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LEVERAGING GIS FOR DATA-DRIVEN DECISION-MAKING IN KAMPALA'S FECAL SLUDGE MANAGEMENT

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Abstract

Rapid urbanization in Kampala has significantly increased the demand for efficient Faecal Sludge Management (FSM) systems. Traditional FSM methods are inadequate, plagued by unregulated disposal, inefficient collection, and the absence of spatial data necessary for strategic planning. Geographic Information Systems (GIS) offer a powerful solution by integrating spatial and non-spatial data to enhance decision-making in faecal sludge collection, transportation, and treatment. This paper explores the potential of GIS in transforming FSM in Kampala, drawing on case studies, identifying current challenges, and recommending future pathways for implementation.

1. Introduction

Kampala, Uganda's capital city, is experiencing rapid urban growth, leading to increased sanitation challenges. Over 90% of Kampala's residents rely on on-site sanitation systems such as pit latrines and septic tanks due to the limited sewer network (KCCA, 2020).

These systems contribute to widespread environmental contamination due to poor regulation, especially in informal

settlements. GIS has emerged as a transformative technology that enables spatial visualization, analysis, and informed decision-making across urban infrastructure sectors, including FSM (World Bank, 2019). This paper examines the role GIS can play in addressing the FSM challenges in Kampala by enhancing data-driven planning and management.

2. The Role of GIS in Faecal Sludge Management

GIS provides several advantages that can transform FSM systems, including:

a. **Mapping Sanitation Infrastructure**: GIS can map the location and density of pit latrines, septic tanks, and sludge treatment plants, which is vital for planning interventions (Ngatia et al., 2022).

b. **Optimizing Collection and Transportation**: Route optimization algorithms integrated into GIS platforms can significantly reduce fuel consumption and operational time for desludging vehicles (Thye et al., 2011).

c. **Monitoring Disposal Sites**: GIS tracking can help monitor sludge disposal activities and prevent illegal dumping, thereby protecting water bodies and communities.

d. **Predictive Analysis**: Historical and real-time GIS data can be used to forecast demand for desludging services and pre-emptively manage high-risk areas.

3. Case Study: GIS-Driven FSM in Kampala

A pilot project conducted by Kampala Capital City Authority (KCCA) and private sanitation service providers utilized GIS to map sanitation facilities in several informal settlements.

The initiative enabled the optimization of collection routes, which resulted in a 20% reduction in fuel consumption and improved service coverage in previously underserved communities (KCCA, 2021). Additionally, the data helped identify sanitation hotspots and contributed to the formulation of a city-wide FSM improvement strategy.

4. Challenges and Limitations

Despite its promise, GIS integration in FSM in Kampala faces several challenges:

a. **Data Gaps**: Many existing maps are outdated or incomplete, making it difficult to make informed decisions (UN-Habitat, 2020).

b. **Limited Technical Capacity**: There is a shortage of trained GIS professionals within municipal agencies and FSM service providers.

c. **Financial Constraints**: The costs associated with acquiring GIS hardware, software, and training are significant.

d. **Policy and Coordination Issues**: FSM responsibilities are fragmented among multiple agencies, resulting in weak coordination and lack of coherent policies (WaterAid, 2020).

5. Recommendations and Future Directions

To harness the full potential of GIS in FSM, Kampala should:

a. **Develop a Centralized FSM GIS Database**: A shared digital platform accessible by government, Private Sector, and Civil Society would streamline data collection and utilization.

b. **Invest in Capacity Building**: Training programs for GIS professionals, urban planners, and FSM operators are essential for sustainability.

c. **Strengthen Policy Frameworks**: Sanitation policies should mandate the use of spatial data in planning and service delivery.

d. **Encourage Public-Private Partnerships (PPPs)**: Collaboration with tech startups, NGOs, and research institutions can bring innovation and funding to GIS projects.

6. Conclusion

GIS offers a transformative tool for enhancing faecal sludge management in Kampala. By providing spatial intelligence, GIS can guide resource allocation, improve service delivery, and ensure environmental protection. The successful scaling of GIS in FSM requires political will, sustained investment, and multisectoral collaboration.

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