack of services, meanwhile, means insufficient or low-quality transportation options, such as limited public transit routes or unreliable vehicles, further restricting people's ability to access essential services and op-

portunities.

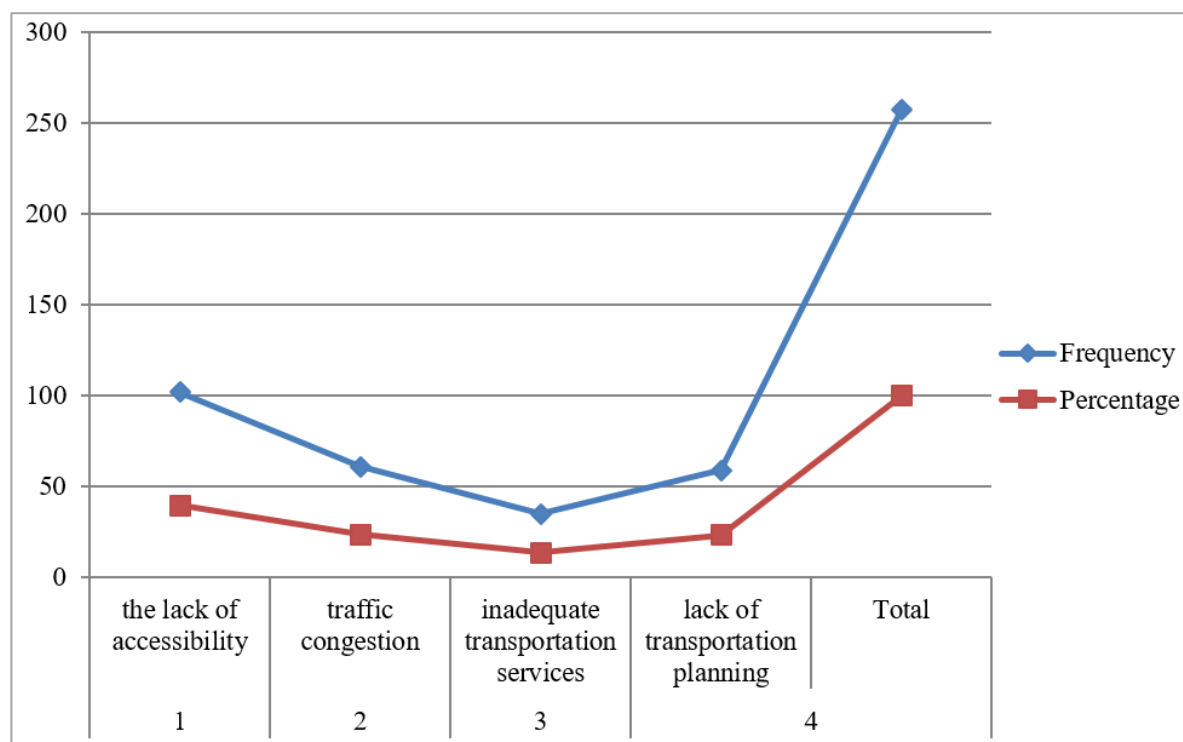


Figure 4. Challenges in intercity commuting: accessibility, congestion, and transportation planning.

Poor accessibility has been caused by inadequate infrastructure, such as insufficient roads or poorly designed transit routes, which make travel difficult, time-consuming, and often unreliable in the study areas, have been observed. This results in residents facing longer travel times or struggling to access public transport in the study areas, thereby reducing their overall mobility and impacting their quality of life. Slow-moving traffic in congested areas extends travel times, potentially increasing commuter stress and reducing productivity [107, 108]. In the study areas, heavy traffic can exacerbate delays and diminish the reliability of transportation systems. It can also contribute to increased vehicle emissions, worsening air quality, and overall environmental impact. Addressing congestion often involves measures such as optimizing traffic signal timings, implementing congestion pricing, and investing in alternative transportation options to alleviate pressure on busy roadways.

In the study areas, inadequate transportation services lead to overcrowding, long wait times, and difficulty in reaching destinations efficiently. This problem may particularly affect low-income or underserved communities that rely heavily on public transport. According to the interview, poor transportation planning results in inefficient transport networks, a lack of integration between different modes of transport, and a failure to anticipate future growth and demand [109, 110]. In the study areas, inadequate planning might lead to poorly designed transit systems that do not address current or future transpor-

tation needs, contributing to problems such as traffic congestion and accessibility issues.

The findings suggest that the lack of accessibility and transportation planning are critical areas that require immediate attention. The relatively high percentage of respondents indicating accessibility as a major issue suggests that many commuters struggle to access transportation options, which could lead to greater reliance on private vehicles and contribute further to traffic congestion. Furthermore, inadequate transport planning exacerbates the challenges, as it may result in poorly coordinated transport routes, inefficient timetables, and an inability to accommodate growing demand (Bruton, 2021; Vuchic, 2017). Without addressing these planning deficiencies, long-term traffic congestion is likely to worsen, which could reduce the overall efficiency of the city's economic and social activities. The results are consistent with the study's objectives, which sought to identify and analyze the challenges affecting intercity travel. The prioritization of accessibility challenges aligns with the hypothesis that systemic and infrastructural deficits are the primary impediments to efficient mobility. The identification of traffic congestion and inadequate transportation services complements the study's focus, confirming the need for both immediate and long-term planning solutions.

The interconnected nature of accessibility, transportation services, and planning highlights the need for holistic approaches to improving the city's transport [111]. Poor planning can often cause a lack of accessibility, while inadequate

transportation services may result from insufficient strategic foresight. Improved transport planning could help address both accessibility and service-related challenges by designing transport routes that better meet commuter demand, creating more equitable access to transportation, and reducing congestion [112]. Additionally, targeted investments in alternative modes of transport, such as public transit or bike-sharing programs, could reduce reliance on personal vehicles, mitigate traffic congestion, and improve environmental sustainability. The findings align with transportation challenges identified in other urban and peri-urban contexts. Studies in rapidly urbanizing cities like Mumbai, India, and Lagos, Nigeria, have similarly cited accessibility, traffic congestion, and insufficient transportation services as major impediments to commuter mobility [113, 114]. These challenges are often compounded by poor transportation planning, as seen in global studies, which further supports the external validity of the current findings. The alignment of these results with broader global trends highlights the universal nature of transportation challenges in urban areas experiencing rapid growth. The study highlights the interconnectedness of urban transportation, emphasizing the importance of integrated systems for accessibility and efficient traffic management [115, 116]. It provides a framework for analyzing commuter challenges and suggests strategies for enhancing road networks and public transportation options.

3.4.2. Professional Adequacy in Integrated Transport Planning: Addressing Perception Discrepancies

The survey results indicate a significant concern regarding the adequacy of professionals available to prepare integrated transport plans. A majority of respondents (87.7%) expressed that there is a shortage of professionals in the study areas qualified to carry out such planning. On the other hand, (126.3%) of respondents believed that there was no problem with the availability of professionals, pointing to a discrepancy in perceptions about the sufficiency of expertise in the field. This disparity suggests a divided opinion on the matter, potentially reflecting varying experiences or exposure to professional services in different areas. Focus group discussions and interviews also support the notion of insufficient experienced infrastructure planners in the study areas. Literature highlights the limited knowledge on integrating environmental aspects into transport planning processes, which is crucial for sustainable urban development. The literature confirms the shortage of experts in integrated transport planning and emphasizes the importance of considering environmental, social, and economic factors in transportation plans [105, 117]. This is an indication that there is a lack of enough experts who work on integrated transport infrastructure planning with in the metropolitan cities. Focus group discussions and interviews also confirmed that there are not enough experienced transport planners in the study areas. Countries like the Netherlands have invested in education and training pro-

grams to develop skilled transportation planning professionals, contributing to successful transport policy implementation [118, 119]. Also, global studies have shown that the lack of skilled professionals is a significant barrier to implementing successful transport systems, especially in developing and rapidly urbanizing regions. The findings of this study align with these international observations, suggesting that the challenge of professional shortages in transportation planning is a widespread issue faced by cities worldwide. Countries like Sweden and Singapore have developed comprehensive transport planning frameworks leveraging multidisciplinary professionals to effectively address urban transportation challenges [120]. These findings point to the importance of human capital in shaping the success of urban transportation planning. The shortage of professionals directly impacts the ability to plan and implement comprehensive, forward-thinking transport systems, and underscores the necessity of investing in education and training programs to build the expertise required for these crucial tasks.

The disparity in responses regarding the adequacy of professionals for integrated transport planning suggests a need for more comprehensive workforce development and training in the field [121]. The significant proportion of respondents citing a shortage suggests a broader expertise gap that requires attention to ensure equitable development across regions, even though some areas may receive adequate service. To bridge this gap, increased investment in education, training, and recruitment of transport planners and engineers is essential. Additionally, encouraging collaboration between government, educational institutions, and the private sector can help to create a more robust pipeline of professionals capable of managing complex, integrated transport projects [122, 123]. The study highlights the importance of human resources in urban transportation planning, highlighting the need for qualified professionals to ensure efficient and suitable transportation networks. It provides a data-driven analysis of human resource constraints, highlighting the need for professional development and educational programs to address the human capital deficit.

3.4.3. Challenges in Integrated Transport Planning and Design

Table 5. Challenges in integrated transport planning and design.

| No | Issues | Frequency | Percentage |
|----|------------------------------|-----------|------------|
| 1 | poor technology | 59 | 23.1 |
| 2 | a gap of knowledge | 50 | 19.5 |
| 3 | lack of rules and procedures | 49 | 19.2 |
| 4 | lack of financial resources | 61 | 23.6 |
| 5 | absence of standards | 39 | 14.6 |

| No | Issues | Frequency | Percentage |
|----|--------|-----------|------------|
| | Total | 257 | 100 |

Source(s): FGDs survey, 2023

The survey results in Table 5 highlight several key challenges that experts identify as major obstacles in integrated transport planning and design. A substantial portion of respondents attribute these challenges to poor technology, indicating that the lack of modern, effective tools and systems is hindering efficient planning and design processes. This is a significant finding in scientific terms, as it underscores the growing need for advanced technological solutions in urban transport management. The respondents who cited a knowledge gap further emphasize the importance of enhancing expertise in the field of transport planning, suggesting that education and training are crucial components for overcoming these barriers. Additionally, respondents pointed to a lack of rules and procedures, highlighting the absence of standardized frameworks to guide planning processes. This lack of structure can lead to inconsistent approaches and ineffective outcomes. Other respondents identified the issue of insufficient financial resources, a challenge that is not unique to the study area but is prevalent across many cities, especially in developing countries. Finally, the absence of clear standards is seen as a contributing factor, reinforcing the need for universally accepted norms and guidelines in transport planning. Collectively, these findings emphasize that integrated transport planning is constrained by technological, institutional, financial, and knowledge-related deficiencies.

These results align directly with the study's goals, which aimed to identify key barriers to effective integrated transport planning. The findings validate the objectives that multiple challenges are contributing to the inefficiency of transport planning and design. The study's methodology using a combination of surveys, interviews, and focus group discussions ensures that these identified problems are not only perceived by experts but also observed through various methods of data collection. The consistency across responses about poor technology, knowledge gaps, lack of rules, and financial constraints suggests that these are indeed central factors in the challenges faced by urban transport planning in the study areas. Furthermore, the diversity in responses points to the complex, multi-dimensional nature of the problem, which requires comprehensive solutions.

The substantial number of respondents who identified inadequate technology as a primary cause suggests that outdated or insufficient technological tools and systems may be impeding the effective development of infrastructure [124, 125]. This could result in increased maintenance costs, de-

layed project execution, and suboptimal designs. The necessity of capacity-building initiatives to provide professionals with the necessary skills for contemporary integrated transport planning and design is underscored by the knowledge divide. Similarly, the absence of financial resources, rules, and procedures highlights systemic deficiencies that can result in inconsistent or incomplete planning and project delays [126, 127]. The absence of standards indicates that a uniform framework for transport development is either weak or absent, which may lead to inconsistencies across initiatives and regions.

The multitude of causes that have been identified underscores the necessity of a comprehensive approach to resolving transport planning and design issues [128]. Modern tools and systems that can improve project outcomes and expedite the design process will likely be necessary to address technological deficiencies. Furthermore, the quality of integrated transport planning and design can be improved by addressing the knowledge deficit through professional development and training programs [127, 129]. The implementation of distinct rules, procedures, and standards through the reformation of institutional frameworks will enhance accountability and consistency. Lastly, the long-term sustainability of transport networks and the successful implementation of initiatives are contingent upon the acquisition of sufficient financial resources. In an effort to establish a more efficient and well-integrated transportation system, it will be necessary for governments, private sectors, and international partners to coordinate their actions properly.

The challenges identified in this study are consistent with those observed in other urban settings, both in developing and developed countries. Similar studies in cities like Jakarta, Indonesia, and Nairobi, Kenya, have highlighted poor technology, financial constraints, and a lack of standardized procedures as significant barriers to effective transport planning [130, 131]. For example, research in Nairobi pointed to the absence of technological innovation in transport planning tools, as well as a lack of regulatory frameworks, which mirrors the results of this study. Additionally, the issue of financial resource constraints is a commonly cited challenge in urban transport planning in both low- and middle-income countries, as seen in studies from cities like Lagos and Cairo [132, 133]. This external validation of the results underscores the relevance of the study's findings within a broader, global context, indicating that these challenges are not isolated but rather part of a larger issue faced by many cities.

The results of this study are significant both conceptually and methodologically. The study suggests a holistic approach to urban transport planning, incorporating technological innovation, capacity building, and strong regulatory frameworks, based on a mixed-methods approach, addressing technological, financial, and knowledge barriers.

3.4.4. Challenges in Integrated Transport Planning

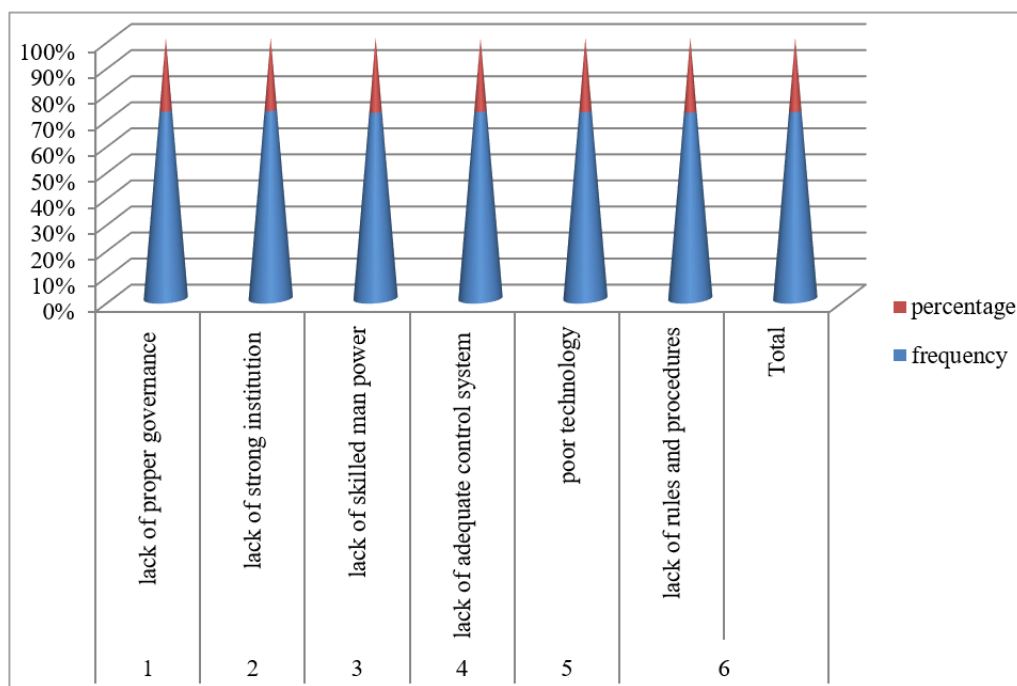


Figure 5. Challenges in the integrated transport planning.

The results on Figure 5 underscored the crucial obstacles that undermine the effectiveness of organizations. The most prominent issue, a lack of appropriate governance (32.5%), indicates a substantial leadership and oversight gap. The lack of competent manpower (13.4%) and poor technology (19.1%) further limits operational capability and human resource development. The absence of defined rules and procedures (12.2%), control systems (10.5%), and strong institutions (10.3%) is indicative of systemic weaknesses in accountability and organizational structure. It is essential to address these issues in a comprehensive manner in order to promote resilience, enhance performance, and achieve sustainable growth.

These findings highlight critical barriers that need to be addressed in order to improve integrated transport planning. In scientific terms, these challenges are indicative of systemic weaknesses within the governance, institutional, and technological support transport planning. Effective governance, strong institutions, skilled professionals, and robust monitoring systems, technology are foundational to creating integrated transport systems that can meet the demands of rapidly urbanizing areas. Previous literatures consistent with study findings, governance are the backbone of coordinated planning and execution [134]. Without a clear governance structure, separate agencies often plan and manage different transport modes, such as buses, trains, and cycling infrastructure, with little collaboration [135, 136]. This results in inefficiencies, as the various modes fail to complement each other, leading to higher operational costs and poor service quality. Integrated transport systems require, technology upgrades, and sustaina-

ble operations [116, 137]. Without adequate funding, cities are unable to invest in modern transport solutions like electric buses, smart traffic management systems, and sustainable infrastructure, leading to a reliance on inefficient and outdated modes of transportation. [138]. Without these, institutions struggle to manage planning processes and facilitate collaboration, leading to inefficiencies and delays. Lack of skilled manpower affects the quality of transport planning and operation, affecting the adoption of advanced technologies like intelligent transport systems [139].

These results directly align with the study's central hypothesis that challenges in governance; technology, institutional weaknesses, and lack of skilled personnel hinder effective integrated transport planning. The significant concern raised about governance corroborates previous research, which has indicated that successful transport planning depends heavily on the capacity and effectiveness of governance structures [135]. The identification of institutional weaknesses and technological challenges further supports the premise that without a strong, coordinated approach, transportation systems cannot be planned, developed, and maintained effectively. Additionally, the recognition of skill shortages and inadequate control systems reinforces the objectives that better capacity-building and stronger regulatory frameworks are essential for successful integrated transport systems.

The lack of proper governance in urban transport systems leads to limited connectivity, increased congestion, and project delays [134]. Weak institutions lack technical expertise, leading to substandard infrastructure and regulatory violations.

Strengthening institutions through capacity building and reform is critical. The shortage of professionals in the transport sector hampers innovation and limits the ability to optimize transport networks. Investing in education and training programs is necessary to build local expertise. Modern control systems, such as intelligent traffic management and data-driven decision-making tools, are essential for improving operational efficiency and enhancing the commuter experience. Additionally, the study's emphasis on skilled manpower and control systems contributes to the theoretical advancement of the field by framing human resource development and monitoring as key components of urban transport success. This insight adds to existing literature by broadening the understanding of the challenges involved in creating integrated transport systems, and provides a foundation for future studies to explore solutions to these systemic issues. This study highlights key issues for improved integrated transport planning, including governance, institutional capacity, financial support, and professional training. It identifies research and policy interventions needed in developing regions and offers insights for strengthening governance structures and institutional capacities.

4. Conclusion and Recommendations

4.1. Conclusion

The study concludes that poor stakeholder collaboration, resource constraints, and insufficient focus on maintaining existing infrastructure significantly impede integrated municipal infrastructure planning. A lack of effective coordination mechanisms exacerbates inefficiencies, while limited financial resources and technical capacity hinder the implementation of sustainable urban systems. These challenges are consistent with those observed in other rapidly urbanizing and under-resourced regions globally, underscoring the universal importance of adopting holistic and systems-based approaches to urban planning. By addressing these interconnected issues, cities can enhance resilience, sustainability, and service delivery.

The study concludes that rapid urbanization intensifies infrastructure challenges, particularly in sewerage systems and solid waste management. The lack of institutional frameworks and financial resources impedes coordinated efforts, exacerbating inefficiencies and environmental risks. Governance gaps, weak urban planning, and inadequate public awareness further hinder effective service delivery. The alignment of findings with global trends highlights the universality of these challenges, situating the study within a broader international context. Conceptually, the research emphasizes the importance of robust governance, stakeholder collaboration, and innovative technologies in addressing urban infrastructure issues. Methodologically, the integration of quantitative and qualitative data offers a replicable model for assessing urban infrastructure challenges.

The findings underline the interconnectedness of accessi-

bility, transportation planning, and service quality as critical factors for efficient urban mobility. The lack of governance, professional expertise, and financial resources creates a compounded problem, limiting the capacity for integrated transport planning. Technological and institutional inadequacies further obstruct the development of efficient systems, reducing connectivity and increasing congestion. The study confirms the objectives that addressing governance, knowledge gaps, and technological deficiencies is essential for achieving sustainable and integrated urban transport systems.

These systemic issues are not unique to the study area but are prevalent in other global contexts, indicating a broader, universal challenge in urban transport management. The results emphasize the necessity for a holistic approach that incorporates governance reforms, capacity building, financial investment, and technology adoption to improve transportation systems.

4.2. Recommendations

Foster collaboration and coordination: Establish collaborative governance structures that facilitate coordination among stakeholders, including government agencies, private sector entities, and community organizations. Encourage joint planning initiatives and integrated decision-making processes to optimize resource utilization and avoid duplication of efforts.

Adopt holistic planning approaches: Embrace holistic planning approaches that consider the interconnections between different infrastructure systems, such as water, transportation, and energy. Integrate climate resilience considerations into infrastructure planning to enhance adaptive capacity and mitigate climate-related risks.

Enhance resource allocation: Allocate adequate financial, human, and technological resources to support the planning, design, and implementation of integrated infrastructure projects. Prioritize investment in drainage infrastructure to address pressing challenges such as flooding and waterborne diseases.

Build capacity and promote community engagement: Invest in capacity-building programs to enhance the technical expertise and skills of personnel involved in infrastructure planning and implementation. Foster meaningful community engagement and participation in decision-making processes to ensure that infrastructure solutions align with the needs and preferences of residents.

Enhance institutional frameworks and institutional reform: Establish formal institutions and legal frameworks to improve coordination, planning, and management of sewerage and solid waste systems. This includes clear administrative roles and responsibilities. Establish clear governance structures and foster collaboration among transport agencies to ensure coordinated planning and execution. Strengthen institutions through capacity building and the development of standardized rules and procedures.

Increase public awareness and adopt new technology:

Launch educational campaigns to promote proper waste segregation and disposal at the household level. Engage communities in decision-making to foster ownership and compliance. Adopt modern tools such as intelligent traffic management systems, data-driven decision-making platforms, and sustainable technologies like electric vehicles to enhance operational efficiency and commuter experience. By implementing these recommendations, policymakers, urban planners, and stakeholders can work towards overcoming the challenges associated with urban storm drainage infrastructure and create more resilient, sustainable, and livable urban environments for current and future generations.

Abbreviations

FGDs Focus Group Discussions

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Ethics Statement

The need for ethical approval was waived off by the Addis Ababa University Graduate Committee because the study involved such things as the use of publicly available data, secondary data analysis, and minimal risk to participants, and the university has no such guidelines and regulations. The Addis Ababa University Graduate Committee granted this waiver in accordance with relevant guidelines and regulations, ensuring the research adhered to ethical standards. Also, Informed consent was obtained from all individual participants included in the study.

Additional Information

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Consent Statement

Even though; informed consent was not required for this study as per the guidelines and approval of the Addis Ababa University Graduate committee given that the study involved the use of publicly available or anonymized data.

Consent Statement of Participants

Informed consent was obtained from all individual participants included in the study. Additionally, verbal consent was

confirmed at the time of the interview or survey.

Consent Statement of Publication

Consent was obtained from all individual participants included in the study for the publication of their data in this manuscript.

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Data Availability Statement

The datasets/DAS/ generated during and/or analyzed during the current study are available from the corresponding author, [Geremew Worku], upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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