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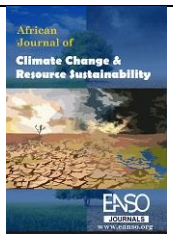

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Original Article

Urban Flooding: A Case of Ng'ombe Settlement in the City of Lusaka, Zambia

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ABSTRACT

Urban flooding has become perennial in most African countries, inducing socio-economic miseries in affected communities. Climate-induced rainfall, community negligence and lack of coordinated infrastructural development policies remain a threat in Africa's sub-Saharan cities. Zambia's City of Lusaka and Ng'ombe settlement, in particular, have not been spared from floods. Using a mixed methods approach, the study investigated the causes and effects of flooding in Ng'ombe settlement in the City of Lusaka. A probability sampling method was used to select 147 respondents whose households were severely affected by floods. A non-probability method was used to select key informants. The key informants were the Provincial Disaster Management & Mitigation Coordinator, and Directors of Planning in the Lusaka City Council, Ministry of Local Government & Rural Development, and Ministry of Housing & Urban Development. Questionnaires and interview guides were used for data-gathering from the respondents and key informants, respectively. The study revealed that 43% attributed the cause of flooding to a lack of professionally constructed drainages while 25% mentioned unplanned settlements as a major cause. Unsupervised construction works and indiscriminate waste disposal came out third and fourth at 15% and 13%, respectively. Those who said their properties were damaged by floods stood at 69%, followed by 20%, whose households were affected by waterborne diseases. Out of the 69% of the respondents who had their properties damaged by floods, 24% of them, who were the majority, built the walls of their houses using sun-dried bricks meant for temporal structures. The study concludes that flooding triggers socio-economic miseries in the Ng'ombe settlement. To avert this, the study recommends the following; construction of professionally designed drainages; strict supervision of construction works by the Lusaka City Council; effective systems of solid waste management; regular clearing of drainages; and normalising illegally built houses, where possible.

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INTRODUCTION

One of the most threatening climatic disasters affecting Africa is urban flooding. Over the past decade, urban flooding has become a menace in many African countries, including Zambia. Urban flooding poses challenges to development because of its devastating socio-economic and environmental impact on the affected communities. Urban flooding has destroyed infrastructure and increased human casualties in some African countries (Abass et al., 2020). Abass et al. (2020) explain that millions of people were displaced during the 2018-2020 period in Africa due to heavy rainfall that caused severe floods in urban areas. Rehman et al. (2019) who looked at mitigation systems for flood disasters in Ghana established that floods occur almost every year. Floods adversely affect livelihoods and infrastructure, and render many people homeless, particularly, those who live in informal settlements (Rehman et al., 2019).

Zambia has not been spared from the devastating effects of floods in urban areas which have a higher concentration of population than rural. The projections in the 2022 Preliminary Census of Population and Housing indicate that almost half of Zambia's population is now concentrated in urban settlements (Zambia Statistics Agency, 2022). In Zambia, people who migrate from rural areas often settle in unplanned settlement areas, with no access to basic services, thus increasing the degree of vulnerability to natural hazards such as floods (Matsushita & Ono, 2023). Lusaka, the capital city of Zambia, which has approximately 3.1 million inhabitants, is recording one of the fastest population growth rates of the continent (over 4.6% per annum) and is severely affected by floods (Matsushita & Ono, 2023).

Ng'ombe settlement, situated in the capital city of Lusaka in Zambia, is one of the settlements affected by heavy floods due to intense rainfall arising from climate change (Kapembwa & Mubanga, 2021). Ng'ombe settlement covers about 933,259.33 m^2 of almost high land (Mwamba, 2020). Most houses in Ng'ombe settlement are not well-planned as they were haphazardly constructed and located very close to each other (Mwamba, 2020). Ng'ombe settlement has an estimated population of 92, 000 people. The population in Ng'ombe settlement is growing very fast due to high birth rates and immigration of people from other areas (Zambia Statistics Agency, 2022). Many residents in Ng'ombe settlement work in the informal sector (Mwamba, 2020). The majority of the residents live in poverty, have no or limited education, are unemployed, lack decent housing, and are prone to diseases due to poor sanitation and overcrowding (Mwamba, 2020).

Ng'ombe settlement experiences untold forms of the suffering of community members due to flooding. Many foundations of houses get

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submerged in water forcing the residents to wade in filthy water ponds (Kapembwa & Mubanga, 2021). Several households have been affected by the floods resulting in deaths, in some instances. Kapembwa and Mubanga (2021) explain that over 200 houses in the Ng'ombe settlement get flooded following heavy downpours, and residents are accustomed to this phenomenon. The flooding in Ng'ombe settlement is historical, hence, the need to find a lasting solution.

Figure 1. Images of waterlogged areas due to flooding in Ng'ombe settlement.

Source: Field survey

Few studies have been conducted to get scientific first-hand information on the causes and effects of floods from the flood victims' perspective in the Ng'ombe settlement. Most information on flooding in the Ng'ombe settlement is found in secondary research reports and some government line ministries' periodic reports. It is this backdrop that necessitated this study to investigate the causes and effects of flooding in Ng'ombe settlement in the City of Lusaka. Specifically, the study aimed to; develop an understanding of the causes of flooding, establish the risks associated with flooding in the communities; and establish the flood victims' perceptions of solutions to the flooding in the settlement.

The study results are envisaged to assist policymakers and other stakeholders in developing feasible strategies that would help to find permanent solutions to the flooding in Ng'ombe settlement. The findings and recommendations of this study can be applied to other settlements in the City of Lusaka which have similar characteristics to the Ng'ombe settlement. Also, the findings and recommendations can serve as a reservoir of information adding to the body of knowledge.

LITERATURE REVIEW

An overview of the concept of flooding in the world

Flooding events have become more recurrent in several countries and present alarming socio-economic threats with major devastating effects. Compared to the figures of the 1900s, the intensity of flooding has almost doubled in all the continents since the 2000s due to climate change (Dalu et al., 2018). In 2022, floods accounted for 50% of people affected by natural hazards (Dalu et al., 2018). The world's upsurge in floods can be explained by various factors, such as climate change which generates changes in precipitation regimes and intensity which often manifests in torrential rains (Chinowsky et al., 2015). Extreme changes in weather patterns worldwide are examples of the effects of climate change that trigger flooding.

An overview of the concept of flooding in Africa

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In Africa, flooding has become one of the major threats to deal with because of the poor/limited infrastructure, low capacities of local governments and lack of coordination by relevant stakeholders (Adelekan et al., 2015). The rapid urbanisation of the African cities has also necessitated the demand for land. People with limited income who cannot afford housing in flood-free areas tend to settle in flood-prone areas, which are mostly cheap (Mwingnè et al., 2022). Additionally, people living in poverty are relatively overexposed to flooding and usually cope with flooding because of limited alternatives (Adelekan et al., 2015). In Africa, management plans to deal with floods are being developed and implemented, however, it appears that effective implementation remains a challenge. For example, despite the effort to address urban flooding in Ouagadougou in Burkina Faso, the problem persists due to the high cost of mitigation measures and the inability of the people to change their attitudes (Mwingnè et al., 2022). As a result, apart from the destruction of properties and economic losses due to flooding, people living in flood-prone areas in Ouagadougou are at a high risk of contracting waterborne diseases (Mwingnè et al., 2022).

Causes of flooding in urban areas

Ineffective drainage systems

Poor drainages are some of the causes of urban flooding in many African countries. The bad drainage systems coupled with poor maintenance cause siltation which results in blockages of drainages leading to flooding (Adelekan et al., 2015). Poor and inadequate drainages have been explained in terms of absence, insufficient, undersized, blocked drains and poorly maintained drainages. Authors have argued that the current system which relies on drainage efficient systems to manage stormwater is not sustainable (Adelekan et al., 2015). Adelekan et al., (2015) explain that such stormwater system management is not environmentally friendly and is developed at the expense of biodiversity. Its use is based on the construction of physical structures, whose size cannot be varied when the run-off they receive exceeds their design capacity, a situation which calls for their removal and reconstruction to increase capacity (Adelekan et al., 2015). Other writers argue that the continued use of drainage efficient systems has a disadvantage on biodiversity as it promotes the orphaning of surface water bodies by ensuring that surface water generated from stormwater run-off is quickly carried away from built-up areas (Dodman et al., 2017). This way, rainwater which could have been stored to infiltrate the soil, retained to recharge groundwater reserves or utilized by surface vegetation flows into the rivers or seas (Dodman et al., 2017).

Poor waste management systems

Poor waste management systems cause flooding in urban areas in many ways. Urban areas generate solid waste, most of which is not properly disposed of resulting in blockages of drains (Dodman et al., 2017). Dodman et al. (2017) argue that solid waste washes into drains and reduces the capacity of drains, resulting in floods. World Bank (2019) explains that about 75% of the solid waste generated within urban areas is properly disposed of, while the rest is left along the streets, waterways, or illegally dumped into drains. These are washed into the drainage system during heavy rains resulting in blockages and flooding.

Poor infrastructure development policies

Jiang et al. (2018) discovered a disjoint between the government policy to address flooding and what was being implemented on the ground. Jiang et al. (2018) argue that in addressing the problems of flooding, interventions to control floods in urban areas should focus on two key direct causes of flooding namely; impervious surfaces and roof water. Impervious surfaces contribute to increased generation of run-off water which eventually leads to flooding. Therefore, an intervention which targets impervious surfaces can be effective in controlling floods (Dalu et al., 2018). Likewise, since roof

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water has been identified as contributing to stormwater run-off that accumulates to cause floods, strategies which target roof water management should be developed (Abeka et al., 2020). With this strategy, the volume of stormwater run-off from roofs that would join the street water could be reduced and easily managed.

Theoretical framework

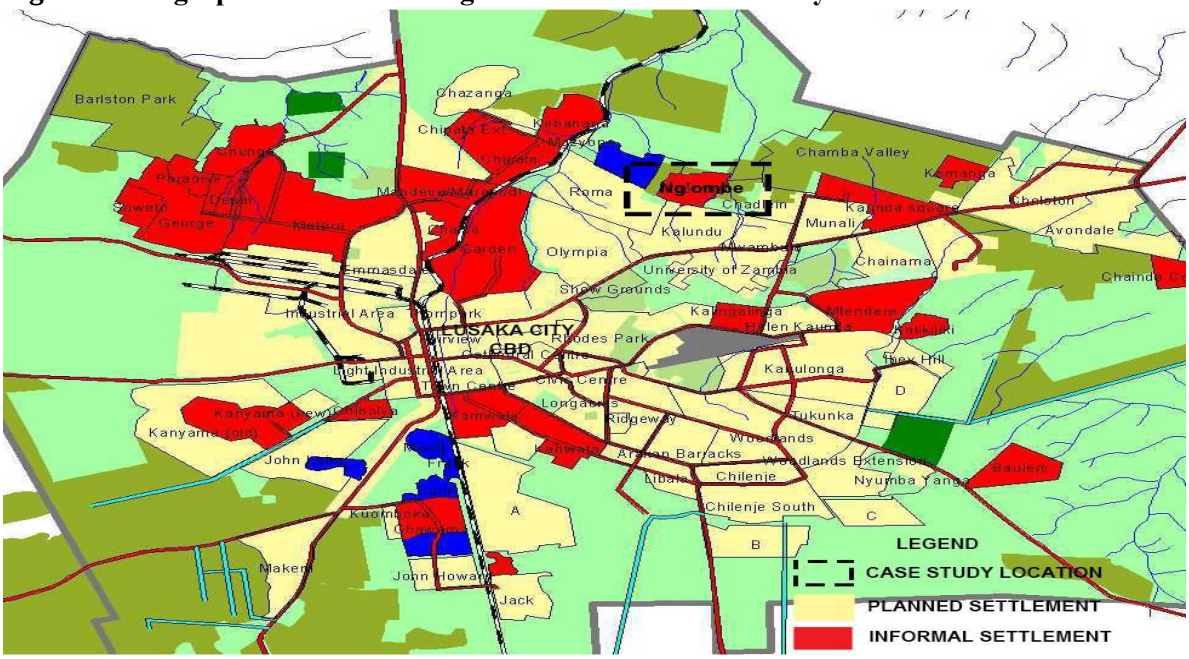
This study used the Pressure and Release Model (PRM) which holds that a disaster happens only if a hazard meets a vulnerable situation (Kallab, 2020). The PRM is an organised framework outlining a hierarchy of causal factors that constitute the pre-conditions for a disaster. It shows how the cause and vulnerability can be traced back from the unsafe condition (Kallab, 2020). The PRM helps to analyse root causes, and factors contributing to the progression of vulnerability and hazards faced within a community (Awal, 2015). The model holds that pressures are caused and increased by sets of underlying causes which encourage those in positions of power to behave in a certain way. Their underlying causes may be political ideas, economic principles, cultural issues and practices. The PRM presupposes that people's vulnerability at local, national or international levels can often be linked to poor governance, inequality, greed, injustice and prejudice (Aziz, 2018). These issues may seem far from the affected communities but may be influential (Awal, 2015). For instance, political decisions about land reform can result in people losing land, and relocating to flood-prone areas making them vulnerable to hazards.

METHODOLOGY

Location of the study area

The study was conducted in Ng'ombe settlement, one of the most densely populated settlements in the City of Lusaka, located about 10 kilometres northeast of the Lusaka Central Business District (CBD) (Mwamba, 2020). Ng'ombe settlement is surrounded by low-density settlements namely; Kalundu to the south, Chudleigh to the north, Chamba Valley to the east and Roma to the west as shown in Figure 2. It was selected as a case study because it experiences devastating floods during the rainy season.

Figure 2. Geographical location of Ng'ombe settlement in the City of Lusaka.



Source: Zambia, Department of Physical Planning and Housing, 2020.

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Research design

This study used a mixed-methods design to collect diverse views on the causes and effects of flooding in Ng'ombe settlement from the respondents and key informants (Creswell, 2017). The mixed-methods design which uses a combination of qualitative and quantitative overtones enabled the researcher to solicit descriptive and numerical data from the questionnaire respondents, interviews with key informants and direct observations (Creswell, 2017).

Sampling techniques

Non-probability sampling was used to, purposely, select the Ng'ombe settlement as the area for study and the key informants (Alam & Kashif, 2021). The key informants were the Provincial Disaster Management & Mitigation Coordinator, and Directors of Planning in the Lusaka City Council, Ministry of Local Government & Rural Development, and Ministry of Housing & Urban Development. Ng'ombe settlement was chosen due to the availability of the register for the victims of flooding whose households were severely affected during the 2022/2023 rainy season. The non-probability purposive sampling was relevant for this study because it enabled the researcher to choose the samples for a purpose (expertise) (Alam & Kashif, 2021). The purposive sampling of the key informants mentioned above contributed to the validity and reliability of the study through data triangulation (Alam & Kashif, 2021). Triangulation of data enabled the researcher to use multiple data sources to examine data validity.

Probability sampling was used to select the household heads of the flood victims whose houses were severely damaged by floods in the Ng'ombe settlement. The correct proportional sample size of the respondents was determined by Slovin's Formula, as shown in Table 1 below (Glen, 2020).

Table 1: Sampling frame and sample size of the respondents

Registered flood-affected households	Severely affected households	Sample size calculated by Slovin's formula: $n = N \div (1+Ne^2)$ at 5% error	Sample size reached out
2,990	300	171	147

Notes: n = Sample size N= Population size e = Margin of error

Source: Survey data

The study reached out to 147 households out of the 171 estimated by Slovin's formula giving a difference of 24 households not administered because the owners had relocated to safer places as their residences were waterlogged and unsafe for habitation. Nevertheless, the sampling technique made it possible for all the flood victims whose households were severely affected by floods to have an equal chance of being picked (Glen, 2020). An equal opportunity for the flood victims to be picked warranted the generalisation of the findings within the Ng'ombe settlement (Huyler & McGill, 2019).

Data-gathering methods/instruments

The study used a survey method in which researcher-administered questionnaires were used to gather data from the 147 household heads of severely flood-affected households in Ng'ombe settlement. Researcher-administered questionnaires were appropriate for this study due to the relatively high illiteracy levels in the Ng'ombe settlement (Zambia Statistics Agency, 2022). Semi-structured interviews, using an interview guide, were conducted on the four key informants mentioned above. The interview method was used because of its flexibility in which questions were asked and interviewees were allowed to respond (Creswell, 2017). Direct observation was another method used. This was done by following the observation guide during the visits to respondents (Huyler & McGill, 2019). The observation was passively done by recording and photographing selected flood scenes and housing structures during data collection (Alam & Kashif, 2021). The observation method supported

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other data sources through pictorial/visual presentation of data.

Reliability of data collection instruments

Reliability of the data collection instruments was achieved by testing the questionnaire and interview guide before the commencement of a full study to establish in advance whether a questionnaire or interview guide would cause problems for the questionnaire respondents, interviewees or interviewer (Creswell, 2017). Creswell (2017) describes this process as small tests of single elements of research instruments that are predominantly used to check their 'mechanical' structures. To carry out this process, a pilot study was conducted where 15 questionnaires were administered to 15 household heads in Ng'ombe settlement. Also, interviews using interview guides were conducted with deputies of key informants. Reactions to this pilot established, in some cases, the need to re-phrase and re-organise the questions and response categories.

Data analysis and presentation

The data were analysed using SPSS software version 22. Descriptive statistics in frequency distributions and percentages were generated to compare the variables of interest (Lury, 2018). Qualitative data analysis was used to analyse classified information captured from open-ended questions of the questionnaires and interviews. Lury (2018) explains that, although qualitative data are not always computable by arithmetic relations, basic figures can be computed after categorising common responses into various classes called categorical variables. The SPSS was used to analyse the categorical variables. This allowed the researcher to review the data in a way parallel to that of quantitative analysis (Lury, 2018). With this attribute, figures were generated in line with common responses used to create simple tables.

Ethical considerations

The participants were told the purpose of the study and how its findings would help tackle the flooding menace in Ng'ombe settlement to get their informed consent (Huyler & McGill, 2019). They were also assured of their anonymity, privacy and confidentiality. All the participants were free to either participate or withdraw at any stage of the research. The interviews took place at the convenience of the participants and permission was sought to use a voice recorder (Lury, 2018).

RESULTS AND DISCUSSION

Biographic and demographic data of the respondents

Under this heading, the sex and age group of the respondents, period of residence, and occupation are presented and discussed with their implications on the floods in the Ng'ombe settlement.

Sex and age group of the respondents

The respondents had almost equal sex representation, with males being slightly more than half (51%) and females slightly below half (49%) as shown in Table 2.

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Table 2: Sex of the respondents and their age groups

	Age range (in years)	Sex of respondents				Total	
		Male		Female			
		n	%	n	%	n	%
The age groups of the respondents	21 to 30	27	18	27	18	54	37
	31 to 40	3	2	16	11	19	13
	41 to 50	14	10	13	9	27	18
	51 to 60	14	10	6	4	20	14
	61 to 70	12	8	6	4	18	12
	≥71	5	3	4	3	9	6
	Total	75	51	72	49	147	100

Notes: n **=** Number of respondents % = Percentage≥ = Greater than or equal to

Source: Survey data

It was established that 37% of the respondents, who formed the majority, fell in the age group of 21 to 30 years, while 6%, who were the minority, fell in the age group of 71 years and above. The respondents falling in the age group of 41 to 50 years came out second at 18% followed by the age group of 51 to 60 years at 14% (Table 2). A similar pattern of the findings came out in the interviews with key informants who explained that the male and female-headed households of the flood victims had almost an equal number on the master register of the affected families in Ng'ombe settlement.

With 37% of the respondents, who formed the majority, falling within the age group of 21 to 30 years it can be argued that this is a productive age that is energetic enough for employment and undertake income-generating activities that can enable them to earn incomes to build houses which cannot easily succumb to flooding. Conversely, this is a group of the population that indirectly pushes the agenda of urbanisation through unplanned settlements that are a catalyst to flooding in Ng'ombe settlement. This argument agrees with some studies conducted in selected African countries which revealed that where urbanisation took centre stage, the waves of urbanisation resulted in fast illegal land cover mostly triggered by the youthful population in search of livelihood (Liu et al., 2019). The fast illegal land cover results in unplanned settlements which cause flooding. Sadigov (2021) adds that rapid population growth in urban areas has generated haphazard development which destroys the landscape's integrity to accommodate large volumes of water run-off.

Period of residence of the respondents in Ng'ombe settlement

One-third of the respondents (33%) who were the majority lived in the Ng'ombe settlement for fifteen years and above, while those who were the new settlers and lived in the settlement for less than three years were the second highest at 24% (Figure 3).

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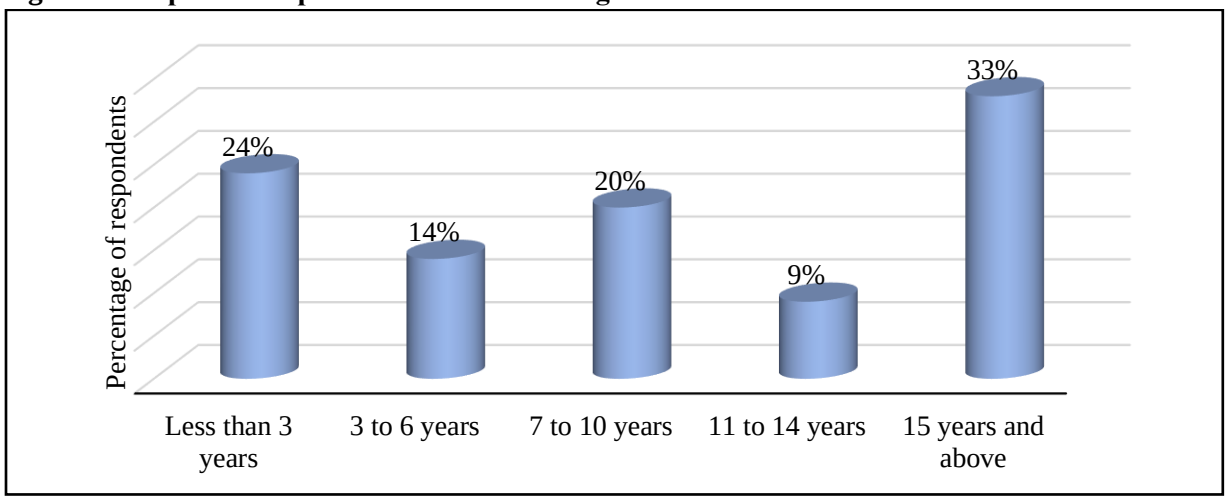
Figure 3. Respondents' period of residence in Ng'ombe settlement.



Source: Survey data

The above results indicate that most Ng'ombe settlement residents have been living there for a long period. The findings also show that the movement of people to settle in Ng'ombe settlement continued in recent years despite the growing threats of flooding in the already-established communities in the settlement.

Occupation of the respondents

The study established that 31% of the respondents, who were the majority, were marketers followed by hawkers who were second at 27%. The private sector employees were the minority at 4%, followed by the civil servants at 13% (Table 3).

Table 3: Occupation of the respondents and types of materials used to build house walls

		Occupation of the respondents												Total	
		Civil Servants		Retirees		Hawkers		Marketers		PSE		Other			
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
Materials used to build house walls	Concrete blocks	5	3	5	4	14	10	8	6	0	0	0	0	32	22
	Burnt clay bricks	8	6	8	5	11	7	10	7	2	1	1	1	40	27
	Sun-dried bricks	5	3	9	6	13	9	18	12	2	1	8	5	55	37
	Sand-lime bricks	0	0	4	3	2	1	6	4	1	1	0	0	13	9
	Poles	1	1	2	1	0	0	3	2	1	1	0	0	7	5
	Total	19	13	28	19	40	27	45	31	6	4	9	6	147	100

Notes: n = Number of respondents % = Percentage PSE = Public Sector Employees

Source: Survey data

It was also established that 37% of the respondents, who were the majority, used sun-dried clay bricks to build the walls of their residential houses followed by those who used burnt clay brick at 27%, while the minority 5% and 9% used poles and sand-lime bricks, respectively. Below are some images captured during visitation to the respondents supporting the results.

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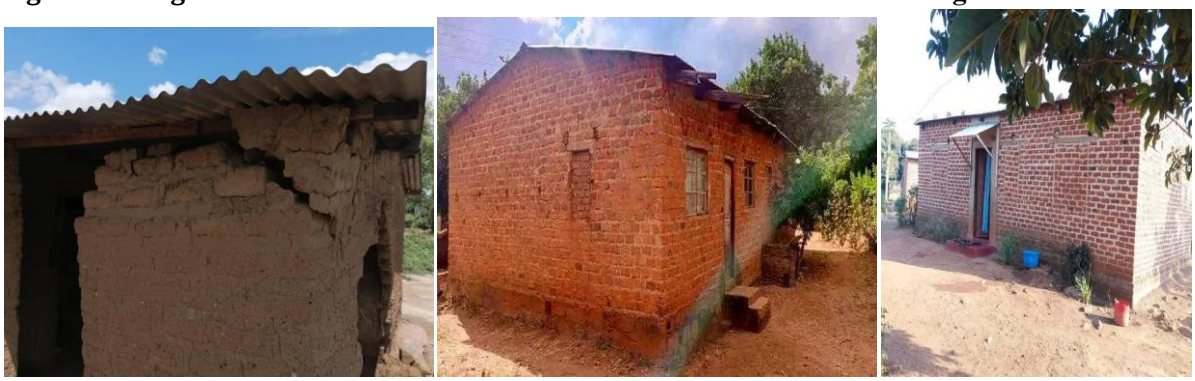
Figure 4. Images of selected houses made of sun-dried and burnt bricks in Ng'ombe settlement.



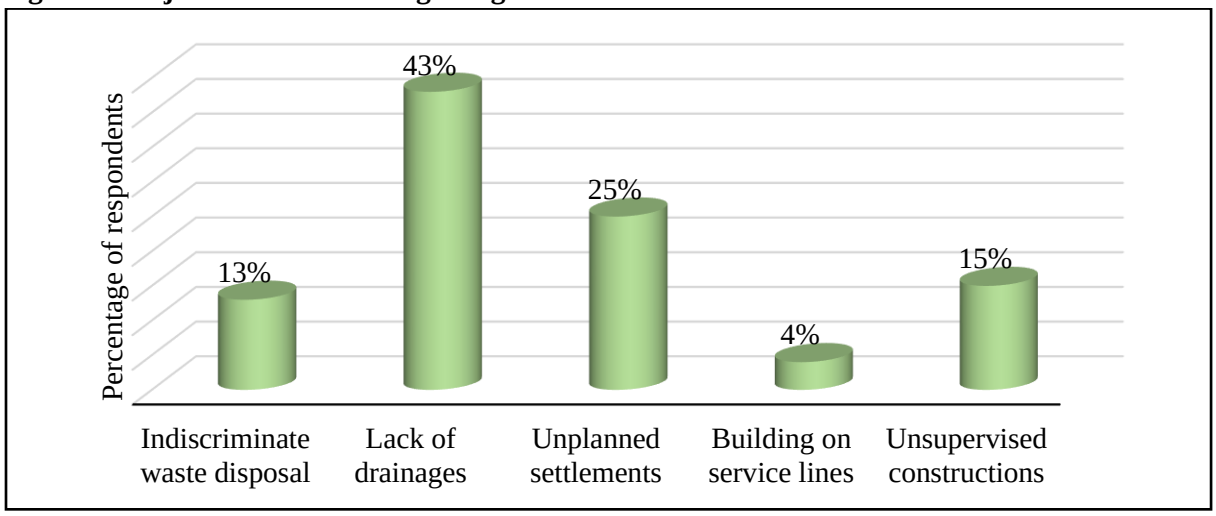
Source: Field survey

Of the majority of respondents who used sun-dried clay bricks, most of them (12%) were marketeers followed by hawkers at 9%, with the private sector and the civil servants being the minority at 1% and 3%, respectively. With most respondents having used sun-dried clay bricks and burnt clay bricks to construct the walls of their residential houses in the Ng'ombe settlement, it can be argued that these bricks are mostly used to build temporal structures and cannot stand the test of time. In the rainy season, sun-dried and burnt bricks absorb water which makes the bricks damp and crumble, especially when there is water logging (Baneshi et al., 2021). However, this weakness affects the sun-dried bricks more than the burnt ones. Baneshi et al. (2021) explain that sun-dried bricks are mostly used to build temporal structures, while burnt bricks can be used to construct strong structures because they are relatively good quality.

Causes of flooding in Ng'ombe settlement

The majority of the respondents (43%) attributed the cause of flooding in Ng'ombe settlement to the lack of drainages followed by those who mentioned the unplanned settlements (25%). The respondents who cited unsupervised construction works and indiscriminate waste disposal came out third and fourth at 15% and 13%, respectively. The minority (4%) claimed that building on top of sewerage service lines was the cause of flooding in the Ng'ombe settlement (Figure 5).

Figure 5. Major causes of flooding in Ng'ombe settlement.



Source: Survey data

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The lack of drainages, unplanned settlements, and indiscriminate waste disposal cited by the respondents as causes of flooding in the Ng'ombe settlement was witnessed by the researcher through observation as depicted in Figure 6. Also, the outcomes of the interviews with the key informants supported the findings above though the difference was in the submission of the minority respondents regarding building on top of sewerage service lines as a cause of flooding. Most key informants argued that sewerage service lines and professionally constructed drainages were almost non-existent in the Ng'ombe settlement. One of the interviewees whose statement summarised what came out from most of them mentioned that there were no proper water drainages in Ng'ombe settlement to drain out excess rainwater, a situation which triggers flooding in the settlement:

> *"The major cause of flooding in Ng'ombe settlement is the non-existence of professionally constructed drainages to drain out excessive run-off rainwater. This run-off water fills up pit latrines which the majority of households use and carries faecal matters around the settlement thereby causing waterborne diseases."*

Figure 6. Images of a selected flooded house, poorly constructed drainage and indiscriminate waste disposal in Ng'ombe settlement.

Source: Field survey

The depiction of Figure 6 can be explained in many ways. The poor/lack of drainages meant absence, poorly maintained, undersized, and blocked drainages, while unplanned settlements meant haphazard, irresponsible and impulsive set-up of dwelling places. In a community set-up with the drainage and settlement characteristics mentioned above, the resultant effect after heavy rains is flooding as water run-off will have nowhere to collect and drain.

The construction of buildings without approved building plans and planning permission from the Lusaka City Council in Ng'ombe settlement arose because of the population increase in other city settlements which put the demand for land to construct housing units. Kapembwa and Mubanga (2021) argue that people relocate to different areas in search of land to settle on and seek livelihood opportunities, which results in illegal settlements. In support of this argument, Abeka et al., (2020) explain that unplanned growth is linked to flooding because of the construction of illegal structures in forbidden areas. In such a scenario, flooding is triggered by a lack of professionally constructed drainages and environmentally approved waste dumping sites because these are not planned for.

The rapid urbanisation of Ng'ombe settlement attracts people with limited income who cannot

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afford housing in the well-planned settlement areas to move and settle in this settlement. Mwamba (2020) explain that almost half of Zambia's population is now concentrated in urban settlements and incoming poor people often settle in unsafe areas with little or no access to basic services, thus exposing themselves to hazards such as recurrent floods.

Menace of the floods on the communities in Ng'ombe settlement

Effects of flooding on the respondents' households

The majority of the respondents (69%) had their properties damaged by the floods in Ng'ombe settlement, with only a few (2%), who were the minority, losing some of their relatives in direct floods. Less than one-third of the respondents (20%), who came out as the second majority, had their households affected by waterborne diseases, followed by those households that lost income (7%) and those whose children lost school time (4%) as shown in Table 4.

Table 4: Major effects of the floods and respondents' educational levels

		Major effects of floods										Total	
		Disease outbreak		Loss of life		Loss of school time		Damages to properties		Loss of income			
		n	%	n	%	n	%	n	%	n	%	n	%
Respondents' educational levels	Nil	5	3	1	1	2	1	23	16	1	1	32	22
	Primary	17	12	1	1	2	1	54	37	4	3	78	53
	Secondary	7	5	0	0	2	1	15	10	4	3	28	19
	Tertiary	0	0	0	0	0	0	9	6	0	0	9	6
	Total	29	20	2	2	6	3	101	69	9	7	147	100

Notes: n = Number of respondents % = Percentage

Source: Survey data

A cross-tabulation of the variables 'major effects of floods' and 'educational levels' revealed that 69% of the respondents, who had their houses severely damaged by floods, had a low educational background. Most of the respondents (37%) of the 69% who had their properties damaged by floods did not go beyond primary school, and 16% did not attend formal education (Table 4). Equally, the majority (20%) of the respondents who came out second whose households were affected by waterborne diseases had a low educational background with the majority of them (12%) having acquired primary school education followed by the 5% who had not been to school (Table 4).

The results presented above on respondents having low education levels agree with the outcomes of other studies conducted in the same compound in different fields. For instance, a case study by Mwamba (2020) which analysed space manipulation in an informal urban settlement of Ng'ombe settlement in Lusaka revealed that most Ng'ombe settlers did not have opportunities to acquire basic education. Further, the study attributed the low educational levels of the Ng'ombe settlers to high poverty levels (Mwamba, 2020).

With little or no education, residents in Ng'ombe settlement could hardly comprehend architectural requirements thereby compromising the quality of their infrastructure such as houses and other amenities which become vulnerable to floods. Also, lack of education compromises Ng'ombe residents' abilities to comprehend and adhere to public health campaign messages. This compromises individual

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and public hygiene and triggers the spread of waterborne diseases during floods in Ng'ombe settlement.

Frequency of occurrence of flooding and predictability of their effects

The study sought to establish the frequency of flooding in Ng'ombe settlement to establish whether or not their effects were predictable. Sixty-one percent (61%) of the respondents agreed that the consequences and effects of the floods in the compound were predictable, with the minority (4%) saying the consequences were unpredictable and 8% were not sure (Table 5). Those who said they could predict the consequences of the floods sometimes stood at 27%.

A cross-tabulation of the variables 'frequency of flooding' and 'prediction of the effects of flooding' revealed that 49% of the 61% of the respondents said that the effects of flooding were predictable in Ng'ombe settlement. Further, flooding of the settlement was said to be occurring yearly (Table 5).

Table 5: Frequency of flooding in Ng'ombe settlement and prediction of the effects

		Frequency of flooding								Total	
		Yearly		Some years		Rarely		Not sure			
		n	%	n	%	n	%	n	%	n	%
Prediction of the effects of flooding	Yes	72	49	14	10	1	1	2	1	89	61
	Sometimes	35	24	1	1	4	3	0	0	40	27
	No	5	3	0	0	1	1	0	0	6	4
	Not sure	10	7	1	1	0	0	1	1	12	8
	Total	122	83	16	12	6	4	3	2	147	100

Notes: n = Number of respondents % = Percentage

Source: Survey data

The study established that flooding in Ng'ombe settlement is perennial, implying that the compound is affected by floods every rainy season. Since the results show that flooding in Ng'ombe settlement is perennial and its effects on the communities are predictable, it is anticipated that communities and households can put up mitigation measures to prevent the adverse effects of floods before the onset of the rains. Equally, institutions with mandates for disaster management and mitigation, disease control and management, urban infrastructure development and housing should have well-coordinated policies and a disaster preventive measures master plan which reflects the reality on the ground to avert flood disasters in Ng'ombe settlement.

The above argument is supported by the outcome of the study by Jiang et al. (2018) on policy development and implementation. Jiang et al. (2018) discovered a disjoint between policy development and what was implemented in the communities to curb floods. The disjoint was attributed to the misidentification of the root cause of flooding. As such, Jiang et al. (2018) recommended that interventions to control floods in urban areas should focus on two key direct causes of flooding namely; impervious surfaces and roof water.

The intensity of the floods in Ng'ombe settlement

Fifty-nine percent (59%) of the respondents mentioned that the floods which affected the Ng'ombe settlement were severe, followed by 21% of them who said the floods were moderate. Others said the floods were mild (11%), with the minority (7%) being not sure (Figure 7).

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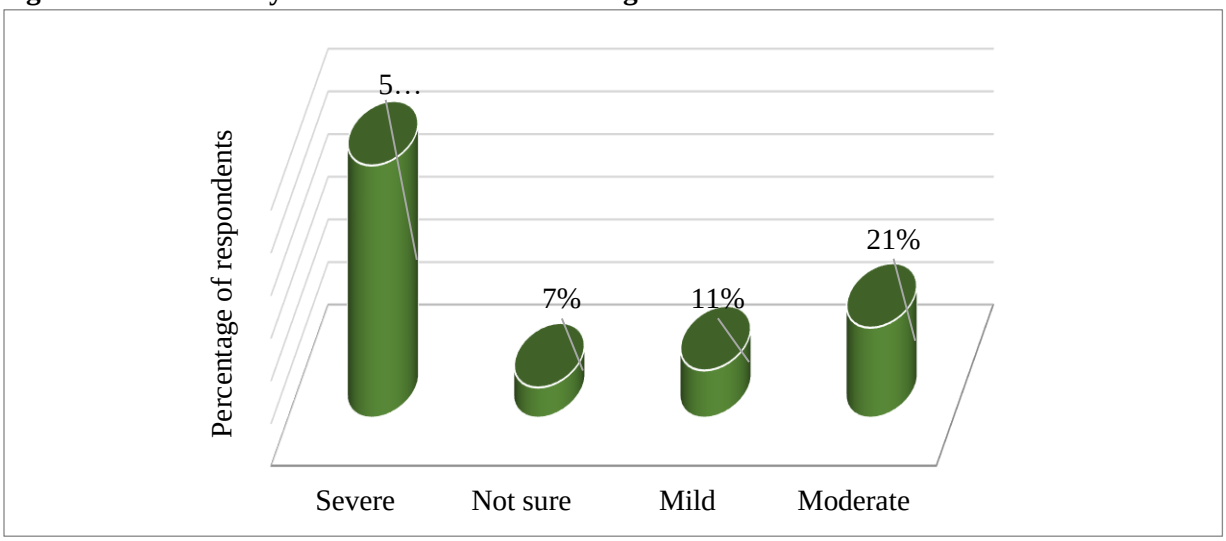
Figure 7. The intensity of the effects of floods in Ng'ombe settlement.



Source: Survey data

The floods that occur yearly in Ng'ombe settlement were severe, hence, the damages to most of the housing infrastructure and severe waterborne disease outbreaks. Matsushita and Ono (2023) agree with the above argument and explain that severe floods create pools of water that submerge sub-structures of houses thereby weakening their foundations. Adelekan et al. (2015) add that overexposed infrastructure to severe flooding crumbles easily. However, regardless of the negative consequences of the severity of floods in many high-density areas, Adelekan et al. (2015) state that residents usually cope with floods because of poverty and limited alternatives.

Respondents' perceived solutions to the flooding in Ng'ombe settlement

The majority of the respondents (31%) suggested the construction of drainages as a solution to flooding in the Ng'ombe settlement, followed by 27% who recommended strict supervision of construction works in the settlement. In others, 20% suggested effective solid waste management, while 17% and 5% recommended regular cleaning of drainages and demolition of illegal buildings, respectively (Table 6).

Table 6: Respondents' perceived solutions to the flooding in Ng'ombe settlement

Characteristic variables	Respondents (n)	Respondents (%)
Construct drainages	45	31
Clean drainages	25	17
Manage solid waste	30	20
Demolish illegal structures	7	5
Supervise constructions	40	27
Total	147	100

Notes: n = Number of respondents % = Percentage

Source: Survey data

The recommendations by the respondents in Table 6 though vary in percentage points, are all important in resolving the flooding dilemma in Ng'ombe settlement. Chitondo et al. (2024) explain that there

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are an increased number of approaches available that could be tapped to address urban flooding anchored on effective disaster management and mitigation plans. Herslund et al. (2016) add that ineffective disaster management and mitigation plans, inadequate basic infrastructure and uncoordinated service delivery contribute to an increase in the vulnerability of urban areas to flooding.

The suggestions given by the respondents can help curb flooding in the Ng'ombe settlement in many ways. The demolition of illegal buildings and re-planning of the compound may help to accommodate a fast-growing population to live in decent conditions devoid of exposure to flooding (Chitondo et al., 2024). However, implementation of such recommendations requires careful consideration as it may have its challenges without systematic sensitisations and warnings. Douglas (2018) explains that the implementation of certain decisions that affect the masses, without political-will, have not been effective because of political interference. The suggestion for an effective waste management system is supported by Dodman et al. (2017) who have argued that urban areas generate a lot of solid waste, most of which is not properly disposed of, resulting in blockage of drains and eventually floods.

CONCLUSION

The lack of professionally constructed drainages coupled with unplanned settlements is among the topmost recognised causes of floods in most parts of Zambia. The City of Lusaka where Ng'ombe settlement is situated is affected by perennial floods. In Ng'ombe settlement, rainfall produces water run-off from impervious surfaces and drains to trigger flooding around the settlement. If left unchecked by the authorities, such flooding would continue to trigger disasters that may inflict irreversible miseries on communities of Ng'ombe settlement in the City of Lusaka. The unplanned settlements in Ng'ombe settlement have resulted in a lack of space to construct drainages, ensuing recurrent flooding in the settlement. Other causes of flooding in the settlement were unsupervised construction works and indiscriminate disposal of waste materials. The floods in Ng'ombe settlement had several negative effects on individual households and communities. Damages to properties such as houses (69%) and waterborne disease outbreaks (20%) were the major notable effects of flooding in Ng'ombe settlement which inflicted untold miseries on the affected communities and households.

Given the above-explained causes and effects of flooding in Ng'ombe settlement, the study recommends the construction of professionally designed drainages by the Lusaka City Council and its cooperating partners. To avoid the recurrence of building houses without planning permission, the study recommends strict supervision of construction works and normalisation of illegally built houses, where possible, as demotions of the same as suggested by the minority respondents would bring discontent among the affected community members and negative political connotation. Also, the Lusaka City Council should come up with an effective solid waste management system. The recommendations may feasibly be implemented if the Lusaka City Council work closely with the Disaster Management & Mitigation Unit, the Ministry of Local Government & Rural Development, the Ministry of Housing & Urban Development, the Ministry of Health, Area Member of Parliament, civic leaders, and the Ng'ombe settlement residents.

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