GIS Application to Contain Cholera Epidemic in the City of Lusaka

Obed C. Kawanga1,2

Abstract
The paper discusses the practical experiences of application Geographical information system (GIS) to contain cholera epidemic in the peri-urban settlements (squatter compounds in Lusaka, Zambia, for the period starting from 20th October 2003 to March 2004). It also highlights the Cholera prevalence trends as well as the spreading patterns for the ten (10) selected compounds in Lusaka, with more emphasis on George/Madimba. GIS application is proved suitable and convenient approach with proper integration of knowledge and easy interpretation of data to aid planning based on identified risk factors that influenced the spreading of cholera epidemic. It also helped to come up with effective intervention strategies that directly or indirectly provided diverse solutions to contain an epidemic and promote community participation. Therefore, several risk factors and indicators that influenced the rate at which cholera was spreading were examined. This includes the following: - Sociological and ecological factors such as social interactions, residence pattern of settlement, and livelihood. It also analyzed the personal hygiene practices, Climatic change as well as logistical aspect (technical planning).

Lusaka is the capital city of Zambia; a fast growing town in sub-Saharan Africa and the Population of Lusaka is estimated at 2 million. The peri-urban population ranges from 40% in small towns to 80% in cities, although local authorities regard these settlements as “illegal” or “squatter” compounds they continue to grow without planning controls.

1. Summary
Zambia is one of the most highly urbanized countries in Sub-Sahara Africa with estimated population of 10.5 million. The rate of urbanization has resulted into unplanned, informal settlements commonly known as Peri-urban areas. The Peri-urban population is estimated to range from about 40% in smaller towns to 80% in big cities. Lusaka City has 44 Peri-Urban Areas. Although local authorities regard these settlements as “illegal” or “Squatter” compounds, they continue to grow without planning controls (Kawanga 2004, 12).

Lusaka is the capital city of Zambia and it is the focal point of Zambia’s economic, political and international affairs. Lusaka was founded in 1913 and on 31st May 1935 it became the administrative center of Northern Rhodesia (Zambia). It was conferred into status in 1960, and became independent in 1964. At independence the city had a population of only 195,700, currently the city is a fast growing town, with estimated Population of about 2 million (CSO 2000 Census).

1 Obed C. Kawanga, Central Statistical Office, P.O.BOX 31908, Lusaka Zambia
2 or founder President; Network for the Environmental Concerns and Solutions (NECOS-Zambia), Lusaka
80% of the population live in un-serviced areas (shantytowns) or peri-urban usually located in flood-prone areas where formal developments avoided. The common excremental sanitary disposal systems in these areas are on-site traditional pit-latrines, which are characterized among other things by short life span, no standard design, odours, permeability, breeding ground for vermin and pathogenic (bacteria and parasites) making a pit-latrine a source of pollution (air and ground water) as well as source of infectious diseases and environmental hazard (LCC & GRZ 1997).

Uno Win bland and Wen Kilama (1985) conducted a study to determine the causes of most infectious diseases; the investigation identified that poor sanitation is the major cause of most human infections. Infections spread through inadequate sanitation include: viral diseases like cholera, typhoid, paratyphoid and bacillary dysentery; protozoal diseases like amoebic dysentery and worm infections like ascariasis, pinworm spread through direct contact, indirect via water, soil and food or via carriers. The study further finds that; without effective community-wide method to contain excremental, the full health impacts of a plentiful water supply will not be appreciated.

Zambia has already recorded major epidemics such as the 2003/04 cholera outbreaks, which recorded 5,900 cases as at 28th March 2004 with 244 deaths. In 1992 Zambia reported 6,250 cholera cases with a Case Fatality Rate (CFR) above 10.5%, while Lusaka district alone reported 6,478 with a Case Facility Rate (CFR) of 1.3% in 1999. In the same year 1999, the cholera outbreak in Lusaka was established as an endemic and was not reported as an epidemic, in an epidemiological environment.

Endemic cholera has ravaged the City of Lusaka for almost every year from 1990 to 2004 except for 1994, 1998, 2000 and 2002. This regular occurrence of the disease has necessitated the need for the NCOES to start preparation for sustainable intervention strategies such as introduction of ecological sanitation to improve the peri urban environment, which is the source of most infections. The changes in the epidemiological environment in Zambia pose a major threat to health security, which is presently manifesting itself in most peri urban areas creating formidable public health problems. The recent cholera epidemic in Lusaka district is influenced mostly by sanitary conditions in the peri urban communities.

Cholera is an epidemic disease and those who are infected develop diarrhea. About 1% develop fulminating diarrhea and vomiting with very frequent, rice water stools, and rapid onset of severe dehydration and death in 70% of such cases unless urgent rehydration. In children it is difficult to distinguish from other diarrhoeas but treatment is the same with emphasis on rehydration. (Monica and Bennett 1985).

2. Introduction

George/Madimba is one of the peri urban areas in Lusaka that started as an unplanned settlement with an estimated population of over 3,000. 47% of the population are male and 53% are female. They occupy an area of about 1.2 Square Kilometres (KM²), representing 0.33% of an estimated 360 Square Kilometres (KM²), of Lusaka district. There is approximetry 567 number of households occupying more than 500 housing units. Madimba is a local name that means gardens (Farms). The first settlers in the area were the American missionaries who belonged to the Church of Christ in the year 1960. Among the earliest settlers were Mr. Lion accompanied by Mr. Muwaango and his family, followed by Mr. Clime. Mr. Clime later sold the land to Mr. Whiteman, who was a coloured in 1970. Mr Andawa then bought the land from Whiteman in the early 1970s. Mr Morton a Portuguese farmer occupied the area that currently belongs to Twikatane, then followed by a Mr. Bwalya. The population by then were only four households. Madimba is located to the northwestern side of the city centre about 10KM away, towards Barlastone park in Lusaka.
west. Since the area is not serviced and underground water table is high, many dig shallow wells in their yards adjacent to their homes and use the water for daily activities. The openings of these wells are generally at ground level, and occasionally up to 4-5 inches above ground (Kawanga, 2004, 4-5). The critical community concern is that every year there are cases of children drowning in open unprotected pits or shallow wells which has reached a death toll of 12, since 1995. Another problem is that toilets, generally traditional pit-latrines are often dug within several yards from the wells. A scenario of having pit-latrines closer to shallow wells has resulted into massive ground water contamination. The biological analyses of the water samples collect from three points in 2004 isolated E.coli, Salmonella and other bacterial responsible for Diarrhoeal cases. During the rainy season, the excrement in the latrines overflow with rainwater as well as percolation of faecal coliform into the shallow wells causing the situation to be even more worse. Cholera is endemic in this area and during the 2003/4 cholera outbreak we applied GIS.

5. Main Water Sources

The main water sources are shallow wells that counted for 68%, Kajima (JICA communal taps counted for 20% and 12% counted for other sources. Most of the residents who draw water from JICA communal taps walk long distances of about 500 meters to 1km or more to those who stay fur away from the communal taps. During rainy season the shallow wells are more contaminated with faecal coliform from latrine overflow due to rainwater run off and percolations from traditional pit latrines. The shallow wells are the danger to the children who drown at least one per year and the number has retained 12 deaths by March 2005. Although wholesome safe water found fur away the residents of Madimba have developed a cost sharing skill to run communal (JICA) water sources found in the near by compounds. The cost-sharing concept demands a monthly contribution of K3000 that is less than $1. The maximum daily litre of water is 20 by 20 litres containers (Budiza).

![Image of floods in Madimba Peri Urban Community](attachment:image.png)

Fig. 1: Floods in Madimba Peri Urban Community Source: Madimba Baseline Survey 2004

Ecological planning in human society occupies a key position in management of its relationship with the natural environment that ultimately leads to economically empowerment, improved support and provision.
of services (Tjalingii, 1995). Ecological landscape lacks in Madimba area resulting in rainy water
collection, making most pathways impassable during rain season. Shallow well are contaminated by rainy
water. Figure 1.

6. GPS/GIS Application

GIS was used at all the stages during cholera out break, it is proved suitable for making technical
decisions. It is a convenient approach for knowledge integration and easy interpretation of data to come up
with cholera intervention strategies. Based on the cases of cholera reported, GPS was used to allocate the
points for easy analysis and interpretations of the risk factors that influenced the spreading of cholera
epidemic. It also helped to come up with effective intervention strategies that directly or indirectly
provided diverse solutions to contain an epidemic and promote community participation. Therefore,
several risk factors and indicators that influenced the rate at which cholera was spreading. Figure 2 & 3.

Data revealed that the month of December in 2003 and January 2004 recorded highest temperature of 31°C
and 31.9°C respectively while November recorded 30.3°C. The high temperature levels are associated to the
seasons reported cholera out break. The two seasons 1999/00 and 2002/03 recorded lower temperature and
did not report any cholera out break, hence high temperatures have some influence to cholera out break.

It was observed that the climatic changes have some influence to the rates at which cholera spreads. The
peak cholera cases was observed on the last week of January from 26th to 1st February 2004 that counted
for more than 800 cases and was recorded highest. The first peak recorded from 5th to 11th January while
the third peak observed in the 3rd week of February 16th to 22nd where as the fourth peak recorded in the
second week of March from 8th to 14th and counted for 531 cases. A peak of 115 cases was observed,
counted for more than 100% from 19th to 25th March 2001. The periods indicated peak cholera cases
recorded high rainfall and favorable temperature for Vibrio Cholera to strive. This situation resulted in
more people contracting the disease as revealed in the chronological and accumulative trends in figures
2,3, & 4.

Fig. 3,4

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8. Conclusions

GIS application is proved suitable and convenient approach with proper integration of knowledge and easy interpretation of data to aid planning based on identified risk factors that influenced the spreading of cholera epidemic. It also helped to come up with effective intervention strategies that directly or indirectly provided diverse solutions to contain an epidemic and promote community participation. Therefore, several risk factors and indicators that influenced the rate at which cholera was spreading were examined. Among the number of factors, which influenced the rapid spread of an epidemic during 2003/04, outbreak, includes the sociological and ecological factors, Settlement pattern, personal hygiene practices and logistics (technical planning) as well as the above-analyzed climatic conditions. The social interactions were observed among the community members and continuous visitation to households reported Cholera cases. Most Shallow wells are poorly sited, close to pit latrines resulting in ground water contamination. Indiscriminate disposal of solid waste was observed, heaps in the midst of the residential areas along or by the side of the road. GPS was used to determine the housing unity arrangements that closely linked with or no space in between, creating congestion in the residential area. Cholera spreads so fast in a congested environment like George/Madimba.

Bibliography