GIS Analysis of Human Excreta Management in Slum areas and its impacts on the Environment -Viwandani, Nairobi Kenya

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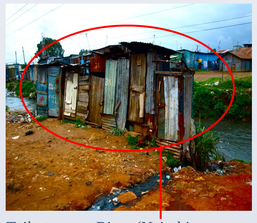
Introduction

- Informal settlement in many developing countries in the world are overwhelmed by lack of essential infrastructure, scarce and strained resources, which causes significant public health problems.
- Nairobi, the largest city in Kenya, has several informal settlements, which lack systems for managing human excreta.
- This research paper, we closely examined the human waste management problem in the Viwandani informal settlement in Nairobi, Kenya.
- Scarce, unsafe, and unhygienic sanitation facilities result in multiple and overlapping health problems in urban informal settlements.

Problem Statement



Toilets near a River (Nairobi River)

Waste water discharge directed into the river

Clean water tanks near toilets

- Diarrhoea has the highest percentage of cases of diseases reported by residents of Mukuru slums of 33%.
- Typhoid remains third in percentage among the diseases affected Mukuru residents with 20%

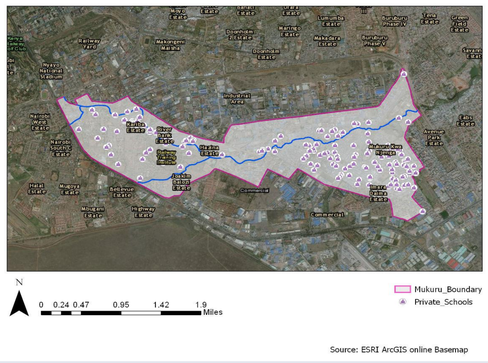
Type of Disease	Frequency	Percentage
Diarrhoea	323	33
Diabetes	215	22
Typhoid	200	20
Fever	105	11
Malaria	72	7
Skin rash	65	7
TOTAL	980	100

Table 1: Percentage of Complaints for slum dwellers for the past six months (Source; Mukuru health center- June 2018).

Methods

Study Area

- Mukuru is a slum located to the South eastern side of Nairobi, in Embakasi sub-county and is one of the largest slums in the city along with Kibera and Mathare.
- The 2009 Census results show the population of Mukuru as 255,094, spread into 4 main villages, namely Mukuru Nyayo32 (53,303), Mukuru Kwa Njenga (130,401), Landi Mawe (26,509), and **Viwandani** (44,881) (KNBS, 2010a; 34-36).



- Urban slums do not have official demographic numbers because slums are not recognized officially.
- Maps of Nairobi almost universally show slums as unoccupied land (Karanja & Makau, 2006).
- This study narrowed down to Viwandani area, located in Imara Daima ward, Embakasi Constituency

Approach and Data Source

- Reviewing literature on slum sanitation in Nairobi.
- Carrying out a survey on the quality of life within the slum.
- Mapping Physical locations of environmental sanitation facilities (water access points, latrines) in Mukuru slums-Viwandani and entered into a Geographic Information System (GIS) database.

Life quality survey

- Established the conditions of toilets in Viwandani area
- Checking on total population of slum dwellers sharing a public toilet
- Established the location of housing and distance from the River (Nairobi River)
- Established colocation of toilets with Clean water points within the study area
- Analyzing the distribution of toilets and Clean water points

Kernel Density

- Kernel Density calculates the density of features in a neighborhood around those features. It can be calculated for both point and line features.
- We chose this tool to calculate the distribution of toilets and the clean water tanks that are close proximity to each other, and the colocation within the radius of 30 meters from the main river.
- We also used a band width (most important criteria) of **h=0.5** since there is a high concentration of toilets downstream.
- The choice of bandwidth will affect the outcome of the results. The larger the bandwidth, the larger the hotspots.
- Using Normal distribution over other univariate kernel density functions gives perfect smoothing and is unbounded.

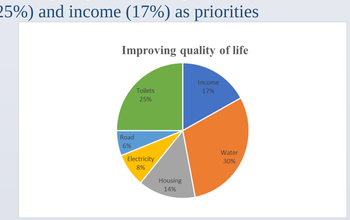
Results

Quality of life Survey

		Very Poor			Poor		Normal		Good		Very Good	
Slum \ Score		0	1	2	3	4	5	6	7	8	9	10	Total
Mukuru	Number	0	2	36	22	12	7	7	5	2	3	0	96
	%	0	2	38	23	13	7	7	5	2	3	0	100

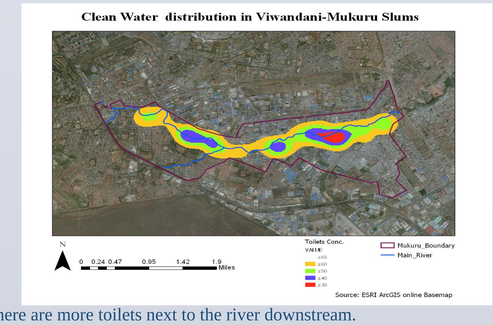
Table 2. Respondents' scores on their quality of life source: KIM USUK 2013

- There were 76% of the respondents in Mukuru that responded that their quality of life was "Very Poor" or "Poor".
- A 65 percent of the slum dwellers that were interviewed responded with dissatisfaction with water supply.
- Of the 65%, 71% claim there is inadequate number of toilets within the slum, and the ones available are situated next to the river, clean water tank, and there is frequent open defecation, which exposes them to diarrhea and food contamination .
- According to slum dwellers, there are 3 sectors among water, housing electricity, road, toilet, income and sewage which could be prioritized to improve their quality of life. Respondents in Mukuru selected water (30%), toilets (25%) and income (17%) as priorities



Toilets distribution

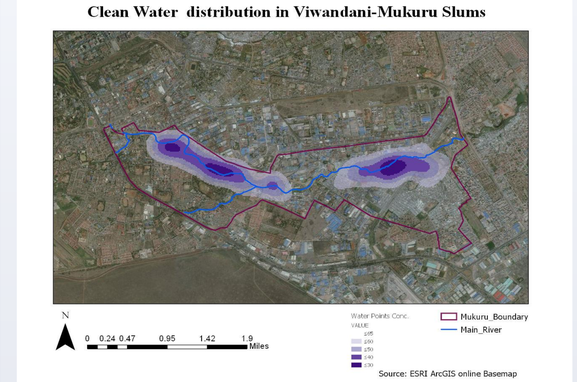
- 90% of toilets that were mapped are within the boundary of 30 meters away from the river and clean water points.
- 75% of Mukuru slum residents reported having poor health.
- This is attributed to poor sanitation and poor management of faecal materials.



- There are more toilets next to the river downstream.

Water distribution

- Children in Mukuru slums are always experiencing chronic diarrhea each new day.
- This has been attributed to most water points located near toilet facilities as well as due to open defecation.
- 82% of water points in the slum are within 30 meters from the toilets, this has brought about health issues within the slum.



Recommendations and Conclusions

- We have shown how self-rated health varies by different environmental conditions in Viwandani and the spatial distribution of toilet facilities.
- Based on the analysis of available toilets and their distribution, action need to be undertaken to improve the living conditions of slum dwellers.
- These strategic actions plans need to be developed not only at the sector level (e.g. water), but also at neighborhoods.
- Slum upgrading projects should be actualized gradually in terms of not only water supply system but also basic services such as housing, electricity, road and sanitation.
- Sanitation programs must encourage the safe disposal of Human feces in order to produce maximum health gains
- Although respondents in Mukuru- Viwandani slums were using improved water supplies such as kiosks and private vendors through water pipes, access to quality water in terms of availability, physical accessibility and economic accessibility based on international guidelines and national policies was not sufficient, exposing them to diseases.

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