

Urban flooding processes in the Nhlamankulu municipal district- Maputo city- Mozambique

Summary

When the rains fall on the Nhlamankulu Municipal District, the population is worried because some of the water is retained in their backyards. This shows that urban flooding is a major concern, which is why this research was carried out, entitled Urban Flooding Process in the Nhlamankulu Municipal District, Maputo City, Mozambique. The general objective is to understand the flooding process, and the specific objectives are to identify the flooding factors, describe the flooding process and its origin. It began with a document review phase and was followed by fieldwork using interviews and direct observation, a literature review using integrative review, content analysis and thematic analysis, and data processing using geoprocessing, the conglomerate and cartographic method and EPI-INFO, 3.4.5. It was concluded that the flooding factors in the district are diverse, ranging from the terrain, with impermeable soils, the silting up of drainage channels due to the deposition of solid waste, the model of land use and demographic pressure, and that they are a reflection of the incipient applicability of public policies and/or strategies for the sanitation of the environment.

Keywords: urban flooding, district, population, effects, health, diseases

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Introduction

Urban flooding represents a critical challenge in Mozambique, causing incalculable material and socio-economic damage, especially in relation to the health of the population. This phenomenon is one of the main socio-environmental concerns in the country.

This study aims to investigate the factors that influence the occurrence of urban flooding in the Nhlamankulu Municipal District, located in Maputo, Mozambique. The subject is extremely relevant due to the adverse impacts that flooding has had on human health and the well-being of local communities.

Rapid urbanization in developing countries such as Mozambique is occurring in an unsustainable manner, contributing to the degradation of the quality of life and the environment. Inadequate urban planning and the disorderly occupation of low-income areas have increased the vulnerability of populations to flooding.¹

The problem of flooding in Mozambique reflects the fragility of government policies in risk areas, resulting in significant impacts on people's lives and the environment.²

This study is part of the broader context of environmental risk management, emphasizing the importance of interdisciplinarity and scientific and technological progress in understanding and tackling these challenges.

In the Nhlamankulu Municipal District, the approach of the rainy season raises concerns due to the potential impact of flooding on the population's mobility and living conditions. The consequences of flooding go beyond material damage, directly affecting the daily activities and health of the inhabitants.

Accelerated urbanization in Mozambique presents a dual scenario, characterized by urbanized and well-planned areas, contrasting with disorganized peripheries lacking adequate infrastructure.³

In summary, the research aims to explore the factors that contribute to urban flooding processes, highlighting the importance of effective

urban management and sanitation policies to mitigate the adverse impacts of flooding on the population.

Flood processes

In the Nhlamankulu Municipal District (NMD) the factors that lead to flooding are:

- I. Public policies and/or strategies to clean up the environment;
- II. Drainage system;
- III. Parceling and/or layout of houses; and
- IV. Demographic pressure.

Public policies and/or strategies to clean up the environment

The poor drinking water supply system for the population, the construction or maintenance of inefficient sewage systems (overflow of wastewater associated with rainwater) and the inadequate disposal of solid waste are caused by the non-compliance or incipient applicability of public policies and/or strategies on environmental sanitation, listed in the Boletim da República III series number 128 of 16.8.2017, Chapter I whose title is National Water and Sanitation Strategy 2011-2025, consequently leading to the occurrence of floods in the DMN. This is due to the fact that there is a drainage system in the study area, but it has not been maintained, which is why it no longer functions according to the purpose for which it was implemented. There is also black water run-off due to clogged drains and poor solid waste management.

Drainage system

Drainage is one of the factors responsible for the flooding of the DMN. It should be noted that there is no structured micro-drainage system in the DMN, so the direction taken by the water depends on the topography. However, the appearance of buildings that are not in line with urban planning and zoning moderate the natural flow paths and, in some cases, end up blocking them completely. As a result, open-

air drainage ditches have been built to solve the exact problem of flooding, but they don't perform the function that was hoped for, since they take water from one point to another without any connection to the macro-drainage system and not only that, but there has also been the dumping of solid waste and domestic wastewater.⁴

Still according to the aforementioned author, "the Chamanculo B neighborhood is considered to be an informal settlement, made up of dwellings built with precarious materials, and with the exception of the main streets built in Pavet, all the remaining roads are unpaved. The neighborhood is located downstream of Chamanculo C, making it a contributor to the surface runoff of the neighborhood in Chamanculo B, since most of this runoff is directed to the existing drain on the side of Avenida de Trabalho. The drain is operational, but it has been slightly clogged due to a lack of cleaning in the ditches and drains. Due to the number of tributaries from the surrounding neighborhoods that this neighborhood receives, almost all of the secondary and tertiary roads serve as channels for rainwater runoff, so much so that, according to local structures, some residents of the neighborhood create holes in their fence walls in order to open up additional paths for rainwater runoff."

People often dispose of solid waste outside the containers, often on the ground or in front of their backyards. During the rainy season, rainwater drags this waste into the canals, obstructing their normal flow. As a result, the canals become sources of flooding due to overflowing water.

Another no less important situation is the irregular cleaning of drainage ditches and their maintenance by those who are entitled to do so, conditioning the flow of water due to the growth of grass inside them. As illustrated in Figure 1.



Figure 1 Poor drainage system.

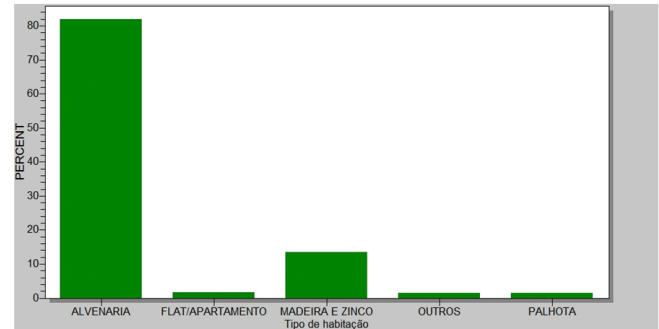
Nowadays, it is common for people to deposit bags containing solid waste in drainage ditches, which hinders water circulation and contributes to flooding. As well as dumping waste in canals, there is also inappropriate land occupation, often ignoring the natural water drainage system. This means that the natural water flow routes are no longer able to cushion floods.

The process of urbanization impacts the natural water drainage system by interfering in the environment through land reclamation, whether of watercourses or springs, deforestation of forest resources, soil sealing and the construction of artificial drainage works.

Adequate water drainage is favored when measures are taken, such as proper maintenance of vegetation cover and preservation of the natural course of water, control of land development and occupation on slopes, preservation of flood buffer areas and flooded areas, and the adoption of buffer strips on the banks of water resources. Unfortunately, these measures are not adequately implemented at the site in question.

Parceling or layout of houses

Informal occupation, the accelerated and disorderly process of urbanization that has taken place in recent decades has transformed the DMN into an area with a considerable population density. The type of housing influences sanitation conditions. In general, most of the population, around 80%, live in brick houses with backyards (Graph 1).



Graph 1 Type of housing in the DMN.

Source: FUMO 2015

In addition to the above-mentioned factors, the current occupation and layout of homes makes the soil saturated and water runoff poor, influencing the occurrence of flooding by not allowing the construction of rainwater drainage channels (Figure 2).



Figure 2 Layout of the houses.

The disorderly occupation of urban space is evident in this district, where there is not only territorial disorder, but also uncontrolled occupation and overcrowding. In many cases, in a yard that should house a certain number of family members, the head of the household sells or builds small houses for rent in the remaining space.

This factor has been responsible for flooding, as the available space decreases and, with the ground saturated due to land use by occupants, any minimal amount of rain can result in flooding."

Demographic pressure

The demographic pressure that the DMN has been under since 1987 has greatly influenced the occurrence of urban flooding, because the district has experienced a very sharp increase in rural exodus, motivated by the civil war that lasted 16 years in the country. Araújo, 1999:372, states that "the outskirts are growing towards the center, causing what some authors call the Ruralization of cities. This growth leads to the emergence of precarious constructions in inhospitable places, the appearance of shantytowns between cement buildings, on barriers and near beaches, causing serious environmental problems".

The growth of this district is also largely attributed to the influx of people from the "cement city" neighborhoods, resulting from the

abandonment and sale of keys by many families of a considerable number of apartments in the rental buildings of the “cement zone” in exchange for plots of land in the outlying neighborhoods to build their own homes.

It should be noted that according to the 1980 census, the population of the DMN was made up of 61,688 men and 53,891 women, totaling 115,579 inhabitants with a population density of 14.4 per square kilogram, in an area of 8 square kilometers. This is due to the fact that there was a rural exodus to escape the civil war in which the country was immersed.

So, from the first Census, that is, from 1980 to 1997, there was a substantial growth of 47,171, according to the 1997 Census, which shows 80,094 men, 82,656 women and a total of 162,750, which corresponds to a population density of 20.34 inhabitants per square kilometer. The 2017 Census shows completely different figures: 61,432 men, 65,647 women and a total of 127,079, which is equivalent to a density of 15.88 inhabitants per square kilometer. This is due to the fact that the young population has left the district for emerging neighborhoods, which have better conditions (Table 1).^{5,6}

Table 1 Comparative Population Data (Census) from 1980 to 2017

Census	Men	Women	Pop density	Total
1980 Census	61,688	53,891	14.4 inhab/Km	115,579
1997 Census	80,094	82,656	20.34 inhabitants/km	162,750
Census 2007	77,168	79,668	19.60 hb/km	156,836
Census 2017	61,432	65,647	15.88 inhabitants/km	127,079

Source: INE Census - 1980, 1987, 2007 and 2017 - Adapted by the author 2022

Final considerations

After researching the study area, it was found that:

The incipency in the applicability of public policies and/or strategies, in this case (Posture of Sanitation and Drainage. Chapter I. National Water and Sanitation Strategy. 2011-2025), as well as the lack of environmental sanitation works, the poor drainage system and the layout of houses or plots; and demographic pressure, are all factors in the occurrence of flooding in the DMN.

In the Study Area, basic sanitation services are fundamentally based on low-cost systems, such as latrines and septic tanks, and it is estimated that only a small fraction of the population is served by a network of underground collectors.

Most of the canalization system dates back to the colonial era, which is why its pipes are obsolete. These are the factors that lead to flooding in the DMN.

Recommendations

- I. Reducing the population to other areas with basic social conditions;
- II. Implement the Drainage and Sanitation Master Plan for Greater Maputo, which has set as a priority the rehabilitation and expansion of drainage systems and innovative solutions to reduce discharges into drainage ditches by introducing techniques to retain flows at source, such as detention areas and green infrastructure;
- III. Implement health surveillance in the DMN to better monitor health cases.

Acknowledgments

None.

Conflicts of interest

The author declares there is no conflict of interest.

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