

The role of communities in building urban flood resilience in Matola, Mozambique

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ARTICLE INFO

Keywords:

Urban community resilience
Mitigation
Adaptation
Floods
Matola

ABSTRACT

Community urban flood resilience is a challenge in different parts of the world, especially in resource-deficient contexts, such as in Mozambique. This paper explores the actions, measures, or strategies the residents of Matola have developed to cope with urban flooding and build community resilience. The study is based on 18 semi-structured interviews, three focus group discussions with 24 residents, two semi-structured interviews with municipal officials from the urban planning sector in Matola, who were present during the 2000 floods, and field observations. The findings reveal that community mitigation actions during the 2000 flood in Matola ranged from reinforcing the material structure of houses and installing water barriers with walls of sandbags, to rescuing and accommodating family and community members in collaboration with municipal rescue teams. Community adaptation measures after the 2000 floods were improving and reconstructing houses destroyed by the floods, raising yard levels with fill, which changed the environment, building new homes in relatively safe self-obtained sites, and adhering to the resettlement promoted by the municipality. The study reveals that during the 2000 floods and the post-flood recovery process, social capital, characterized by pre-existing strong social cohesion and mutual trust among community members, was vital in bringing people together to support and rescue community members besieged by the flood. The municipality's official network of collaboration with communities, represented by their elected leaders, was a relevant factor for community flood resilience because it favoured establishing ongoing connections between the parties identifying the main waterways for the creation of drainage channels and organizing the gradual resettlement of residents who had lost their homes in the flood. However, the findings reveal that with a rapidly increasing population and an accelerated horizontal land occupation for different uses, there seems to be a mismatch between the urban development plans and the municipal efforts to build flood resilience, and what is happening in practice with some constructions violating official regulations.

1. Introduction

Flood risk has been increasing globally [1–3], with over 100 floods being recorded annually since 1998, numbers never reached before [4]. Changes in precipitation patterns due to climate change have generated heavy and concentrated rainfall, causing floods [3, 5, 6]. The location of many cities in coastal areas and near the downstream portions of rivers creates unavoidable urban flood risks.

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Cities have high densities of population and of social and economic infrastructure, and thus face great risks of the destruction of infrastructure, disruption of socio-economic activities, and loss of human lives [7–9].

Currently, the widely accepted way to address urban flooding is through mitigation and adaptation measures, as part of managing natural disasters and building resilience, with emphasis on urban planning that considers different levels of flood risk [5,10]. Increasingly, a participatory approach to promoting resilience to urban floods is being identified as an appropriate strategy, building on actions and measures carried out by the affected communities, whether individually or collectively [7,11]. Participation in building resilience to urban floods necessarily involves a shift away from top-down, state-led approaches towards including actors from both the government and non-government sectors as well as all people in the affected community or communities. “Community” as used here refers to residents of a particular geographical location, but also to “communities of circumstance”, meaning that the people in a community have shared experience of a common adverse incident [12].

This approach of including individuals and community groups aims at redressing imbalances in participation to ensure that local knowledge and priorities are incorporated in urban planning processes for flood mitigation and adaptation measures [7,13]. In addition to individual and stakeholder capacities, such participation requires effective community leadership that can mobilize the wider community and build in-group trust, which is crucial to maintaining cohesion and collective organization [12]. However, participatory approaches to addressing urban floods and building community resilience face challenges in many countries. In England, for example, the planning system is particularly hamstrung by the inability of communities or relevant stakeholders to come together and produce larger-scale, integrated, and water-sensitive flood-resilient designs [14]. Lack of coordination and poor cooperation are among the key obstacles to achieving effective climate adaptation facing Swedish authorities, where cooperation is often limited to information transfer as opposed to engaging in two-way collaboration. This is especially true for the involvement of citizens [15].

If participatory approaches to addressing resilience to urban floods are difficult to implement in countries that have high technical and financial capacities to do so, what about in developing countries? Various difficulties in approaching participation in promoting resilience to urban floods are also experienced there. In the city of Lagos, Nigeria, the concerns of flood-affected communities have not been effectively addressed, mainly due to the difficulties in achieving effective community participation in urban planning and executing the mitigation and adaptation measures [16]. In Accra, Ghana, there have been difficulties in addressing mitigation and adaptation actions by mutual agreement that accommodates the concerns of communities in urban planning by the Metropolitan Assembly of Greater Accra (MAGA) due to “differences in the social goals of the wealthy elite and the poor; and the repeated failure of public participation and consultation” ([17]:267). While MAGA carries out actions to reduce exposure to floods, such as expanding drainage systems and demolishing infrastructure in risk areas, poor people keep building in risk areas, even in areas where MAGA has demolished structures [17,18].

Urban flooding in large coastal cities has also affected Mozambique, whose cities suffer cyclical flooding due to heavy precipitation resulting from strong tropical cyclones [19]. One of these cities is Matola, which has suffered from several floods. In the year 2000, the most devastating flood in recent decades caused the destruction of socio-economic infrastructure, loss of property, displacement, and loss of human lives [20–22]. Actions and measures to build flood resilience in Mozambique have been characterized by inefficiencies due to lack of financial resources, deficient technical capacity, and difficulties in involving politicians, planners, and local communities to act jointly in a participatory manner. It has also been noted that most urban communities in Mozambique lack sufficient material and financial resources to enable them to recover after floods, and people struggle to maintain their lives and livelihoods, depending on the resources and capacities they have [13,23–25]. Despite the many challenges mentioned in the literature, urban communities in Mozambique, and particularly in Matola in the face of the rapidly increasing urbanization, keep struggling in various ways to cope with cyclical flooding to build or promote community resilience [26,27]. This study, therefore, sets out to better understand what mechanisms urban communities in Matola have developed to cope with and foster resilience to floods. What measures and actions did the communities in Matola adopt to cope with the 2000 floods to build resilience? How does the rapidly increasing population and accelerated horizontal land occupation affect flood resilience building?

The extent to which an urban community demonstrates flood resilience following a disaster largely depends on the local context [28], which includes the characteristics of the community such as financial capacity, physical/material and environmental conditions as housing and land, social capital or trust and cooperation, community communication, and interaction with local institutions or entities [7,28–30]. In addition, Patel et al. [31] also mention local knowledge, health, and preparedness as core elements. This paper aims to find out what actions, measures, or strategies the residents of Matola have developed to cope with urban flooding and build community resilience, and how these have been affected by the local context, particularly the rapidly increasing urbanization. The knowledge gained contributes to national and global scientific debates on community flood resilience in the face of constraints, by showing paths to promoting resilience that have been tried so far. This study focuses on community experiences and practices in building flood resilience and indicates what did and did not work properly and what needs to be improved in building flood resilience, to mitigate the effects of future shocks.

2. Community resilience

2.1. Conceptualization

Conceptualizations of community resilience draw on various fields in the physical, health, and social sciences. As a social concept, resilience has its roots in ecological resilience, seen as the ability of natural ecosystems to “bounce back” to their original state or form following major stress and disruption (e.g., Ref. [10,32,33]). Furthermore, “resilience is mainly described as the ‘capacity’ of an actor, individual, community, social unit, organization, society, or system to cope, absorb, recover, mitigate, adapt, withstand, or resist the

impacts of hazards” ([34]:3), emphasizing the transformative and adaptive capacity of actors adjusting to change [35,52]. Seeing resilience building as a process, rather than an outcome, is an approach that fits well “with the dynamics of resilience in social–ecological systems” ([36]:11).

Community resilience is a concept strongly linked to the sustainability of social systems and is thus related to the socio–ecological approach to resilience. Community resilience has conceptually developed relatively recently [29,36], and there seems to be no common and agreed-on definition, although there are common core elements among the different definitions [31,37]. Berkes and Ross [36] argued that the different definitions are consistent in their focus on the adaptive capacity of resilient systems in the face of change, seeing communities as dynamic social systems, and according to Magis ([35]:412), resilient communities “learn to cope with, adapt to and shape change”. The core issue is to identify and build on communities’ strengths in building resilience to collectively face adversity and adaptation. In recent decades, community resilience to disasters, such as urban flooding, has gained importance when identifying the strengths of specific populations threatened by disasters to build and foster resilience [7,29,33,38].

Magis ([35]:402) defined community resilience as “the existence, development, and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise”. In turn, community flood resilience is the ability of a community to maintain or quickly return to desired functions in the face of flood events, to adapt and adjust to changes, and to learn, transform, and innovate socio–ecological and technical elements across space and time that affect the community’s current and future adaptive capacity [29,39]. In community resilience, communities are the primary and active agents in shaping their own well-being and capacity to adapt to change. This means that community members intentionally develop their individual and collective capacities and come together to respond to and influence actions and measures taken to sustain and develop the community to meet future events [35,36].

2.2. Community in building urban flood resilience

A flood situation in an urban community can be described as a series of three phases; imminent flood with high-water levels, occurrence of flood with protection failures, and post-flood recovery [29,39,40]. According to Koers et al. ([40]:2), five interlinked capacities concerning flood resilience can be identified: prevention of flooding, limitation of flood impacts, recovering, adaptation and transformation. Wickes et al. [28] argued that the extent to which a community can demonstrate resilience following a disaster largely depends on the local context, i.e., the characteristics of the community in which the disaster occurred, which can be expressed in terms of different dimensions. Through the lens of community flood resilience five interlinked dimensions can be identified, comprising the financial, physical and environmental, social capital, information and communication dimensions, as well as the ability to act collectively and (re)organize [7,29,39]. The dimensions of community resilience bring together sets of community resources, capacities and abilities to develop actions and measures to build or improve resilience [7,28,29,39].

The financial dimension refers to the ways in which the existing economy and its ability to sustain economic growth, influence the community’s ability to prepare for and recover from a flood event. It includes diversity of individual or collective income bases and access to financial resources [29]. In low-income communities and households, as in cities in developing countries, the possession of physical assets, such as land, are essential to people’s livelihoods and financial security. Land can facilitate access to financial resources (credit) that can improve the financial and social condition of individuals and families [7,29], therefore, landowners need to be more active in promoting or building flood resilience [41]. Furthermore, it has been argued that accessing financial resources through physical assets such as land contributes towards reducing urban poverty in low-income community members, households, or communities, enabling transformative adaptation through short- and long-term planning, and social and political participation [7,29].

The social capital dimension indicates available social and cultural resources that a community can draw upon to maintain their livelihoods [29]. Social capital, in the form of enhanced cooperation and trust among community members, can facilitate collective action to meet difficulties that arise due to flooding [12,29,39]. The main characteristics include strong social networks, well-established trust and participatory, inclusive processes, as well as local knowledge, health, and preparedness as core elements [29, 31]. Social networks show the level of community cohesion and ties that facilitate social cooperation and coordination for mutual benefit in building flood resilience [28,29]. Linked to the social/cultural dimension is community competence. The *community competence dimension* reflects the community’s diverse abilities, including the ability to develop multi-layered solutions to complex problems, and the ability to participate in meaningful political networks and decision-making. Moreover, it reflects the community’s perceptions of positive change both in recovering and moving forward and the ability of the community to collectively believe that they can rebuild, restructure, and revive [29].

The institutional and organizational dimension can be interpreted as the people responsible for executing flood disaster-related functions to promote and build flood resilience. It indicates the effectiveness of relationships among and within community organizations and other entities such as the local urban planning sector, the disaster risk management sector [29]. The level of a community’s resilience is also influenced by external capacities, particularly by emergency management services, but also by other social and administrative services, public infrastructure, and a web of socio-economic and political linkages with the wider society, civil society or non-government organizations (Twigg, [53]; [42]).

The physical and environmental dimension indicates the capability of the physical system, including the built environment along with existing infrastructures, to perform at acceptable levels during and after a flood event. In a flood-resilient community, there are available and accessible infrastructures and community facilities, such as transportation means, emergency shelters and healthcare that support emergency management [29]. Good management of natural resources such as water and land provide space to live and work. Therefore, the availability of accessible natural resources for livelihood activities has a significant role in enhancing community resilience to floods [7,29]. For instance, wetlands can absorb impacts of floods and improve the recovery process [29].

Studies of community resilience to natural hazards in developing country contexts have found that there is a very strong link between social cohesion and trust between community members and building community resilience. Patel and Gleason [43] and Joseph et al. [44] found that despite limited physical and financial resources, vulnerable communities can utilize their social capacities and cohesion during a disaster, and that it may compensate for weaknesses in other dimensions in building flood resilience. They specifically raised the importance of immediate responders being people who have a crucial role in life-saving actions simply by being present in the disaster location. Collective actions happen spontaneously to cope with disaster, and the authors emphasized that such resilience is found in communities with strong social capital and cohesiveness. The community's social capital and cohesiveness are expressed during community collaboration and interactions with the city's administrative entities and emergency management services. The ability of strong social capital and cohesiveness are revealed during emergency actions or measures for preventing flooding and limiting flood impacts in recovering, and in adaptation and transformation measures [7,29,37], placing them at the core of this study.

3. Methodology

3.1. Description of the study area

Matola is a major city, located in the Infulene and Matola River catchments in southern Mozambique, with a short stretch of coastline on Maputo Bay (see Fig. 1). With an estimated area of 368.4 km² divided into three administrative areas, Matola has experienced rapid population growth, from an estimated 424,662 inhabitants in 2000 [45], to 1,032,197 in 2017 [46], based on official censuses. According to other estimates, based on UN World Population Prospects, Matola had 498,000 inhabitants in 2000, increasing to 1,915,000 in 2024 [47].

Matola was purposively chosen for this study because it suffered from a most serious flood in the year 2000 [20,22], and has since suffered from cyclical floods. The flood in the year 2000 was one of the most devastating floods in Mozambique in recent decades [19, 20,22]. As floods occur in the rainy season (October to March), an urban plan was adopted in 2010 to regulate land use in light of flood vulnerability, with the intention to promote resilience [48]. In 2012/2013, for example, there were floods that, in addition to degrading infrastructure, such as roads, bridges, schools, hospitals, housing, and access roads, displaced several families who had resettled in Maputo Province (which includes Matola) and the City of Maputo [49]. In 2021/2022, the rains tended to be above normal from October to March in Maputo Province [50] (see Fig. 4). This put great pressure on the municipal administration and on the urban communities, which struggled to maintain their environment and livelihoods in the face of flooding.

There is an established administrative hierarchy in the Municipality of Matola that serves as an official collaboration network within municipal entities in times of crisis. At the lowest level there are block leaders (*chefe de quarteirão*) elected by the community members. The block leaders answer to the leaders of the neighbourhoods (*secretário do bairro*) to which the blocks belong. These leaders are appointed to their positions by the heads of administrative posts (*chefe do posto administrativo*), who answer to the President of the Municipality.¹

3.2. Data collection methods

One area in each of the three administrative areas in Matola was purposively selected for the study. The selection criterion was that the areas should be at risk of flooding, have experienced floods in 2000, and experience cyclical floods in the hot and rainy season (October to March). The criteria for selecting the study participants were that they should be resident men and women in the selected study areas who experienced the floods in 2000, aged over 30 years to be old enough to remember the incident, and living in medium-to low-flood-risk areas. Individual semi-structured interviews and focus group discussions were the main data collection techniques. Individual interviews and focus group discussions were used to gather personal information in dialogue with people, focusing on people's actions in the face of floods and on their sense of collectivity. During the first fieldwork campaign in 2020, semi-structured interviews were conducted in one study area. It was noted that, although the interviewees spoke of actions as a community, they had an individual focus, which led to focus groups being conducted. This technique made it possible to obtain more general and common opinions about how communities acted collectively. The semi-structured interviews were carried out with 18 individuals (8 female and 10 male), six from each administrative area. Seven interviews were conducted in January 2021 and 11 in June–July 2022. Three focus group discussions, one in each administrative area, were carried out in June–July 2022. A total of 24 residents (12 female and 12 male), participated, with each focus group involving seven to nine residents living in flood risk areas and who had experienced the 2000 flood.

The interviews and focus group discussions had the same focus: experiences of the 2000 flood and awareness of flooding in Matola; the adaptation and/or mitigation actions used by the population since the 2000 flood; and the future in terms of what people envisioned in case of floods equal to or greater than those of 2000. To supplement the interview techniques, direct observations were conducted throughout the fieldwork periods, and documented in photos to testify to what was described and presented in the interviews. Two municipal officials (1 female and 1 male) from the urban planning sector in Matola, who were present at the time of the 2000 floods, were also interviewed. This interview aimed to seek information about the involvement of the local authorities in

¹ The municipal administration deals with all issues related to the lives of community residents; it comprises various municipal councils with associated technical departments.

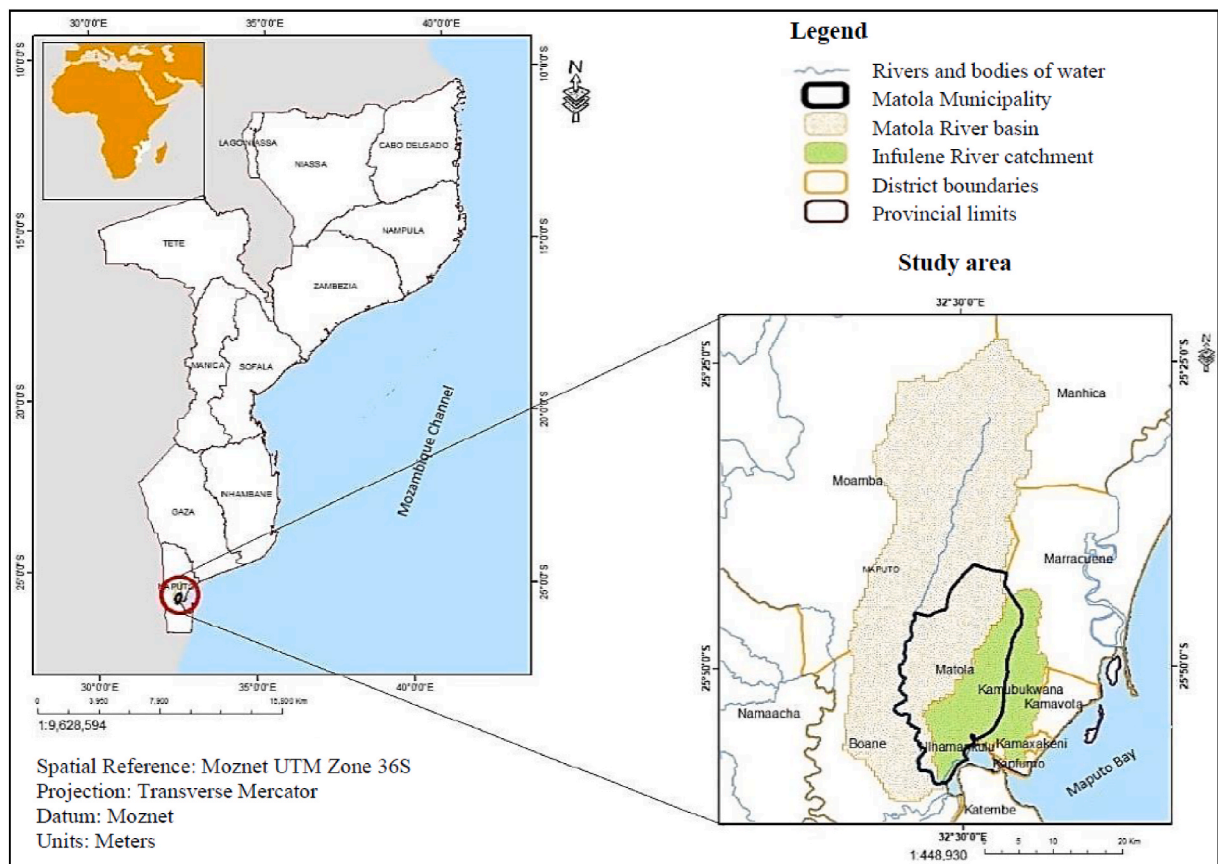


Fig. 1. Location of Matola [51].

promoting resilience to floods, and in cooperation with local communities. This study was developed based on informed consent from participants, and offered them anonymity in relation to the specific statements presented in the research results.

Data analysis involved the triangulation of data resulting from semi-structured interviews and focus group discussions with members or residents of Matola communities, data from relevant documents, and observations. Data were analysed and interpreted using NVivo Software. The study uses socio-ecological resilience discourse as a conceptual framework, particularly concerning community resilience to floods, looking at the actions and measures that the communities have adopted since 2000, using as a lens the dimensions of promoting community resilience provided in the conceptual framework. This conceptual framework was used to analyse, explain and discuss how communities in Matola developed actions and measures to promote resilience to urban flooding, and to finally present the conclusions.

4. Coping with flooding in Matola

This section presents the residents' experiences, actions, and measures related to flooding. All data are based on the semi-structured interviews and focus group discussions carried out with community members in the three selected administrative areas of Matola.

4.1. The major flood in 2000

4.1.1. Experiences of flooding

All study participants had experienced the 2000 floods, which were of a magnitude never experienced before or since, as expressed by a focus group participant:

For decades from generation to generation we lived in these areas. Although these areas are low-lying, we had not experienced such precipitation as would result in floods. (Man, aged 67, June 2022)

The participants stated that in the early hours of February 6, 2000, they were taken by surprise, completely unprepared to prevent water from entering their homes and backyards and filling their agricultural fields. All neighbourhoods of Matola were flooded, even places where one did not imagine seeing water. In areas of low flood risk, people could remain in their homes. However, people living in low-lying areas faced severe problems. Many of their homes were partially or completely destroyed and their possessions swept

away by flooding, since their homes were often precariously constructed of sticks, reeds, zinc sheets, or poorly-made concrete. In addition, agricultural crops, poultry, and livestock were destroyed or swept away, meaning that many people lost a large part of their family livelihood assets. The flowing waters also caused great erosion in steep areas, resulting in the impassability of some streets, making the evacuation of families difficult so that small boats had to be used. No information had been disseminated clearly indicating the magnitude of the floods, explaining why it had not been possible for residents to leave the flood-threatened areas in advance.

The floods that began on February 6, 2000, were unforgettable. It was a surprise for me and the whole family, to be woken up early in the morning by the water invading the house. When I went out of the house, I saw that the yard and the surrounding landscape looked like a sea where there was usually no watercourse. (Man, aged 51, January 2021)

The floods occurring since the year 2000 have not been of the same magnitude, even though they have damaged infrastructure and people's family, financial, and community lives.

4.1.2. Emergency actions during floods

During the 2000 floods, the immediate action taken by residents was to try to bar the entry of water into their houses. For those with backyards, they tried to seal off the entry of water with sandbags. With the continuous flooding, residents of two-floor houses could occupy the upper floor, which offered some protection until the arrival of the evacuation teams. Other residents had to resort to the roofs of their houses with their belongings, moving children, food, some furniture, and small livestock to these relatively safe places. The women among the study participants stated that they faced great difficulties in these actions, as one interviewee explained:

Particularly on February 6th, I was desperate because my husband was not at home. I needed to take care of the children, placing them in a safe place, but I also needed to gather some belongings and food. (Woman, aged 51, January 2021)

For women affected by floods in the absence of their husbands, taking care of the children was a great challenge. Many men were occupied outdoors, helping install barriers to water entry, or carrying children and goods to the roofs of houses. Many men were unable to return home for a few days, which caused great concern to everyone, due to the uncertainty about what was happening to their families. The immediate actions taken to deal with the floods aimed at minimizing the negative impact of the floods on households.

The extreme floods lasted for six days before the water began to recede. During the floods, caring for family members was people's priority, followed by recovering household assets. Families living in areas where the risk of flooding was high and where the floodwaters overtopped the flood barriers were forced to abandon their homes. These families had to move in with relatives or other community members or be rescued and moved to accommodation centres for flood victims that had been rapidly set up by government entities and provided a relatively safe environment. Matola municipal authorities and the National Institute of Disaster Management (INGC) also set up rescue teams. However, due to the scarcity of both the community's and rescue teams' evacuation transport, community members had to walk several kilometres to reach the accommodation centres, running the risk of being swept away by the water, as one interviewee explained:

Although it was risky, we walked through the water in desperation with luggage and our children. But this was the only alternative, as we had to go to the accommodation centre. We tried to stay close to each other, helping each other so that we did not lose anyone, neither us nor our children. (Man, aged 53, July 2022)

According to interviewees, going to accommodation centres with luggage and children was very risky for women and children; however, with the support of community members who helped transport luggage and carry children, the situation became relatively safe.

When abandoning their homes, people took with them what they could, including furniture, food, and livestock, according to the material and financial capacities of each household. Regarding the financial and material losses caused by the floods, interviewees and focus group participants stated that, as far as they knew, there was no monetary support for the flooded communities from government entities or disaster relief support partners, either during or after the 2000 floods. According to focus group participants, community members distributed monetary support among themselves via pre-existing small groups called *xitique*, informal rotating saving and credit groups. This support was not high in value, but nevertheless helped to provide some basic items to sustain the displaced and those staying in the homes of relatives or neighbours. These activities took place while people awaited humanitarian support from government and municipal entities in the form of food, provisions, and even tents in some cases.

During the days of flooding, community members walked many kilometres to get to their workplaces, even though it was risky. According to the interviewees, some employers demanded that they come to their workplaces. Others travelled long distances to check the condition of their livelihood goods where they carried out their economic activities, such as in small shops, market stalls, and carpenters' workshops. This was important to community members, as they depended on their earnings or income-generating activities for their families' livelihoods.

4.1.3. Community collaborative actions

According to the interviewees and focus group participants, the population of Matola acted as a community during the floods due to strong social networks and well-established trust, believing that collectively they would be able to help one another. The relationships of mutual trust, rooted in local customs and practices, were a vital factor in the actions taken by community members affected by the floods.

According to the focus group discussions, community actions were extremely important during the six days of flooding, as the rescue action carried out by the government was late and did not immediately reach all the locations most affected by the floods. Even

after the rescue teams had started working and assistance was given by the government, conditions were not sufficiently improved for everyone, as verified by the inadequate supply of rescue equipment, tents, food kits, etc. Therefore, the mutual help among community members was vital. Groups also worked with hoes and shovels to clear channels in streets to drain water and create passages to rescue community members and their belongings. The community actions of small groups in different neighbourhoods were based on social cohesion, and people acted according to their capacities in rescuing people and recovering property, transporting people and goods to safe places, providing food and supplies, and finding accommodation, as explained by a focus group participant:

During the 2000 floods, the temporary abandonment of our flooded houses for the higher areas of the neighbourhoods, such as the homes of friends and relatives and accommodation centres created in schools and markets by the municipal government, was a process sustained by the mutual help of community members, with the support of the rescue teams set up by the municipal authorities and INGC. This consisted of the transport of people and goods, and rescuing and recovering people and goods swept away by the waters and reported as missing. (Man, aged 63, July 2022)

Despite the lack of resources, the collaboration between community groups and the municipal administrative structure was vital during the 2000 floods. According to municipal officials of Matola who were part of the rescue team during the floods in 2000,

The 2000 floods rescue activities consisted of alerting the population, rescuing and transporting people, food and goods, placing families and their goods in camps, and distributing tents and food items, among others, in cooperation with the communities (Municipal official of Matola, woman, November 2020).

The municipal administration was fundamental in disseminating information about what was being experienced in the different neighbourhoods during the floods. The collaboration also helped the rescue teams evacuate people and goods and distribute relief kits and basic supplies.

4.2. Community actions and measures after the 2000 floods

4.2.1. Choices of where to settle

Soon after the 2000 floods, community members had to make strategic decisions. The first decision was where to settle and create good living conditions for their families, and whether to rebuild their old homes or build new homes in less flood-prone places. According to the interviewees and focus group participants, most of the families managed to return to their old homes, unless their homes had been destroyed or were in a high-risk flood area. People helped one another to rehabilitate houses, using material of their own or supplied by the municipality. This was done in small groups going from house to house of the group members, which helped them to quickly rebuild and return to their homes. The communities also collaborated with municipal entities in providing information about people who required assistance with necessities, such as clothes, food, utensils, and construction materials.

Although municipal entities and the government tried to assist people, it was not enough for all those affected. The interviewed women reported that their challenges were great during this time. Women often had to divide their time and efforts between taking care of their children and looking for food,² whether from neighbours, relatives, or even at employment sites, because the food provided by the humanitarian assistance was not enough for everyone. At the same time, families had to struggle to rebuild their houses, as one woman explained:

For me, it wasn't easy. I'm not saying that for the men or neighbours whose husbands were present it was easy, but my situation was desperate because I had to make choices about where to go all alone and having to face the challenge of rearranging the house and having to take care of small children until my husband returned from South Africa.³ (Woman, aged 53, July 2022)

This post-flood process was challenging since families in the communities suffered, lacking almost everything. Some families could only return to their homes long after the floods because the floodwater took a long time to recede. Other families whose homes remained flooded months after the event had to abandon their homes and be resettled, organized by the municipality, as described by a focus group participant:

We came back here. Although the water hadn't completely receded yet, it was possible to walk here. But our neighbours in the lower area couldn't return, it wasn't possible to enter their houses and the water took a long time to subside. And some neighbours in the lower area definitively abandoned their homes and were resettled by the municipality. (Woman, aged 56, July 2022)

The construction of homes for resettlement took a very long time, and community members had to wait in the accommodation centres. This situation made some people abandon the scheme and look for relatively safe places where they could acquire plots of land to build their new homes on their own. Such action, however, depended on the material and financial capacities of the families.

4.2.2. Improving living conditions

After the 2000 floods, community members took measures to restore and improve their physical and material living conditions. People who had remained in, and those returning to, their homes, had to undertake improvements. Among such improvements were

² Caring for children and providing food for the family are typically women's gendered responsibilities in this context.

³ It is common for men in southern Mozambique to go to South Africa to work.

raising backyard land levels with fill, constructing better fences, rebuilding or improving destroyed houses, and building houses with conventional material (e.g., concrete blocks and cement). This included recovering material and goods damaged during the flood or acquiring replacements. Families that were resettled had to move to houses constructed by the municipality, even if some had to extend their new houses to accommodate their households. Other actions carried out among community members included family support or assisting in transport to workplaces and taking children to schools in new areas.

The process of rebuilding the material conditions of each household, and of the community in general, took a long time. Some families managed to rebuild their living conditions relatively quickly, while others needed longer to do so. Even up to the present, some families are still struggling from certain material losses, as one interviewee explained:

As you can see, I am still struggling to improve the house and little by little I am filling up the backyard of the house to ensure that whenever the rain falls or a flood like the one in 2000 happens, at least neither the house nor the yard will be flooded. The results have been good, because so far, whenever it rains, the water runs towards the street and into the stream. (Man, aged 56, June 2022)

Another measure taken by those who could afford it was the acquisition of radios and televisions to follow news media and to stay informed of alerts about possible occurrences of events such as floods, strong winds, heavy rain, and other weather conditions. This was extremely important for community members, who were aware of the need to follow weather information and not be surprised by new risk events.

The adaptive capacity was highly dependent on the material and financial capacities of each household, and on access to mutual help that exists among groups of community members. However, all adaptation actions carried out by community members immediately after the floods, and over time, depended on financial resources raised from formal or informal businesses and/or employment, and on monetary contributions in *xitique* groups.

4.2.3. Community interactions with the municipality

After the 2000 floods, interaction between the communities and municipal entities continued during the provision of post-flood humanitarian support, and in the process of returning community members to their homes or building new ones. The strong social networks and trust among community members helped block leaders and urban planners get detailed information about the conditions of community members affected by flooding and during the recovery period. This detailed information, such as the registration of displaced community members, lost property, and missing persons, helped increase the effectiveness of the humanitarian assistance organized by the municipal authority and local self-help operations. According to focus group participants, teams of community members and urban planners were created by the municipality to identify families needing resettlement and to survey families whose residences needed to be rebuilt, in addition to assistance with food, tents, clothes, blankets, and others. According to municipal officials of Matola active during the 2000 floods,

These teams also selected the resettlement areas, based on local knowledge among community members, and discussed models and size of resettlement housing. Partial urban plans were drawn up immediately, starting in 1° de Maio, Kongolote, and Nkobe neighbourhoods, previously identified as safe for resettlement of flood-affected community members or households. Although resettlement has taken place gradually, there are still families waiting to be resettled. (Urban planner, Matola Municipality, active during the 2000 floods, man, November 2020).

Municipal assistance with construction materials for rebuilding houses, such as galvanized sheets, beams, and cement, did not reach all the registered victims. Therefore, community collaborative actions continued through neighbourhood groups (Fig. 2), for example, in helping one another when rebuilding houses.

The teams of community members and urban planners created by the municipality identified waterways and drainage areas in the different neighbourhoods based on local knowledge and helped construct channels for water flow. Some drainage channels were constructed based entirely on the manual labour of community members. However, many channels have gradually become filled with soil and garbage, and in some cases have become blocked during the construction of access roads, houses, and other infrastructure, no longer allowing the passage of water in the rainy season.

Cyclical flooding is an ongoing problem in Matola, and community members are dissatisfied with its handling. Even so, the collaboration of community groups with municipal entities continues, mainly through the transmission of information through the administrative collaboration structure, from block leaders to the President of the Municipality. When necessary, meetings are held between municipal officials and community members – that is, representatives of each family in the block or neighbourhood participate, to discuss various problems or situations affecting the community. The administrative collaboration structure involves different sectors of the Municipal Council, aiming to guarantee sustainable socio-economic development within the municipality. Thus, urban planners and other municipal technicians take part in meetings in the communities, as they are the ones dealing directly with community issues, under the guidance of an administrative leader.

According to focus group discussions, population growth and increasing numbers of new residents of different social strata and backgrounds have led to cracks in the social cohesion that residents experienced during the 2000 floods. At that time, everyone knew one another and interacted like family, although people lived dispersed, but today it is “everyone for oneself”, which has made communication between residents or community leaders and new residents somewhat difficult.



Fig. 2. Meeting with community members (photos: author).



Fig. 3. Infrastructure being constructed in prohibited places (photos: author).

4.3. Current community concerns about risks of flooding

Interviewees and focus group participants pointed out that, since the 2000 floods, Matola has suffered from almost cyclical floods. Although these floods have been less intense than those in 2000, they have damaged economic and social dynamics in the municipality. In recent years, when there has been heavy rainfall during the rainy season, floods have been exacerbated in some neighbourhoods by construction in areas susceptible to flooding, often in places that are natural waterways. Blocking the passage of waters in this way means that even areas not normally flooded will become so. According to one interviewee:

The construction that has taken place since 2000 of housing, commercial, and industrial infrastructures in flood zones and water channels is a very complex problem. Some water drainage channels that we created after the 2000 floods have already been buried by these new infrastructures, which have raised the level of land. This current scenario affects us negatively in times of intense precipitation, causing flooding in some blocks of our neighbourhoods due to blocked water flow. (Man, aged 54, July 2022)

The above situation is associated with how the Municipality of Matola has issued land titles, or “DUATs”. There are cases of giving DUATs to citizens who then build industrial, commercial, or housing infrastructures in places that are natural waterways. These land areas are marked by INGC with signs reading: “Area vulnerable to floods. Construction of houses prohibited” (see Fig. 3).

Those who appear in neighbourhoods with DUATs issued by the Municipality of Matola continue with their construction, even though in inappropriate places. According to interviewed urban planners from Matola, constructions in floodable areas actually occur, on the one hand, because of political interests that sometimes override the suggestions of urban planners in partial urbanisation plans, and on the other hand, because citizens informally occupy flood-prone areas.

What happens is that we, as technical planners, produce urban plans that show the different uses of urban land, such as areas that are flood-prone or waterways.⁴ However, due to political interests, we are forced by the rulers, our superiors, to assign

⁴ Areas that serve as natural rainwater drainage during the rainy season.



Fig. 4. Flooded neighbourhoods in Matola, rainy season 2021/2022 (photos: author).

DUATs. In other cases, citizens without land use rights build infrastructures in floodplains or waterways. (Urban planner, Matola Municipality, man, November 2020).

According to many community members interviewees, this situation is very complicated, since they as ordinary citizens lack the power to remove the buildings that contribute to the increased frequency of flooding. Not even community leaders have power in relation to the municipal entities. When community leaders explain to the new residents that they are taking a great risk by building in flood-prone areas, the new residents ignore this, as one community leader explained:

We, as residents of the neighbourhoods who lived through the drama of the 2000 floods, inform the new occupants that these spaces are flood prone. But unfortunately, they insist on occupying these areas, as some have DUATs that were approved by the Municipality of Matola, a higher authority than us. (Community leader, aged 68, June 2022)

Also characterizing Matola over the last 22 years, as noted by interviewees, is the construction of roads raised above the level of the surrounding housing land. These roads have been constructed without efficient rainwater drainage systems, whether culverts, channels, or bridges. This means that with heavy precipitation, after soil saturation, some neighbourhoods become completely flooded due to floodwaters accumulating in road-blocked waterways (see Fig. 4).

This situation has led to demonstrations by residents. The reaction of the municipal entities consisted of an appeal for calm accompanied by assurances that the municipality would create conditions to solve the flooding problems in some areas, by constructing drainage systems and removing structures in areas of high flood risk.

Overall, poorly regulated construction and the absence of proper drainage systems have made the area far more vulnerable to floods than it needs to be. Given this, many of the interviewees stated that if there were again a flood equal to that of 2000, the damage would be even greater. In 2000, there was not as high a rate of land occupation by residential, commercial, and industrial infrastructure and paved roads as there is today. In 2000, much of central and northern Matola was traditional family farmland, interspersed with areas of natural vegetation and natural access roads, but even so the floods were devastating.

5. Discussion

The 2000 floods were devastating to the local communities, the City of Matola, and many other areas and cities in Mozambique. The floods took people living in Matola by surprise, as no early warnings or other information alerted them to the magnitude of the impending floods. The 2000 floods served as a harsh “wake-up call” that, from that time onwards, something had to be done to limit the negative effects of heavy rainfall and floods in the future.

The immediate emergency actions taken by women and men in the communities were of both a family- and community-focused character. The first actions were to secure the closest family, especially the children. Then, community members helped one another rescue and accommodate neighbours, relatives, and other community members. They served as first responders, and although not trained for such emergency action, they did the best they could based on the social cohesion in the communities, as also found by Joseph et al. [44] in the case of floods in Kerala. During the emergency phase, the communities also collaborated with the municipal administration, which formed rescue teams together with community members and urban planners. These collaborative actions were fundamental during the emergency phase and served as a basis for ongoing collaboration between the municipality and the communities, showing community competence in collective action and problem-solving, as highlighted by Bulti et al. [29]; see also [39]). In high-risk areas, where the water was deep, families had to abandon their homes and move to flood victim centres arranged by government entities. Due to insufficient rescue team transport and emergency support, community members helped one another arrive safely with their belongings at the centres, as well as supplying some food and basic items. As far as the study participants knew, there had been no monetary support from the government either during or after the floods; instead, community members made small, but highly valued, contributions to help others worse off, as also found by Joseph et al. [44].

During the early recovery phase, the flood-affected community members had to make many decisions on what actions and adaptation measures to take. These mainly concerned how to create safe living conditions, whether through rebuilding and improving

old homes or moving to new resettlement housing. Another measure was to buy radios or TVs to be able to follow news and weather information. Many collaborative actions took place, such as mutual help with transportation or family sustenance. This mutual help among community members, financial as well as material and social, has been and still is a crucial part of community members' daily lives.

A key finding is that the existing social capital in the communities was vital for resilience during and after the floods. Strong social cohesion is important for community resilience, as the existence of social networks and local organizations is linked to a community's well-being following a disaster, something found in several studies (e.g., Ref. [28,37,38,43,44]). The case of Matola shows how the community members collectively used various available community resources to help one another, also collaborating with municipal and government entities, both during and after the 2000 floods. Communities were the primary active agents in shaping their capacity to respond and adapt to change, highlighted as central to community resilience (e.g., Ref. [7,35,36]).

After the floods, interactions between the communities and municipal entities continued, with the teams formed of community members and urban planners playing a fundamental role in helping community members return to their homes, identifying families to be resettled, and taking action to clear drainage channels, based on community knowledge of the waterways. This interaction was important in designing partial urbanization plans for resettlement sites and also in developing the types of houses to be constructed in these sites. As discussed by McEwen et al. [11], such collaborative actions have favoured agency in functioning and sustainable community groups to address problems, decide on collective actions and measures to be taken, and communicate information in time of crisis, all of which are important in building resilience, as also found by Bulti et al. [29], Wickes et al. [28], and Xu et al. [39]. An important finding suggests that although families were rescued and resettled by municipal authorities, it is possible that the local social capital was just as important for the community's resilience as were the material and infrastructural resources provided by the municipality and its partners to the flooded communities. Community members were the first responders and have continued to help one another since the 2000 floods, which suggests that community-level resources may play a greater role than supposed in the ability of local communities to recover and adapt, innovate, and move forward. This possibility should be considered in natural disaster management. However, as other studies suggest, external financial assistance provided by insurers and government support, among others, may still be crucial in supporting local community resilience [11,28,29].

With a rapidly increasing population and accelerated horizontal land occupation in Matola, there seems to be a mismatch between what the municipal development plan and resilience strategy state, and what is happening in practice, since construction happens without consideration of the same, even in violation of official regulations. Constructing buildings and infrastructure in areas vulnerable to flooding could put the local communities in danger due to the damming effect when construction blocks waterways. Such exposure increases vulnerability and the risk of flooding, as argued by Xu et al. [39]. This constitutes a theoretical contribution of this study that follows from its retrospective approach. Analysing resilience to floods from the year 2000 to the present, the study reveals that the increase and change in the local population lead to local social transformations, which over time affected the perceptions of risk, and in turn, attitudes and actions taken individually or as communities. Such changes in attitudes and actions over time can increase the hazard or contribute to improving flood resilience. This situation highlights the importance of a participatory planning process, as noted by McEwen et al. [11], in which all stakeholders – such as urban planners, political leaders, community leaders, and old and new residents – are aware of the factors that positively and negatively affect the flood resilience of a community or neighbourhood. In line with Bulti et al. [29], McEwen et al. [11], and Zhong et al. [38], all stakeholders need to act to improve and strengthen resilience to future flood events according to their levels of agency. This includes recognizing the value of local differences and knowledges as bases for local decision-making that reinforces community resilience, in shared efforts to minimize the negative impacts of urban flooding.

6. Conclusion

This analysis of the actions and measures that the communities in Matola developed suggests that collective community-based actions and measures played the most crucial role in coping with the urban flooding in 2000, and that they continued to be crucial during the recovery phase. The community-based collective actions and measures also extended to collaboration with the municipality specifically, but also with various government entities.

Although various kinds of resources were needed to cope with and adapt to the flood event, the core resources, or dimensions, in these actions and measures were the strong social cohesion and networks of mutual trust in the communities, rooted in local customs and favouring cooperative and participatory actions between community members and government teams. The readily available social resources could, therefore, partly compensate for limited access to material and financial resources. These important findings can inform current official policies for disaster management. However, in rapidly changing social contexts, such as those of accelerated population and urban growth, community characteristics may change, and formerly strong social relations and networks may weaken and have much less significance should there be another major flood event in the future.

We conclude that there should be improved participation in urban planning and resilience building measures, involving all stakeholders in considering what it means to live with and adapt to floods. There is a need for more cohesive cooperation with communities in urban planning actions to promote resilience to floods. The municipal authorities of Matola should not allocate DUATs for the construction of industrial, commercial or housing infrastructures in flood-prone areas or waterways and should effectively prevent citizens from occupying these areas. More consistent community organization would increase agency and strengthen community interest in participatory actions and planning in ongoing interaction with the municipality to better prepare for mitigation actions for and/or adaptation to urban floods, such as maintaining the few existing drainage systems in the municipality and demanding that new construction include suitable drainage systems to prevent future permanent flooding.

Understanding the role of community resilience to urban floods in Matola, developed in a context of technical and financial constraints, serves as a point of reflection in relation to the socio-ecological resilience discourse, and makes a retrospective study showing what worked and what did not work, and therefore, what can be improved. Furthermore, the study shows the need to pay attention to structural changes within communities, especially because with changes in population, community members' perceptions of risk may change, and flood risk coping strategies and actions may also change with consequences for communities' flood resilience. This knowledge can be useful, whether in Mozambique or in other similar contexts around the world when addressing community resilience to floods or to other hazards. Additionally, the results support previous studies, especially of communities facing multiple constraints in developing countries, such as Joseph et al. [44], Lwin et al. [37], and Patel & Gleason [43], in finding that social capital, characterized by mutual trust and social cohesion, is fundamental to building and promoting flood resilience. As demonstrated in this study, social capital allows for cooperation and collaboration among community members to face flood hazards with a greater probability of success according to their resources, instead of just depending on and/or waiting for official government aid.

CRedit authorship contribution statement

José Lourenço Neves: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Margareta Espling:** Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization.

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Funding

This work was supported by the Sida – Mozambique Bilateral Programme (Grant no. Sida- 51140073).

Declaration of competing interest

there are none.

Acknowledgments

We wish to thank Mattias Sandberg, Petter Pilesjö, and Inocência Pereira for their support when conducting this research. We are grateful for the comments made by the anonymous reviewers and the editor, which helped us to improve the paper.

Data availability

The data that has been used is confidential.

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