Community-led Climate Adaptation in Informal Settlements: Dar es Salaam, Tanzania

Study areas

Kwa Pakacha Settlement – Tandale Ward, Kinondoni Municipality and
Kombo Settlement – Vingunguti Ward in Dar es Salaam City Council

Tanzania Federation for the Urban Poor

CENTER FOR COMMUNITY INITIATIVES

Contents

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Summary

People resident in urban informal settlements are highly exposed to global climate change and, due to poverty, adverse environmental conditions and a lack of risk reducing infrastructure, are least able to adapt to growing risks. With the number of people resident in cities expanding by around 2.2 billion globally over the next three decades, there is an urgent need for safe and affordable settlements that are resilient to changing climate conditions.

This report forms part of a wider project, funded by the World Bank, looking at community-led climate adaptation in informal settlements. It reports the outcome of community-led data collection in two low-income urban areas of Dar es Salaam - Kwa Pakacha and Kombo, exploring effects of changing climate conditions.

Through a process of community-led research, data was collected and analysed to provide new insights into the experience, impacts and the strategies adopted by residents to cope with climate change. This analysis helps to fill gaps in official data, to empower people to act collectively to reduce risks and to identify areas for collaboration between communities and government to improve settlements.

The research found a majority of residents in the two settlements had earnings below the international poverty line ($2.15 per day) and were reliant on unstable informal sector employment. Poverty increases exposure to climate risks, limiting options to avoid the worst conditions and, where people already struggle to meet basic needs, to invest in the adaptation of housing and environment.

The location of both settlements on low-lying former farmland makes them particularly vulnerable to flooding. While Pakacha has benefited significantly from the Dar es Salaam Metropolitan Development Project (DMDP), a lack of investment in Kombo exposes residents to flooding of rivers and tributaries, blocked by solid waste. The density of buildings, lack of green space and poor quality of construction offer limited protection from adverse weather conditions. While people recognise the risks from climate change, there is little understanding of how to adapt, which increases vulnerability and impacts.

- Health impacts - hot and damp conditions are a cause of skin and respiratory infections, particularly affecting young children, older adults and people with chronic illnesses. Heat affects sleep patterns and risks of flooding and storms is a cause of stress for residents. While around half of respondents have sought medical attention for climate related illnesses, just 10 per cent have medical insurance, creating additional financial burdens on households.
- Economic impacts – the financial costs of extreme heat, flooding and storms reduce incomes, due to lost workdays and the loss of vended goods (i.e., food perishing quickly in heat) in adverse conditions. Over a year, with overlapping climate events, households could be spending up to one third of their income on short-term repairs, maintenance and property replacements, aside from the additional financial impact of lost income and unplanned expenditure. Economic impacts undermine the ability of households to cope with climate conditions and, where events occur in quick succession, can significantly increase vulnerability.

While households are not passive in response to climate risks, poverty, environment conditions and a lack of knowledge on how to adapt lock people

into a diminishing cycle of coping. Across all climate risks, action is largely taken during or after adverse weather conditions, with little investment in preparation or risk reduction. Limited collective action or sustained partnership with government, diminishes the adaptive capacity of communities to better prepare for the challenges of climate change.

Where actions are taken, these are often changes to behaviours such as wearing lighter clothing during heatwaves, rather than investments in housing (e.g., installation of ceilings or painted roofs) or the natural environment (i.e., planting trees for shade). Decisions are shaped by unstable incomes, a lack of access to loan finance and limited knowledge to assess the cost effectiveness of various short- and long-term adaptation options. With a significant proportion of household income already used for short-term recovery, there is a need to scale community-led adaptation, making better use of household investment to reduce risks and to build new delivery partnerships with government.

- Community-led adaptations – alongside household actions, there is local support for efforts to improve the function of drainage by removing solid waste, working with government to extend and maintain infrastructure within settlements (including the DMDP structures in Pakacha) and retrofitting housing. These actions can be led locally, but need to be enabled by city government, providing the policy support and technical assistance required for delivery.
- Government-led adaptations – DMDP has demonstrated the difference that large scale investment can make and the importance of extending and connecting infrastructure across settlements. Communities highlighted the importance of participatory land-use planning to reduce climate risks, increasing the coverage of drainage, sanitation and road networks and joint work with the community to plant and maintain trees to provide shade and raise the absorbative capacity of green space. Government leadership is key to meet the cost of major investment and to ensure that informal settlements are integrated into the systems of the city.

The community-led data and analysis has provided new insights into the challenges and the responses to climate change in Dar es Salaam's informal settlements. It has also identified new spaces for joint action between communities and city government to enable community-led adaptation and the co-production of sustainable urban development. With significant scope for action, the community recommendations aim to reduce vulnerability and contribute to longer-term adaptive capacity, focusing on the following.

- Enhancing the natural environment through joint efforts to plan for, reinstate, protect and maintain green space and tree coverage within settlements.
- Increasing the coverage and effectiveness of infrastructure and services in communities, with priority given to the installation and maintenance of drainage and sanitation networks.
- Improving the resilience of the built environment, by enabling communities to invest in and improve housing to reduce climate risk.

Actions need to be underpinned by improved data collection and structures for partnership working. The scale of climate risks and the complexity of informal settlements require new approaches and the capacity of communities and government working together. This report provides evidence, but requires leadership to translate it into action.

1. Introduction

There is clear evidence of the disproportionate impact of climate change on informal and low-income urban settlements across developing countries.[i] Rising sea-levels, increased rainfall, erratic storms and high winds pose significant challenges, globally, for more than 1 billion people that live in slums without access to basic services and in informal settlements, without legal rights and protections.[ii]

Urban populations are expected to nearly double by some 2.2 billion people over the next three decades, with 68 per cent of people living in cities by 2050.[iii] Current patterns suggest that much of this growth will take place in informal urban settlements.

The increased rate of unplanned urbanisation will bring significant challenges for governments to meet demand for affordable housing, viable infrastructure and transport, basic services, and jobs. It will be important to ensure cities develop in a sustainable way, as physical fabric and land use patterns can be locked in for generations.

Populations resident in informal settlements are vulnerable to climate risk due to the low durability and location of their homes, combined with a limited capacity to cope with changing climate conditions. It is vital to fill gaps in official data on the composition and needs of informal settlements. This should lead to increased devolution of investment targeting urban areas most at risk from climate change. To meet these challenges, new ways of working are needed to strengthen the adaptive capacity of communities, working in partnerships with governments to deliver locally led climate actions.[iv]

This report forms part of a World Bank project looking at community-led climate adaptation in informal settlements. It is the product of detailed community-led research in Kwa Pakacha - Tandale ward in Kinondoni Municipality and Kombo - Vingunguti ward in Dar es Salaam City Council to understand the impacts of climate change and the coping strategies of residents in these settlements. The research has been undertaken by the Tanzania Federation for the Urban Poor (TFUP), an affiliate of Slum Dwellers International (SDI) network[v] and the Tanzanian based not-for-profit organization of Centre for Community Initiatives (CCI), supported by the International Institute for Environment and Development (IIED).

The project aimed to build evidence to inform community-led action, in partnership with municipal authorities in Dar es Salaam, to adapt settlements to climate change. The process of participatory research has demonstrated the value of capturing local knowledge to fill gaps in official data and its potential to shape investment delivery and mobilise residents, as stakeholders and agents of change. To meet the financial need for investment and to create pathways for delivery in complex urban areas will require effective local leadership, local knowledge and collective action to co-produce resilient urban settlements.

The research was undertaken by community members in Kwa Pakacha, an area that has received major capital investment in infrastructure as part of the World Bank Dar es Salaam Metropolitan Development Project (DMDP), bringing multiple improvements and reduced climate risks to the residents of this neighbourhood. The research was also undertaken by residents of Kombo, a settlement that is yet to access major infrastructure funding and faces increasing risks from climate conditions. Evidence from these two settlements provide new

insights into perceptions of climate change, the vulnerability of low-income residents and how people survive and recover from shifting weather patterns.

The report has been structured to first provide some background on the context of informal settlements in Dar es Salaam and climate conditions. It includes brief profiles of the two settlements and the participatory methods used to gather information. It then provides an analysis of the findings, identifying the key climate related challenges and barriers and opportunities for community-led action. The report concludes with a synthesis and a set of recommended actions. It is planned that these are developed further through discussion with authorities, funders and the community to form a detailed plan of action.

2. Context

2.1 Growth of Dar es Salaam

Dar es Salaam is the largest urban region and the main commercial centre in Tanzania. Administratively, it comprises the five municipalities of Ilala (known as Dar es Salaam City Council), Kinondoni, Kigamboni, Ubungo and Temeke. Population growth is among the highest in Africa and the number of residents is expected to rise from approximately 7 million to a projected 50 million people by 2060.[vi] The Dar es Salaam population is young, with 31.5 per cent of people aged between 0 – 14 years and 44.2 per cent of young people between 15 - 35 years old. Growth is driven by both birth rates of city populations and ongoing rural to urban migration.[vii]

Rising populations has led to a sprawling urban area, with Dar es Salaam doubling in size between 1990 and 2014.[viii] While there has been significant commercial and infrastructure investment in the city, a majority of residential development has been unplanned, leading to approximately 70 per cent of the urban population living in informal settlements.[ix] This pattern of development has put increasing pressure on service provision and resulted in dense settlement and the occupation of unsuitable land in flood plain areas between the city's major rivers.

The dense configuration of informal urban settlement reflects both the demand for space and also the inability of low income residents to access the formal housing market. A majority of self-built dwellings are in the traditional Swahili style, with multiple occupants and shared common areas used for access and cooking. Homes are often overcrowded, without direct access to water and sanitation and built with materials that lack resilience in changing climate conditions. Settlements are unplanned, with frequent sub-division of plots and a lack of adequate infrastructure, lighting and footpaths.

Dense housing in Kwa Pakacha

These conditions contribute to congestion of spaces and incidents of anti-social behaviour such as street robbery, noise, criminal gangs and violence, which lower the quality and the safety of urban living conditions.

The rate of population growth has exceeded the economic development of the city, with a heavy reliance on informal work, self-employment and home-based industry. Available data indicates that around 58 percent of households in Dar es Salaam operate in the informal economy, with concentrations anticipated to be higher in informal settlements. Of those working in the urban informal sector, 66 per cent depend entirely on informal activities for a livelihood, while 16 per cent use these activities as a secondary source of income.[x]

Informal employment in the main sectors of vending, motor repair, casual labour and personal services, often offer low and unstable incomes. Poverty among the growing populations of informal settlement limits financial capacity to cope with climate and other compounding crises, reproducing vulnerability to changing climate conditions.

2.2 Climate in the city of Dar es Salaam

Dar es Salaam is located at 6°48' S, 39°17' E, on a natural harbour on the coast of East Africa, with sandy beaches in some areas with a surface area of 1,393 square kilometres (km^2) and a total land area of 565 km^2.[xi] The climate is tropical and coastal, with average highs of 32.5°C during the warmest months of January and February and annually over 1,000mm of rainfall, peaking in two rainy seasons from October to December and a long rainy season from March to May. Temperatures and humidity remain high throughout the year, with limited seasonal variation and an average change of just +/- 9°C during a 24-hour period. The climate of Dar es Salaam can be significantly affected by global weather systems, including El Niño and the Inter-Tropical Convergence Zone, bringing thunderstorms over a large area.[xii]

Erosion of Msimbazi riverbank, Kombo

Climate change is expected to create increasing risks to the residents of Dar es Salaam and pressure on existing infrastructure and settlements. The volume of **rainfall** is projected to slowly increase over the remainder of this century, with growing frequency of intense heavy precipitation. This may increase flooding in low-lying, riverine and areas of the city with inadequate drainage. Increased water flow of rivers adds to the erosion of unprotected riverbanks, with severe consequences for housing in hazardous areas. The heightening risks of flooding intersect with anticipated sea-level rises that could affect around 8 per cent of the city less than 10 metres above sea level.[xiii]

Climate forecasts indicate rising **heat** levels, with an average temperature increase of 0.5°C to 1°C by 2040 and between 2 - 4°C by the end of the century, with a slightly higher increase in minimum temperatures. This is accompanied by a major jump in the number of extreme hot days (above 34.6°C), which may more than double from around 40 days per year to between 80 and 140 days per year, creating significant risks to life and wellbeing.

More erratic weather conditions, including increased **wind** and storms, are likely to affect Dar es Salaam, as climate conditions change. Early warning of storm conditions are vital, as high winds can have a devastating impact on informal housing, particularly in areas with few trees providing protection. The coastal position and exposure to Indian Ocean weather systems are likely to increase the vulnerability of the city to future storm conditions.[xiv]

These changing weather conditions will have a disproportionate impact on the urban poor and residents of informal settlements in Dar es Salaam. Settlements have limited resilience to shifts in weather patterns and economic conditions constrain the ability of households to adapt housing and infrastructure. Limited local governments financial and technical capacity, in contexts of rapid urbanisation, has led to an uneven distribution of infrastructure developments across the city.

Most informal settlements in the city are located in watershed areas close to river basins, tributaries and wetland areas that used to be farms, just 40 years ago. The location of these settlements increases vulnerability to climate risks from flooding and extreme heat, compounded by health

crises and the informal acquisition of land and low standards of building construction.

Climate change poses a major threat to lives and livelihoods and, without multi-level programmes of adaptive actions, places large sections of the urban population in Dar es Salaam at serious long-term risk.

2.3 Settlement profiles

Participatory research was undertaken in two informal settlements in Dar es Salaam – Kombo, which is in the Vingunguti ward of Dar es Salaam City Council and Kwa Pakacha, which forms part of the Tandale ward of Kinondoni Municipality. The location of these settlement can be seen in figure 1.

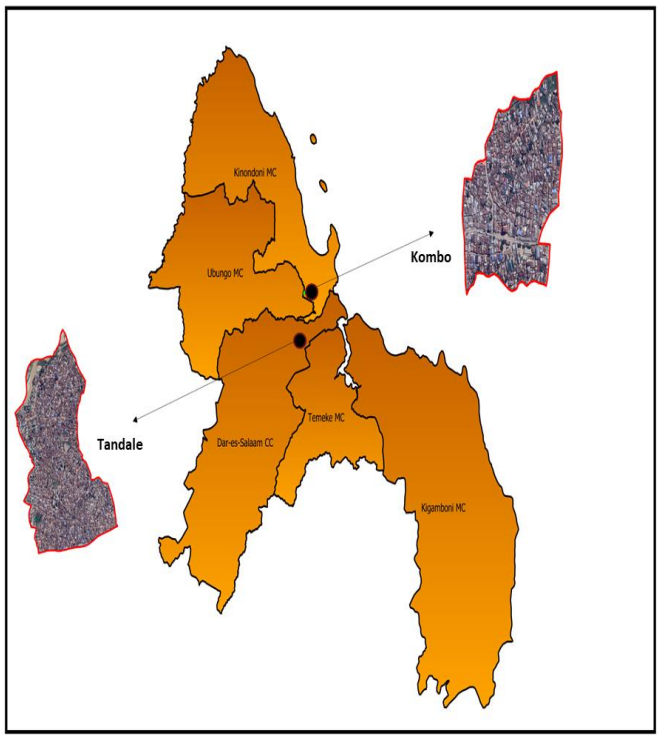
The **Kombo Settlement** has an estimated population of some 19,358 people and is one of six sub-wards within the Vingunguti ward. Kombo forms part of an historic settlement in Dar es Salaam that was established to cultivate wetlands adjacent to the Msimbazi River Basin. The ward name Vingunguti derives from a Zaramo word for the dividing of agricultural pads for cultivation. Kombo refers to a well from which water was drawn for irrigation of rice and vegetables.

Much of Kombo settlement is on low lying land, adjacent to the Msimbazi river basin, which often floods. It is characterised by congested housing, with densities of up to 40 houses per ha[xv] and limited provision of infrastructure. The settlement has seen little significant investment, due to the costs and difficulty of implementing improvements in services.

Kombo has a relatively stable population, with over three quarters (76.5 per cent) resident for more than five years and two thirds (64.0 per cent) for more than 10 years. Around half (50.2 per cent) of homes have been constructed by the current occupants, with a further quarter (27.6 per cent) inherited. A majority (74.6 per cent) are house owners and 82.3 percent choose to live in Kombo for economic or social reasons. Despite the relatively poor environmental conditions, 41.2 percent of residents say that they are satisfied or very satisfied with their homes, with just 4.4 per cent indicating that they are very dissatisfied.

While there are significant risks associated with changing climate conditions, for residents of Kombo the proximity to economic opportunity, established social networks and assets bound up in their buildings and possessions are key factors that tie them to this settlement.

Figure 1. Dar es Salaam, research sites



The **Pakacha Settlement** has an estimated population of around 5,869 people and is one of six sub-wards within the Tandale ward in the Kinondoni Municipality. Like Kombo, the settlement was originally farmland, supporting agriculture and fishing activity along the Ng'ombe River, a major Msimbazi Basin tributary. From the 1970's it became increasingly settled, as populations migrated from rural areas to access economic opportunity in the city. The growth of the settlement was accompanied by the formation of a large market area, selling fruit and vegetables, servicing traders and consumers from across Dar es Salaam.

Pakacha is a dense and unplanned settlement that historically has experienced severe flooding. Pakacha has two major water courses that create a boundary for the settlement: the Kiboko drainage to the north and Mzinga drainage to the south, plus a number of smaller tributaries that are used as drainage channels, within the settlement. Excess water flow and blockages to drainage, caused by solid waste, have resulted in flood damage to large parts of the settlement, with major impacts on residents and businesses.

Improved Ng'ombe River embankment, Tandale

The settlement, as part of a wider set of improvements across Kinondoni municipality, has benefited from major investment from the Dar es Salaam Metropolitan Development Project (DMDP). Major capital works have sought to significantly reduce flood risk through construction of river embankments, drainage channels and roads, alongside improvements to footpaths and street lighting. Additionally, DMDP has supported economic and social infrastructure in Tandale ward, with the construction of a covered market and a health centre.

Similar to Kombo, the resident population of Pakacha is relatively stable, with two thirds (65.3 per cent) living in the settlement for more than five years and over half (58.9 per cent) for more than 10 years. Pakacha has a higher proportion of residents inheriting their property (55.7 per cent) and lower level of self-build (29.7 per cent) compared to Kombo settlement.

There is also a much higher proportion of tenants in Pakacha than Kombo (43.6 versus 25.4 per cent) a difference that may increase as infrastructure improvements boost land values and owners move out and offer their homes for rent to generate income. The primary reasons for living in Pakacha are similar to Kombo, with 77.7 per cent of people identifying economic and social reasons for living in the settlement. Levels of satisfaction are high with nearly half (47.2 percent) satisfied or very satisfied, notably the proportion of people saying they are very satisfied with Pakacha is nearly three times that of Kombo.

In both settlements the risks of eviction are low as residents can access residential licences and other forms of legal recognition that provide rights of occupancy. These entitle residents to be consulted and compensated where government makes changes to land use.

While both settlements have similar histories and conditions, Pakacha has marginally better education and income levels than Kombo, which may affect

overall vulnerability to climate risks and adaptive capacity. More significantly, the research suggests the DMDP improvements in Pakacha are incentivising private investment and enterprise in the settlement. Alongside reduced climate risk, economic multipliers underline the importance of extending investment within Pakacha and to Kombo and other settlements in the city.

3. Research objectives, study areas and methodology

3.1 Objectives

The research forms part of a wider project looking at models of community-led climate adaptation in informal settlements. The data collection in Dar es Salaam has taken a community-led participatory approach to fill gaps in official information and explore the experience and effects of climate change in low-income urban settlements. In this research, the principal climate issues were rainfall and flooding, rising heat levels and the effects of wind and storms on settlements. To explore these issues, three overarching questions were set to guide the design and delivery of the research.

(a) How is climate change impacting on the lives of residents of informal urban communities in Dar es Salaam?
(b) How are residents of informal settlements responding to changing climate conditions?
(c) What adaptation solutions are needed to reduce the impact of climate change on low-income communities?

The research was led and delivered jointly by the Centre for Community Initiatives (CCI), a Tanzanian NGO working on urban development issues and the Tanzania Federation for the Urban Poor (TFUP) a grassroot group organising residents of informal settlements and an affiliate of Slum Dwellers International (SDI). A participatory research approach has been adopted to recognise the unique knowledge and experience of people living in informal settlements and to build capacity for local leadership and action to address growing climate risks.

3.2 Study areas

Two urban informal settlements in Dar es Salaam were selected for the research: Pakacha in the Tandale ward of Kinondoni Municipality; and Kombo in the Vingunguti ward of Dar es Salaam City Council – background to these sites is described in section 2.3 above. These locations were selected because they are established informal settlements with active grassroots TFUP networks, similar socio-economic profiles and face similar risks from climate change. They were also selected because of the difference in infrastructure investment, with DMDP funding being used in Kwa Pakacha, but not in Kombo. This difference provided a point of comparison between the two sites.

Survey interview in Kombo

3.3 Research methods

The research process and primary methods used are identified in figure 2. This structure ensured full engagement of community leaders in the design of the research and provided a sound foundation for the collection and analysis of data. The research had six key parts, as outlined below.

Design and set up – the objectives and research questions were discussed with TFUP leaders in the targeted communities, to refine the focus, inform the design of research tools and to agree implementation arrangements.

Training of data collection team - the TFUP leaders supported the recruitment and training of nine community

researchers and three graduate trainees. Delivery and technical support in setting up the offline questionnaires was led by CCI. Training was delivered over four days and included a detailed walk through the questionnaire to ensure familiarity and a consistent interpretation of the questions. Sessions were also held to clarify ethical and selection criteria and allow the researchers to practice the survey tools. The final day of the training consisted of piloting the questionnaire, refining terms, timing the survey and practicing uploading data.

Household surveys – Prior to commencing data collection, local government leaders were engaged and were asked for permission to conduct the survey. A representative sample of residents was identified in each settlement. This was defined spatially, to ensure equal coverage of adult residents across the sub-wards, and a sample sufficient to achieve a 95% confidence rate. Data collection used an offline Open Data Kit questionnaire, stored on the ONA platform and server account accessible only to the CCI research coordinator, to ensure confidentiality. In total 552 surveys were completed (270 in Pakacha and 282 in Kombo), with a random selection of residents from each settlement.

Focus groups – were organised to explore in-depth perceptions and experience of climate conditions and effects on communities. A purposive sample approach was taken, selecting from respondents to the household surveys. Nine groups were held in total to discuss experiences and coping strategies. The groups included: local government leaders at ward and settlement levels; a women's group; a trader's group; residents of Tandale to discuss DMDP; a group discussion on heat; and a focus group with young people.

Stakeholder interviews – semi-structured interviews were held with four key organisations that had insights into or were important in the response to climate change. These included: Kinondoni Municipality DMDP coordinator; Ardhi University; the solid waste collector for Pakacha; and the Tanzania Red Cross Society.

Verification and analysis – as a final stage of the data collection, a one-day workshop was held with TFUP leaders to share the emerging findings and data analysis. This provided an opportunity for local leaders to help interpret the information and to agree recommendations to be included in the final report. Survey, focus group and interview data was analysed thematically and spatially by CCI to identify key issues and potential actions to address climate change risks.

Overall, the process took around six weeks between May and July 2024 to design the questionnaire, recruit community researchers, undertake data collection and analyse the data ready for verification. The process was relatively quick as the Federation was familiar with community-led enumerations and some of the community researchers had previously been engaged in data collection, during COVID -19.

3.4 Strengths and challenges of the methodology

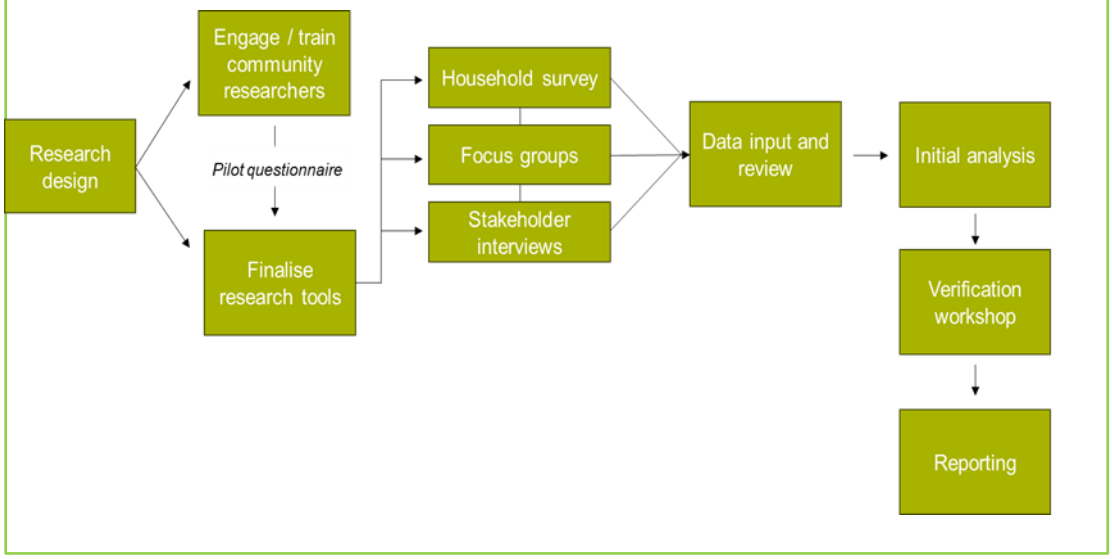
The community-led research method grounds both the process and the outcomes of the data collection in the experience of local residents. Community members working in their own settlements, with their peers, is a validation of local knowledge. Community-led data collection has the advantage of securing access to hard-to-reach communities and obtaining direct insights into lived experience. The involvement of local government leaders in the research helped to ensure the

safety of researchers in the settlement. Access was possible due to approval and support of local government and members of the Federation, who accompanied the research team around the settlement.

There were some challenges to data collection. Both community researchers and local residents have a limited understanding of climate change and concepts of climate risks. This knowledge gap was addressed through training to help researchers to understand the meaning of key terms and ideas. It was also reflected in the phrasing of survey questions, to build from people's experience of different climate conditions and connect to more abstract ideas of risk.

Engagement of participants was also carefully managed to balance the need to obtain data on the experiences of climate change, while avoiding raising expectations of immediate action. As previous surveys had been undertaken in the settlement by other agencies, respondents wanted clarifications of the research objective before giving consent to participate in this study. The role of Federation and local government leaders were vital to provide reassurance on the purpose of the survey and how it connected with wider advocacy efforts to improve settlement conditions. The community research team was trained to elaborate on the research objectives, without making promises that would confuse dwellers about their presence in the settlements.

Figure 2. Research process



4. Key findings: vulnerability to climate change

Poverty and the quality of environmental conditions are key factors in determining the vulnerability of communities to climate risks. Climate vulnerability is defined as a susceptibility to harm and a lack of capacity to adapt to changing conditions.[xvi] There is significant global evidence that low incomes both reduces the resilience of households to adverse climate impacts and, over time, lessens their ability to cope with changing conditions.[xvii] This section explores these issues, drawing on the survey and focus group data, to look at the characteristics of people and place in Pakacha and Kombo and their exposure to climate risks.

4.1 Community characteristics

The residents of both Kombo and Pakacha have low incomes. On average, a majority (56.2 per cent in Pakacha and 64.4 per cent in Kombo) have an income of less than Tsh 150,000 per month (approximately $60 USD) and equivalent to daily earnings (7 days per week), below the international poverty line of $2.15 per day.[xviii] Fewer than 2 per cent of residents in these settlements have income of over Tsh 500,000 per month. This compares with national data that shows that nearly two thirds of employees (59.4 per cent) earn above Tsh 300,000, with 22.9 per cent earning between Tsh 500,000 and 900,000 per month.[xix]

In both settlements the primary source of income is from earnings, with over two thirds (74.6 per cent in Pakacha and 68.4 per cent in Kombo) of residents engaged in self-employment. This is typically informal trade activities, with food vending, street trading, personal services and causal labour forming the majority of paid work for residents - 54.8 per cent in Pakacha and 59.8 per cent in Kombo. Reliance of these forms of work are likely to produce low and unstable incomes, with for example, over two thirds of workers (67.9 per cent) in these sectors earning between Tsh 10,000 – 50,000 per month on average.

Livelihoods in the informal sector are susceptible to climate disruptions, such as extreme heat, floods and heavy rainfall, affecting daily business operations. Self-employed workers have limited access to social protection schemes, formal insurance, banking and savings, which reduces their ability to safeguard for and recover from climate shocks. Floods and other extreme weather conditions may lead to displacement within the city, disrupting businesses, markets, and transport and leading to income loss. Where people have a mix of income streams, they may have some ability to vary activity, but recurrent climate events increase their long-term vulnerability.

Outside of earnings from employment, 23.9 per cent in Pakacha and 28.1 per cent in Kombo are reliant on income from savings, pensions and remittances. While non-earned income is most significant for elderly and younger people, with 28.8 per cent of elderly and 24.3 per cent of youth relying on remittances, evidence from surveys suggests that mixing income streams is used to diversify earnings and reduce risk.

Low and unstable incomes limit the options available to households to reduce vulnerability to climate risks. Incomes and investment in improvements are short-term reflecting insecure patterns of work and earnings. Decisions on expenditure are made alongside other priorities to meet basic needs. As discussed in section five, short-term action to cope with climate events is likely to be relatively expensive and have limited impact on vulnerability. This pattern of coping traps people in cycles of repair and recovery until the next event.

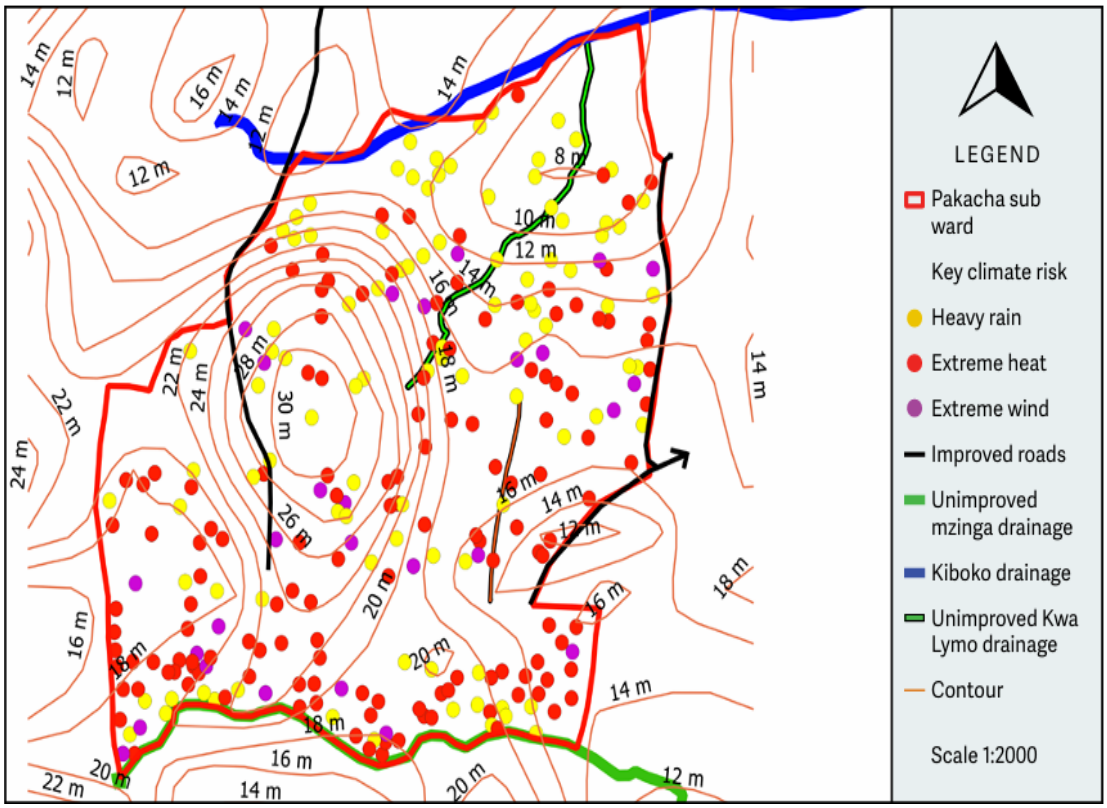
Residents of the two settlements have low educational attainment, with over two thirds 66.1 per cent in Pakacha and 71.3 per cent in Kombo not progressing beyond primary education. Educational attainment has been shown to build human capital, reduce vulnerability and enhance adaptive capacity due to improved employment prospects. Education enables people to better understand climate risks and make more informed decisions about locations, housing construction materials health and livelihoods.[xx] People with higher educational attainment are more likely to access financial services, diversify their income sources and engage in advocacy efforts for better services.

4.2 Settlement characteristics

Vulnerability is also influenced by the physical location and the development of the settlements. As indicated in section two, both Pakacha and Kombo were historically farmland on the flood plains of rivers flowing through the city into the Indian Ocean. As such, they are low lying and at high risk of flood during rainy seasons. Data from the surveys shows that around one third of (39.3 per cent in Pakacha and 31.6 per cent in Kombo) of respondents confirmed that their homes were in high water table areas and evidence gathered during site visits, showed that many of these homes had experienced water encroachment through their foundations.

The physical characteristics of the settlements correspond with perceptions of climate risk. As can be seen in figure 3, there is a shift in the primary climate concern from rain (and floods) in the low-lying northern part of Pakacha, where land elevation falls to below 10m and the higher southern parts of the settlement, where the primary concerns are about rising heat levels. While this settlement

Figure 3. Perceptions of climate risk and topography, Pakacha



has benefited from major improvements under DMDP, there remain unimproved areas such as the Kwa Lyimo tributary (drainage) that are cause of flooding during the rainy period.

Pressure for land and a lack of planning control has also led to development of housing in hazardous areas near rivers. The number of informal settlements in Dar es Salaam have nearly doubled between 2002 and 2024, from 56 to over 100. While contrary to Tanzania National Human Settlements Development Policy (NHSDP) of 2000, homes have built on land in immediate risk of flood and erosion damage. In Kombo for example there are shells of dwellings that have been abandoned close to the Msimbazi River due to continuing risks of flooding. Also, in Pakacha, housing in low-lying areas of the settlement show evidence of water damage to brickwork following flooding. Despite the risks these areas are attractive for settlement because they are close to key economic areas of the city.

Waste in Lymo drain, Pakacha

The dense forms of settlement development and methods of self-build housing construction contribute to the climate vulnerability of communities. Evidence from the surveys and focus groups show that the congested configuration of buildings reduces air flow and contribute to overheating of dwellings. The high demand for land reduces green space and tree cover, limiting the absorptive capacity of soil and vegetation and available shade. Housing design and materials, such as tin roofs, provide little protection from rain and rising heat levels.

A further environmental factor significant for climate risk is the ineffective disposal of solid waste. While 91.8 per cent of respondents in Pakacha said that they use the locally appointed waste collector to dispose of solid waste and 72.8 per cent in Kombo said they used unofficial waste collectors, the accumulation of plastics and other waste is a major problem in settlements. The accumulation of waste in improved and unimproved channels blocks drainage, contributing to flooding of homes and public areas. Despite some collective action by community members, the lack of a structured approach to shift behaviours and to maintain clear drainage increases the risks of flooding and undermines the function of drainage improvements in the settlements.

Water eroded walls, Pakacha

"People are constructing houses without following the urban planning regulation and standards, which has led to housing congestion." ***Focus Group, Pakacha***

The location, layout and occupation of informal settlements play a major role in the vulnerability of these communities to changing climate conditions. While some highly hazardous locations may need to be vacated, with the cooperation of communities, much can be done to

change behaviours, improve the quality of housing, infrastructure and the shared environment of settlements to reduce the level of risk for the people that live there.

4.3 Exposure to climate risks

Around four out of five respondents (80 per cent in Pakacha and 79 per cent in Kombo) see climate change as a serious issue affecting their lives and wellbeing. However, respondents indicated that they lack understanding of the issues. Across the two settlements around half of residents (46.8 per cent in Pakacha and 50.4 per cent in Kombo) said that they had a fair understanding, with one quarter (23.2 per cent in Pakacha and 25.0 per cent in Kombo) stating that they had a poor or very poor understanding of climate change. This knowledge gap is a concern, as understanding is key to planning effective adaptation actions and building capacity for change. As set out in section five, despite a lack of knowledge, residents do their best to cope with climate conditions, however the efficacy of these actions may be limited by information and finance gaps.

While knowledge levels vary, the risks and experiences of climate hazards are shared across the two communities. All respondents have been affected by either heavy rains extreme heat or wind, with rain and heat being the predominant impacts for around 90 per cent of respondents. As shown in figure 4, there is a notable difference in the responses between the two settlements, with higher concern for rain and flooding in Kombo than Pakacha. This may be a consequence of DMDP improvements in Pakacha, perceived risks of flooding among settlement residents.

"Flooding is one of the most [serious] challenges I face. When it rains water enters to my house, things are destroyed. Since my house is in a high-water table area, it always floods whenever it rains." ***Focus Group, Kombo***

Figure 4. Main climate concerns, by settlement

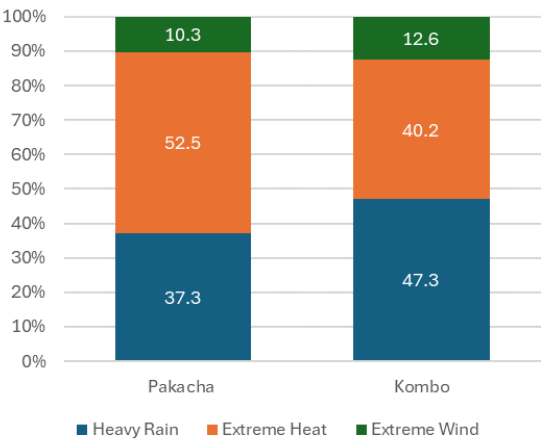
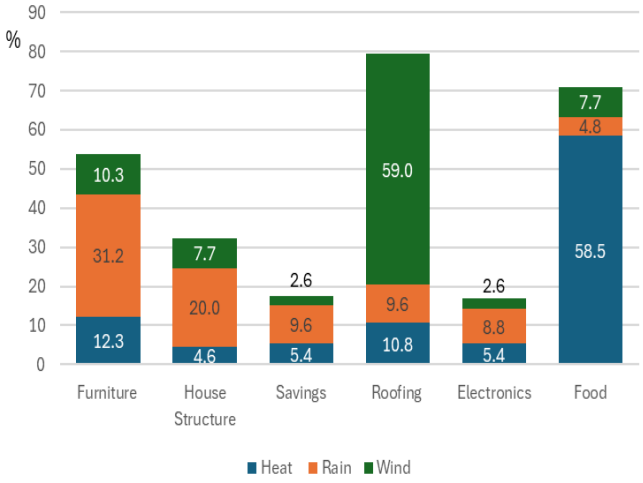


Figure 5. Primary impacts of climate risks



Heat is clearly an important issue for residents, with nearly half of respondents across the two settlements (46.4 per cent) citing heat as their primary climate concern. The perception of heat, which has less obvious immediate impacts on wellbeing, contrasts with the overtly destructive force of floods and high winds. Like the overall picture, there appears to be a lack of understanding about the health risks associated with extreme heat, with around one in five (22.5 per cent in Pakacha and 17.3 per cent in Kombo) indicating that they were not very or not at all aware of the risks from high heat conditions. Focus group discussions also indicated a lack of

knowledge of simple measures to reduce heat, such as painting roofs and external walls to reflect heat.

Adverse climate conditions make existing vulnerabilities, caused by poverty, worse for residents. Climate issues, particularly extreme heat, have a major impact on health, causing skin conditions for over half of respondents (52.8 per cent), respiratory effects (11.9 per cent) and urinary tract infections (9.9 per cent). Heat also has a significant psychological impact, with 38.8 per cent of respondents reporting they had difficulty sleeping during hot seasons and worry of flooding and wind creating stress. Around half of respondents (48.7 per cent) had sought medical assistance to address ill health caused by high heat levels, which not only demonstrates the severity of the impact, but as less than 10 per cent of residents have health insurance, the additional financial burden of heat conditions on families.

Climate also impacts on access to work and the income of families already reliant on low and unstable incomes. Around one in five (18.0 per cent in Pakacha and 22.2 per cent in Kombo) responded that extreme weather conditions prevented them from going to work and, for those able to work, resulted in a loss of income (39.9 per cent in Pakacha and 45.4 per cent in Kombo).

With the high reliance on informal and trading activities, adverse weather conditions can have a double financial impact, with a loss of customers and for some a loss of capital, such as the destruction of goods (e.g., food or clothing) due to high heat, rain or windy conditions. While impact on income will vary, in a majority of cases (65.0 per cent in Pakacha and 54.0 per cent in Kombo) financial losses were up to one third of monthly income. This creates a short-term pressure on income, but can also undermine resilience building, as loss and repair costs reduce savings and larger investments in adaptations.

"Children have difficulty sleeping and sometimes they get skin rashes, due to extreme heat. Also, adults with high blood pressure are much affected by extreme heat." ***Focus Group, Pakacha.***

Weather conditions also cause destruction of homes and property, which can have a major impact on the wellbeing of households, create unexpected costs or debt or make people homeless. As illustrated in figure 5, the specific impacts of heat, rain and wind differ significantly. Heavy rain leading to flooding affects the structure of homes and their contents, ruining furniture, electronics and other possessions in contact with water. Heat has a more concentrated impact on food, spoiling both domestic supplies and food intended for sale through vending. Wind has a major impact on roofing, which in itself can expose dwellings to other adverse climate conditions.

The financial costs of climate damage can vary by incident, however averages indicated show that rainfall causing flooding is the most expensive, with repair and replacements costing more than one month's earnings for 49.6 per cent of respondents and over twice monthly earnings for more than a quarter (26.4 per cent) of residents. This compares to 41.1 per cent experiencing costs equal to a month's earnings due to extreme wind and just 16.9 per cent for high heat conditions. These costs can deepen poverty, diminish savings and, where climate events occur in quick succession, can significantly increase the vulnerability of households, reducing ability to recover from the next event.

"I have the national exams in October, so when it rains heavily sometimes it is difficult to go to school. This reduces time for me to prepare for the exams and the timetable of the national exams can't be changed due to heavy rain, so it may result in failure." *Focus Group, Pakacha.*

Vulnerability is not evenly distributed across communities, with the research highlighting some of the differential impacts of climate conditions on residents of the two settlements. Based on focus group discussions, infants and young people were shown to be particularly affected by climate events. The health of infants is impacted by hot and damp conditions, causing skin irritation and chest infections. Young people face difficulties attending school when roads are flooded and during extreme heat when overcrowded classrooms hamper learning. Flood waters cause drainage channels to overflow into homes, causing stomach complaints and infections in small children. Also, young people and adults with chronic conditions and disabilities have reduced mobility during storms and underlying health problems can be exacerbated by heat.

The evidence gathered with communities during this research underlines their vulnerabilities to changing climate conditions. Poverty and reliance on insecure forms of work result in disproportionate impacts on income and wellbeing from adverse climate events. The location and poor quality of housing provides limited protection from extreme rain, wind or heat. While these impacts are shared across the two settlements, children and adults with chronic conditions face additional challenges to health, mobility and wellbeing.

5. Key findings: adaptive capacity

The capacity of households and communities in informal settlements to strengthen resilience, avoiding future climate risks, is vital to reducing vulnerability.[xxi] Adapting behaviours and environments, based on a firm understanding of climate change, is essential for low-income populations to move away from basic coping and recovery strategies that offer diminishing levels of protection and security. This section uses the community-led research findings from Pakacha and Kombo to examine how residents respond to the climate risks and how they might build adaptive capacity to better prepare for the challenges of climate change.

5.1 Communities taking action

Despite the difficulty of adapting housing and environments to climate change, households and communities do take action to reduce risks. However, data from the two settlements points to a range of coping strategies that are largely focused on behaviour changes and small-scale modifications that enable recovery until the next event.

The evidence suggests that with limited financial capacity and knowledge on adaptation methods, residents are locked into a cycle of short-term coping, with little longer-term or collective investment in adaptive actions. Income insecurity and a lack of access to long-term financial products prevents larger-scale investment in housing. Adaptation expenditure competes with a need to meet everyday costs and repeated exposure to climate events erodes savings. A lack of technical knowledge to assess adaptation options to reduce risks, reinforces short-term affordability as the primary criteria for investment. Partial coverage of basic infrastructure into settlements and a focus on disaster risk reduction rather than planning and adaptation, by government, fails to create an enabling environment for community-led investments.

Raised doorways to avoid flood, Pakacha

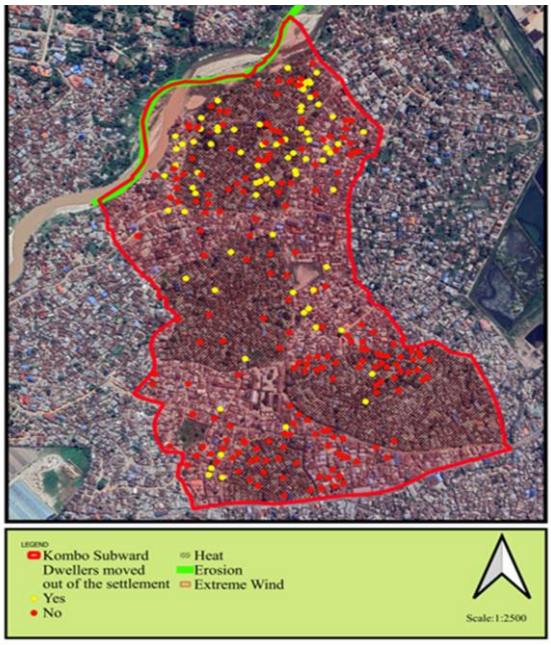
For periods of extreme heat, actions are limited to coping with conditions in the present. The principal responses to the risks of high heat are to use cooling devices, such as fans (39.7 per cent), which according to focus groups could increase monthly electricity costs by around 20 per cent. People also identified wearing lighter clothes (21.5 per cent), drinking more water to avoid dehydration (14.9 per cent) and at night to sleeping outside (11.9 per cent) as core strategies to manage heat. There is limited variation across the two settlements, with Pakacha respondents relying more on cooling devices, and a greater share of Kombo choosing to wear light clothing, responses that may reflect the marginally stronger economic position of residents in Pakacha.

Climate coping responses differ depending on the level of community awareness and willingness to use weather early warning forecasts. The Kombo community has benefited from a two-year DARAJA[xxii] programme to encourage the use of weather alerts, delivered by CCI. Survey data shows that a higher proportion of Kombo residents regularly use weather alert information (77.2 per cent in Kombo

"During floods people die and houses are washed away. The ones that are affected too much include children and women, for example during evacuation it is difficult for women carrying a child on her back to save herself from floods." *Focus Group, Vingunguti*

and 67.1 per cent in Pakacha), the benefit of which is reflected in higher per centages of people in Kombo taking preparatory action ahead of all climate risks.

Figure 6. Temporary relocations due to climate risk, Kombo



For extreme rainfall and flood risks, residents of Pakacha and Kombo focus on adaptations to housing to reduce the likelihood of water entering their homes. The primary actions taken to manage risks of flooding are to build walls at access points into their homes (approximately 28.6 per cent of respondents), raising the foundations of the home (10.1 per cent) and uplifting steps (9.5 per cent). These actions are intended to provide some protection, but their effectiveness depends on the height of water during the rainy period.

Responding to high winds primarily relies on securing roof sheets through adding nails or weighting sheets with stones or planks of wood (60.4 per cent of responses). Residents also try to manage high winds by closing windows in their homes, to reduce risks of damage. In the market areas, efforts are made to weigh down plastic sheets that provide the waterproof roofing or on the goods for sale to avoid items being blown away and damaged.

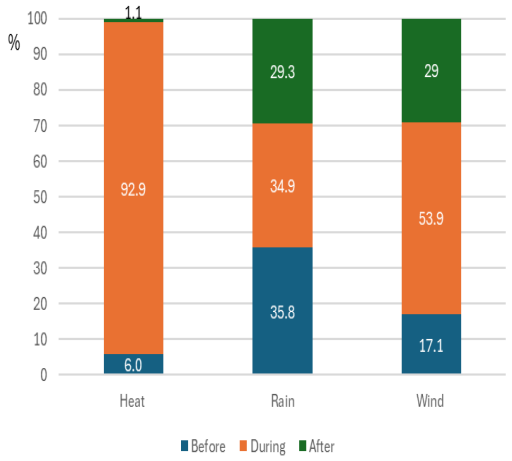
In extreme cases residents move out of their dwellings until the climate risk has passed. Due to the high costs and disruption of temporary relocation, this is a last resort coping strategy, with just one in five (20 per cent across the two settlements) taking this option. However, there is a marked difference, with relocation adopted by nearly three times as many people in Kombo than in Pakacha (28.7 per cent and 11.1 per cent respectively). The primary driver of relocation is heavy rainfall leading to flooding. As shown in figure 6, those people closest to rivers (yellow dots) and at high risk of flooding during rainy seasons are more likely to temporarily relocate to avoid risks.

The short-term character of responses is confirmed when the timeliness of actions is considered. Figure 7 shows the results of questions on when people take actions to reduce the risks from weather events. The responses highlight how most actions for heat and wind risks are taken when the event is happening, with a majority of action against flooding taken before and after climate events. This would seem consistent with the types of actions described above, where more preparation time is needed for structural changes to homes for installation of flood prevention measures. It does however underscore the dependence on coping measures rather than preparation for seasonal changes and investment in adaptation to reduce the causes of climate vulnerability.

5.2 Costs of actions

The financial burden of coping with and recovering from adverse climate conditions is significant and is likely to be a key factor limiting longer term investment in adaptive actions. Drawing on the survey results from Pakacha and Kombo, levels of expenditure on the measures described above vary, with actions to reduce heat the lowest, with two thirds of respondents (66.7 per cent in Pakacha and 75.0 per cent in Kombo) spending between Tsh 10,000– 50,000 (around one third of monthly income) on coping actions. Flood reduction actions are the most expensive, with around four out of five (82.2 per cent in Pakacha and 79.0 per cent in Kombo) spending up to Tsh 150,000 (an average month's income) on coping. Actions to address risk from high winds are similar to heat measures, with 72.2 per cent in Pakacha and 66.3 per cent in Kombo spending between Tsh 10,000 – 50,000.

Figure 7. When climate risk actions are taken



These coping measures are likely to be repeated seasonally or as climate impacts occur and therefore are a regular cost burden on households reliant on unstable incomes. Over an annual period, considering that climate conditions are overlapping rather than sequential, households could be spending up to one third of their income on repairs, maintenance and property replacements aside from the additional financial impact of lost income and unplanned expenditure on medical costs, drinking water and electricity for cooling devices.

While these costs may be necessary in the short term, they add to the financial strain on households, affecting the money available to pay for everyday necessities, education and healthcare as well as productive investment in income generating activity. Short term recovery costs also reduce capacity, over the longer-term, for investment in adaptation of homes and environments to reduce the risks of climate change. This pattern is likely to compound poverty and vulnerability, creating a negative cycle of coping that is expensive, relative to income. This suggests a need to find a way to use resources collectively or as part of co-production with government, to support adaptation in ways that do not increase financial insecurity and the vulnerability of residents in these settlements.

5.3 Community-led and local action

Respondents to the surveys and focus groups identified the need for action beyond the household, to reduce climate risks at a settlement level. This focuses on what could be achieved collectively by the community and through residents working in partnership with local and national government.

The Tanzania Federation of the Urban Poor (TFUP) have a well organised and defined leadership structure at national, regional, ward and settlements levels. In Pakacha there are three TFUP groups and four in Kombo. Most of members in these groups are women and young people who engage in saving, entrepreneurship activities and community initiatives, such as collective cleaning of drainage channels. Local government is also represented at a settlement level, where a chairperson and other local representatives are elected by residents and there is an executive

secretary, appointed by the government to support local leadership.

With this structure in place, residents see the potential for more coordinated actions within settlements to reduce risks and impacts of changing climate conditions. Suggested actions primarily focused on addressing flood risks, with over two thirds focusing on improvements to and maintenance of drainage systems within the settlements (68.3 per cent in Pakacha and 76.9 per cent in Kombo) and improved observance of weather alerts, to be better prepared for climate risks (19.3 and 13.2 per cent respectively).

Mzinga drainage channel, Pakacha

Suggestions for community-led improvement to drainage systems included culverting of tributaries and drains within the settlements to manage wastewater and reduce flooding. This focused on extending the networks in Pakacha that had been installed through DMDP and investment in new structures in Kombo. Communities saw a role in maintaining these structures, alongside local authorities, to ensure they were in a good state of repair and through community-led action, to keep them clear of solid waste and silting.

During focus group discussions, participants identified tree planting being undertaken by some individuals in the settlements on their own land, as activity that could be expanded. Wider projects of tree planting have previously been funded through the Tanzania Social Action Fund (TASAF) in Vingunguti ward and by the NGO All Together in Dignity (ATD) in Pakacha. While these initiatives had merit, focus groups identified that they had limited involvement of community members, faced problems identifying appropriate land and lacked plans to maintain trees after they had been planted. More active engagement of communities in the design and management of these initiatives and a stronger link to planning enforcement, to address competing land use issues, would enhance the impact of future initiatives. The commitment of local government and community leaders to local ownership and maintenance of tree coverage is vital to ensure the sustainability and impact of investments.

There were also actions that communities felt needed to be led by government. Again, with a focus on flooding, there was a strong emphasis (48.0 per cent in Pakacha and 37.5 per cent in Kombo) on improvements to drainage systems, but also better communication with residents about climate risks and weather information (15.1 and 9.3 per cent respectively). A majority of house owners (56.4 per cent Pakacha and 74.6 per cent Kombo) were willing to engage in discussion with government or private stakeholders to improve settlements resilience to climate risks. Discussions highlighted the involvement of residents in planning decisions, beyond the consultative arrangements already in place, and enforcement of existing land use policy, such as prohibiting building within buffer zones and riparian areas to prevent further degrading of the settlements.

Adaptation to reduce erosion, Pakacha

The priority for government action in Pakacha and Kombo was drainage (48.0 per cent in Pakacha and 37.5 per cent in Kombo). There were some notable differences between sites, which reflected specific risk factors and the DMDP improvements implemented in Pakacha. In Kombo around one in seven (12.6 per cent) said improvement to river defences was a priority for government (compared to 2.2 per cent in Pakacha). Kombo also wanted to see more investment in roads and guidance on adapting to climate risks. This included information on where to build, construction techniques and strategies to reduce climate risks. Communities were open to increased collaboration to understand and adapt to changing climate conditions.

"The government should help us to plant trees […] and encourage at least every individual to plant a single tree to houses with spaces, to reduce extreme heat." ***Focus Group, Kombo.***

The specific issue of heat risk was also considered by residents, with suggested roles for collective community action and partnerships with local government, such as tree planting. At a community level, respondents saw actions to improve the quality and resilience of their homes as being a priority. There was an interest in urban forestry (44.6 per cent in Pakacha and 38.6 per cent in Kombo) to reduce heat for the 75 per cent of dwellings that lack trees around their homes. There was also willingness to engage in community action to modify or retrofit houses to achieve cooler temperatures within dwellings (39.6 and 39.3 per cent respectively). It is notable that around one in six did not know what action they could take, underlining the information gap present in the community.

The data also identified actions for government to improve the planning of settlements, to address the high-density that were viewed as a key contributor to the experience of heat within homes (35.0 per cent in Pakacha and 33.1 per cent in Kombo). These overlapping interests in housing improvement and tree planting underline the opportunity for collaborative action involving communities and government.

Discussions highlighted community-led adaptations aimed at reducing climate impacts. Examples included burying tyres in steep unimproved roads and paths to slow the erosion of land and adjacent properties during floods. Residents of Kombo organising to undertake 'community clean-ups', volunteering to collect solid waste and clear drainage channels. There were examples of the planting of Bamboo trees along the Msimbazi River to try and reduce erosion of the riverbank. While these actions are intended to lessen the impact of climate, they are limited by the resource and capacity of communities and offer just short-term responses to long-term challenges.

Pakacha has benefitted from major infrastructure investment as part the DMDP. This has included improvements to roads, drainage, the embankment of rivers and the installation of street lighting across

parts of Tandale ward. Feedback from focus group discussions highlight that these improvements have made a major impact, reducing the risks of floods, improving community safety and encouraging private investment. The DMDP demonstrates the significant difference that major capital schemes can have in informal settlements.

"The drainage has helped us much, especially in areas prominent to floods. Yet they should also help to build these small drainage channels, which have huge impacts of flood in Pakacha when it rains."
Focus Group, Pakacha

The research shows a willingness to connect state-led investment, through DMDP, to community-led upgrading activity. In the example of Pakacha, there is an opportunity to extend the improvements made to roads and drainage in some parts of the settlement to reduce flooding caused by unimproved Lyimo drainage, if more funds could be available. Collaboration offers a basis for organised residents to help to expand and maintain infrastructure to maximise the benefits of investment and to ensure sustained impact over time. Using contracted or co-production approaches provides a means to align government and community inputs on actions such as tree planting and settlement master planning (integrated land use plans). Placing communities at the centre, rather than an afterthought, of decision making and actions to improve the resilience of housing to changing climate conditions is key to the sustainable development of settlements.

6. Conclusions and recommendations

The global context of climate change will see major shifts in weather patterns over the next 30 years. Many developing nations will experience rising heat and sea levels, more erratic and intense rainfall and increased frequency of storms. These global patterns have a micro impact on the health and wellbeing of individuals, families and settlements, with residents of low income and unplanned areas of cities disproportionately affected and least able to adapt to changing climate conditions.

This community-led research has sought to understand the experience of climate change and the coping strategies of residents of informal settlements in Dar es Salaam. Focusing on issues of vulnerability to climate risk and adaptive capacity, the research starts to fill a major evidence gap on the effects of climate change in informal settlements that is essential to inform the design of urban programming.

While the scale of challenges set out in the report may seem daunting, there is real potential for organised communities and city government to collaborate and develop more inclusive and integrated programmes of action. In contexts of limited funding, it is vital that partnerships maximise the use and effectiveness of the resources available, drawing on the skills and full capacity of communities and government working together.

6.1 Key conclusions

The community-led research demonstrates the significant impacts that climate conditions have on residents of informal settlements in Dar es Salaam. By taking a participatory approach, the study has generated new evidence and insights into the perceptions and experiences of climate risks and how individuals and communities cope with changing and hazardous conditions. As set out in the findings, extreme heat, excessive rainfall leading to flooding and high winds have cumulative impacts on the health of residents, their incomes and wellbeing. The intersection of poverty and climate risk create challenging situations for urban communities trapped in cycles of adversity, coping and recovery.

The research has addressed a lack of official data on experience of climate change and the needs of people in informal settlements. It highlights the deep vulnerability to climate risks among residents of Pakacha and Kombo. Underlying these vulnerabilities is household poverty caused by low incomes, a reliance on insecure work and trade and a lack of financial and material assets to fully recover from adverse climate events. Vulnerability is heightened by locational factors, with settlements built on flood plains and in areas that have lacked significant investment in urban infrastructure, prior to the DMDP initiative. Pressure on land will increase the density of settlements further and reduce natural environments essential to the liveability of communities.

It is clear that residents of Kwa Pakacha and Kombo are locked into coping practices that, over time, undermine their capacity to adapt to changing climate conditions. The costs of recovery, which may constitute up to one third of household incomes per year, compounds poverty and reduces ability to tackle risk. Gaps in knowledge hamper planning and preparatory actions that could control climate impacts over short and long terms. Strengthening collaboration between communities and local institutions would enhance the impact and sustainability of climate actions.

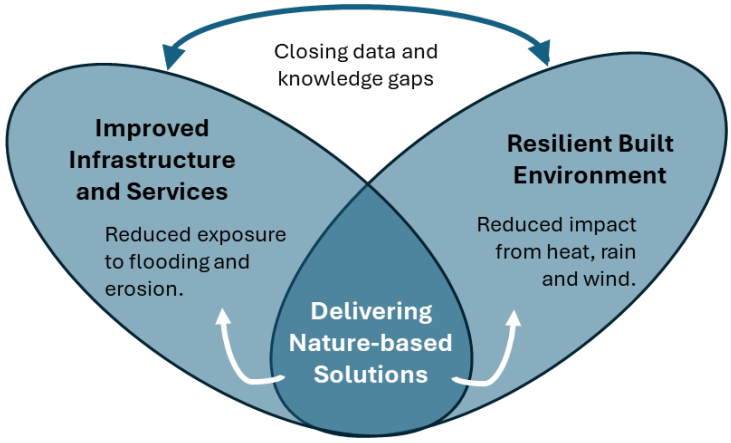
For community-led action to be effective it needs to start with a recognition of the

complexity of urban informal settlements and the interdependencies of poverty, environment and climate that create vulnerability. Tackling risks requires partnership and leadership at a local-level able to understand the challenges and to mobilise people and funds to deliver long term change. Concerted efforts to deliver change at a settlement level, to fully utilise the resources available and build adaptive capacity is vital for the future of cities.

6.2 Recommendations

Based on the evidence gathered by communities in Pakacha and Kombo, the report identifies recommended actions to address extreme heat, flooding and high winds. The recommendations have been structured to respond to the specific risks identified during the community-led research, with the intention of reducing vulnerability in the short-term and contributing to longer term adaptive capacity.

Figure 7. Recommended action areas



As illustrated in figure 7, the recommendations are structed across three programme themes and connected by actions to close data and knowledge gaps on the effects of climate change on informal settlements. The primary action areas are firstly to improve infrastructure and services delivery to substantially reduce the risks of flooding and erosion. Second to increase the resilience of the built environment, with adaptations to improve housing and public spaces that reduce exposure to adverse climate conditions. Thirdly, to deliver nature-based actions that reinstate tree cover and open space to protect and increases the long-term resilience of settlements. In figure 7, nature-based solutions overlap with infrastructure and built environment to underline the importance of a nature-first approach to integrating green / grey adaptations for reduced exposure and reduced impact of climate risks.

This structure is designed to address the specific deficits in infrastructure, housing and natural environment identified in the research that amplify climate risks. They are also organised to recognise the interconnectedness of the challenges, in ways that are relevant to local residents and can be developed as community-led and co-production initiatives. The programme themes recommended actions and how they relate to climate risks are set out in figure 8 below.

It is also recommended, firstly, that a follow-on delivery plan is produced, from this report, jointly by community leaders, government and funders to define the specific resources, governance and delivery arrangements needed for each action area. These should build on existing collaborative structures, such as Federation savings groups, settlement disaster committees and infrastructure consultative groups (set up under DMDP) to involve local leaders and community members in the design and long-term implementation of interventions. Using existing governance and collaborative arrangements provides shortcut routes to including residents in decision making and an opportunity to repurpose or redefine

familiar structures to address climate challenges.

Secondly, local authorities are recommended to explore how contracted services, such as solid waste collection and drainage maintenance, can integrate inputs from organised communities. The evidence suggests gaps in service coverage and some challenges in the effectiveness of current arrangements. By enabling stronger community engagement, authorities will gain access to local knowledge and inputs of collective action into the operation and maintenance of services and infrastructure by people that have a direct stake in this provision working well. Moreover, involving local people builds accountability, drives behaviour change and encourages stewardship and the sustainability of improved infrastructure.

Thirdly, it will be important to consider how the limited resources for climate adaptation are used most effectively. This should focus on how public and private investment can be more effectively integrated into delivery design, including the use of household expenditure and collective savings. It should consider how funding instruments at a city level, such as bonds and results-based finance, could be used to incentivise and support delivery.

There is a need to support and sustain community engagement in the design and delivery of adaptation actions and to continue processes of knowledge building. Data gaps are a major impediment to designing effective urban programmes, but can be closed through a commitment to community-led research and participation. This will require long term capacity building of community groups and their NGO partners to maintain communication channels and gather the data vital to implementing and evaluating adaptation schemes.

While this study has generated new insights from community-led research, impact will depend on how this information is translated into action. The analysis here provides a basis for discussion and joint planning among communities and government to allocate resources and to design participatory forms of delivery.

Figure 8. Recommended actions

Programme theme	Recommended actions	Addressing climate risks		
		Heat	Flooding	Wind
Delivering nature-based solutions	Community tree planting – supported programme of planting and care	Provides shade to housing and in public areas.	Increases absorption of excess water.	Reduces exposure to winds and storms.
	Weather information – drive behaviour changes and increase preparatory actions through the up-scaling of the DARAJA initiative.	Improved adaptation to heat to lower health impacts through us of early warning weather information.	Better preparation and actions to reduce risks of flooding.	Inform housing improvements to reduce risks and impacts.
	Reinstate green spaces – in hazard areas to maximise planting and urban agriculture use.	Form cooling stations / public spaces for play and community activity.	Riverbank planting to reduce flooding and raise 'sponge' capacity of land.	Reduces exposure to winds and storms.
Resilient built environment	Settlement master planning – reblocking and making space for improved housing and infrastructure.	Reduced density and improved air flow and shade.	Spot zoning to reduce risk and future development of unsafe land	Orientation of buildings to reduce exposure to wind.
	Housing upgrading – savings led programme to improve housing quality and resilience.	Improved ventilation reduces internal temperatures.	Improved foundations and barriers to reduce flood risk.	Improvement to build quality and resilience to climate conditions.
	Roofing improvements – improvements to design and materials used.	Reduced thermal conductivity of materials and ceiling space.	Reduced leakage of rainwater into dwellings.	Improved security and resilience of roofing.
	Reflective painting – of roofing (cool roofs) and external walls.	Significant reduction of internal temperatures.	-	-

	Cooking systems – promoting uptake of clean sources of heat including a social enterprise to reduce entry cost of gas units	Reduction of internal heat related to cooking	-	-
Improved infrastructure and services	Extend and maintain improved drainage – partnership programme with city authorities.	-	Reduced levels of flooding across settlements.	-
	Community-led SWM and recycling programme – plan to collect and recycle solid and organic waste alongside city waste collectors.	Reduced heat from dumped waste materials.	Reduced blockages of drainage due to accumulated waste.	-
Closing data and knowledge gaps	Climate knowledge hub – capacity for community data collection, learning and exchange on climate risks and low-cost adaptations.	Improved understanding of the effects of heat and possible adaptations.	Learning about strategies to reduce flood risks in informal settlements.	Strategies and actions to reduce risk and damage to property.
	Community craft and construction skills training programmes – improve ability to self-build incremental adaptions	Improved ability to improve insulation.	Improved ability to reduce flooding in dwellings.	Increased resilience of dwellings.
	Enhanced engagement in policy and planning – support for Federation involvement in infrastructure (DMDP) and disaster committees	Increased policy awareness and engagement in heat adaptation issues.	More effective management of flood risks.	Raised profile of wind as a climate risk in informal settlements.

Endnotes

[i] IPCC (2022) Cities, Settlements and Key Infrastructure. Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.
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