Ghana

Co-production methodologies to deliver city-level flood resilience and reduce health inequalities in sub-Saharan Africa

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Focus

The risk of flooding is increasing due to climate change, urbanization and population growth. More than 1.8 billion people globally are at risk. Of these, 44% live in sub-Saharan Africa.

Climate change is increasing the frequency and intensity of rainfall events and making them harder to predict. Urbanization can result in the confinement of waterways and a reduction in soil permeability (e.g. by paving). Combined with population growth, this increases the number of people inhabiting high risk areas such as floodplains, riverbanks and wetlands.

Flooding impacts almost every person, activity and industry, and can cause environmental degradation and biodiversity loss. These impacts can be classified into three categories:

1. Primary - as a direct result of contact with the flood (e.g. drowning);
2. Secondary - via intermediate mechanisms (e.g. water-borne disease);
3. Tertiary - longer-term and manifest months or years after (e.g. famine).

People subject to the same flood hazard will experience different risks based on their vulnerability. Vulnerability is determined by exposure (i.e. likelihood of being in the way) and susceptibility (i.e. potential to be negatively impacted) and is controlled primarily by socioeconomic factors. Effective flood risk strategies require an understanding of these components of risk. They involve managing the hazard (through actions that reduce the magnitude of the flood) and reducing vulnerability by targeting exposure (moving people away from high-risk areas) or susceptibility (e.g. by improving housing quality) (Moulds *et al.*, 2021).

Top-down measures have typically failed to achieve equitable outcomes (Moulds *et al.*, 2021; Reckien *et al.*, 2023). Similarly, adaptation strategies that are designed only to limit economic damage without considering impacts on population health, almost always represent maladaptation. The co-production of research with societal partners, represents an opportunity to deliver equitable outcomes and directly inform decision making (Audia *et al.*, 2021).

This case study presents an illustrative example of the application of co-production methodologies to deliver city-level flood resilience in sub-Saharan Africa with a focus on reducing health inequalities. Tamale is the third largest city in Ghana. It has a population of around 300,000 which is expanding by 3.6% per year (Tamale Metropolitan Assembly, 2021). The city has emerged as an economic centre in West Africa

due to its strategic position, but it is also subject to challenges including high rates of poverty and increasing exposure to climate extremes – such as flooding.

Team

Pathways to Equitable Healthy Cities is a global partnership between universities which seeks to explore the links between environmental change and human health through the lens of equity. The team included researchers at the University of Ghana, Imperial College London and King's College London, complemented by researchers with technical or local knowledge. Local researchers from Tamale were pivotal in establishing the contextual landscape and in scoping and engaging societal partners.

Methods

The project followed the 'loops and building blocks' framework for co-production. This approach aims to structure inclusive engagement and governance, and ensure equitable contribution (Audia *et al.*, 2021). An important first step was to meet with traditional authorities, explain the research motivations and secure permission to work in Tamale. A two-day workshop including 50 participants served to identify challenges and opportunities relating to climate change and health.

Day one of the workshop included short presentations to introduce concepts of co-production and climate change. Open discussion sessions gave every participant the opportunity to speak. On day two, participants self-organized into breakout groups around key themes from day one (flooding, food, heat, and water, sanitation and hygiene) before reconvening to share insights and conclusions. Researchers collated a report which was shared with participants, with the opportunity to provide feedback. The report is available here: https://equitablehealthycities.org/focus-cities/tamale/.

Participants selected flooding as a priority challenge. Subsequently, researchers conducted semi-structured interviews with expert stakeholders which guided participants to discuss key themes such as climate change, equity, and barriers to adaptation, but also allowed them to discuss other themes that they identified as important.

Expert stakeholders identified six areas of high flood risk. Focus groups of between five and 20 participants (predominantly, male chiefs and elders) were selected by

Figure 1: Images representing some of the stages of the co-production methodology. Top left shows the installation of the ultrasound sensor over a storm drain. Bottom left shows some of the participants of the initial workshops. Right shows interviews, breakout groups and focus groups.
(Credit: Ben Howard and Cynthia Awuni)

community leaders and facilitated by local researchers, who relied on extensive note taking to capture data. A thematic analysis of this data was subsequently conducted.

At each stage, participants were asked to recommend further stakeholders. This served to validate the initial participant scoping exercises, whilst also ensuring that important partners were not unintentionally excluded. In future, household surveys would allow more citizens to engage with the process to capture a wider range of views.

Sensors were installed in the selected communities to provide hydrological data, used to characterize flooding. Sensors to measure inundation (i.e. flooded or not) were installed in communities and embedded in participatory monitoring networks. An ultrasonic water level sensor was installed in one of the Tamale's major storm drains, to use as a pilot to test the acceptability of this technology in future research.

Results

Actors

Flood management in Tamale involves a complex system of stakeholders. Institutional actors are organized around a centralized local government involving several

departments. Precise responsibilities are not always clearly defined, leading to blind spots and limiting accountability. Direct interaction with communities is mostly facilitated by disaster response teams in response to a natural hazard.

Non-institutional actors also play a vital role. Traditional authorities – chiefs of the Dagomba people who represent 80% of Tamale's population – are primary stakeholders in local governance (Tamale Metropolitan Assembly, 2021). They can influence people's behaviour and they also manage land ownership and allocation. Communication between institutional and traditional systems is mostly facilitated by elected assembly representatives. The interaction of these systems creates a complex hybrid governance format, presenting both challenges and opportunities.

Drivers

Common themes emerged regarding the causes of flooding in Tamale. Reported drivers can be classified into three groups:

1. *Drainage networks*
   Storm drains are often built reactively following severe floods or to protect areas of high economic value. This piecemeal approach results in poor design and construction. Some drains, for example, stop in the middle of communities (Figure 2a). In some cases, participants reported problems with flooding only since the drains were constructed.
2. *Behaviour*
   Poor waste management practices have resulted in blocked drains (Figure 2c), which generate localized flooding. Furthermore, existing 'communal labour' to clean drains has diminished due to non-governmental organization (NGO) activities that have monetized community cleaning.
3. *Urban planning and enforcement*
   Paving and construction in urban areas has resulted in larger surface water volumes that overwhelm drain infrastructure. Despite planning rules that demarcate buffer and drainage zones, construction continues in high-risk areas due to (i) poor enforcement and (ii) land allocation by traditional leaders.

Few of the focus group participants highlighted climate change or changing rainfall patterns as a driver. When prompted, however, most reported that rainfall had become less predictable with higher intensity events. A lack of nuance in regional and city-level precipitation data means that signals of climate change are overlooked. For

Figure 2: a) A city-level storm drain that stops abruptly in a poor community. b) Piers of concrete blocks added to a mud house to increase its resilience to flooding. c) A roadside storm drain blocked with solid waste rendering it ineffective. (Credit: Ben Howard and Cynthia Awuni)

example, average daily precipitation is not able to capture rainfall intensity, which is the most important parameter for the flash floods in Tamale.

Impacts

In the focus groups, impacts were categorized as primary, secondary and tertiary. These have been simplified in Table 1.

Adaptation

Most participants were not familiar with the term 'adaptation', suggesting a lack of previous consultation. However, every participant had considered ways in which they, and the city, could adapt (Figure 3).

Inequitable access to adaptations is evident in Tamale, as in other cities in sub-Saharan Africa. City-level storm drains, for example, reduce exposure for some,

Primary	Secondary	Tertiary
Drowning	Disruption to services	Loss of business
Damage to housing	Damage to sanitation systems	Long term health effects
Damage to roads and bridges	Increases in disease	Repeated disruption of agriculture (food insecurity, shortages, and famine)
Damage of property	Limited access to economic and educational opportunities	Trapped in poverty by a cycle of shock-recovery
	Homelessness	Homes are abandoned
	Mental health challenges	

Table 1: Reported impacts of flooding classified into primary, secondary and tertiary effects

primarily in high-income areas, but increase exposure and exacerbate flood risk for others, primarily in low-income areas. However, most participants prioritized improving storm drain infrastructure, even those who are currently impacted by poor storm drain design.

Access to community and household adaptation was similarly determined by socioeconomic status. Poorer people had limited access to adaptation measures, at most using sandbags to build small embankments or adding piers to mud houses (Figure 2b). Many adaptation activities do take place in Tamale, but how they interact to determine individual risk remains unclear.

End-users

End-users were central to the research process and included traditional authorities (male chiefs and elders) and expert stakeholders. The outcomes of this research can be used by funders and investors (private, government and NGOs) to justify financing interventions in Tamale, as well as to inform how investment is allocated. Similarly, governments can use this evidence to lobby for investment.

Lessons learned

Inclusivity

Co-production is a collaborative approach that brings together typically isolated societal actors. It allows stakeholders to understand each other's challenges and

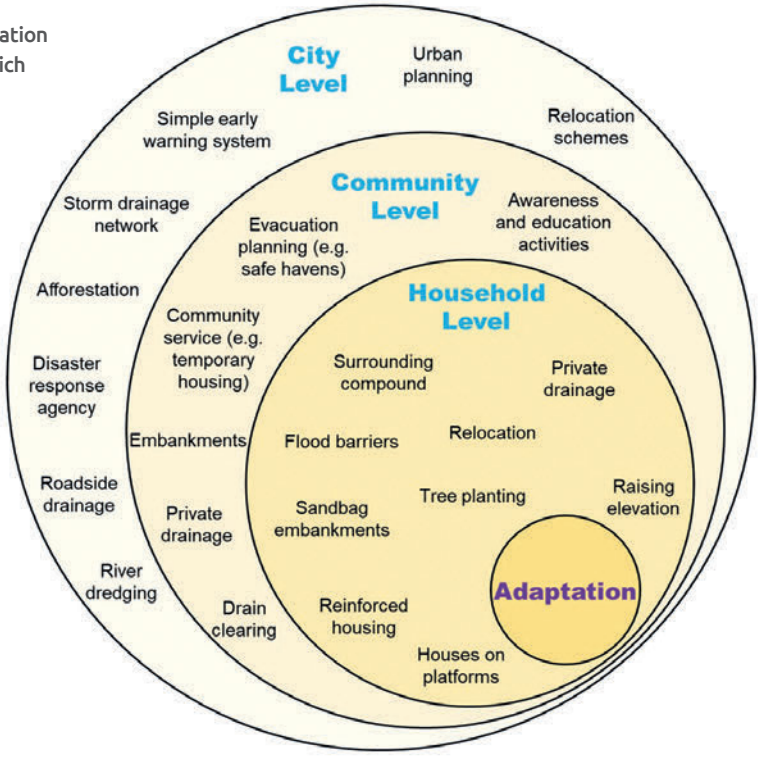

Figure 3: Levels of adaptation to flooding in Tamale which interact to influence an individual level of risk

generate shared goals. Methodologies, however, must allow inclusive participation without demoralising and disengaging community interviewees. The semi-structured style used in this study proved essential. It allowed flexible questioning on the same themes (i.e. pitched at the level of the participant) prompting deeper discussions between interviewees and subject experts.

Dissemination

Research insights must be disseminated in multiple formats suitable for a range of stakeholders and be made accessible to stakeholder communities. City-level flooding strategies cannot be successful without cross-sector awareness and buy-in. In this study, for example, most participants did not know about, or have access to, critical information such as flood management plans and policies, weather forecasts or resources about climate change. These plans do exist online (e.g. Tamale Metropolitan Assembly, 2021), but barriers to access, such as limited internet connection, remain. Information, therefore, must be delivered in inclusive and salient

formats. A simple solution would be to distribute research outputs in both print and digital formats.

Trust-building

Traditional leaders provided detailed insights into flooding in their communities. However, engaging traditional authorities involves building trust over time, particularly where communities have been subject to extractive research practices in the past. Leveraging positive personal histories can accelerate trust building, for example, if local researchers have existing relationships with community leaders, or can be introduced by those who do. Thereafter, researchers must demonstrate a commitment to the co-production process and more generally to the well-being of participants. Further, local training on the maintenance of sensors and the use of hydrological data increases community awareness of flooding and empowers individuals and communities to take action themselves.

Impact inequality

This research revealed cross-cutting effects of flooding for society, including significant inequities in impacts and severe consequences for health and sustainable development. Flooding adaptations are evident on several levels but are typically implemented in a piecemeal approach. This has resulted in instances of maladaptation, whereby those with the highest risk end up with the least benefits. In some cases, this has even exacerbated the flood risk. Overall, this reduces city-level flood resilience. Financing adaptation efforts without resolving the failures in existing mechanisms is likely to accelerate maladaptation, risking the livelihoods and well-being of the most vulnerable people. Instead, investment should aim to generate a reliable and accurate evidence base, develop city-level strategic plans and fund local capacity building.

Conclusion

The outcomes of this research can be used by funders and investors to justify financing interventions, and by expert stakeholders who can make evidence-based decisions with a new emphasis on equity and justice. Community involvement is key. It empowers communities to transition from passive recipients of interventions to proactive agents of change. Ultimately, this encourages communities to take owner-

ship of their resilience efforts to become influential contributors to high-level dialogues and international discussions.

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Bibliography

Audia, C., Berkhout, F., Owusu, G., Quayyum, Z., Agyei-Mensah, S. Loops and Building Blocks: A Knowledge Co-Production Framework for Equitable Urban Health. *J Urban Health*. 2021;98 (394–403). https://doi.org/10.1007/s11524-021-00531-4

Moulds, S., Buytaert, W., Templeton, M.R., Kanu, I. Modeling the Impacts of Urban Flood Risk Management on Social Inequality. *Water Resources Research*. 2021 (57). https://doi.org/10.1029/2020WR029024

Reckien, D., Magnan, A.K., Singh, C., Lukas-Sithole, M., Orlove, B., Schipper, E.L.F., Coughlan de Perez, E. Navigating the continuum between adaptation and maladaptation. Nat. Clim. Chang. 2023 (1–12). https://doi.org/10.1038/s41558-023-01774-6

Tamale Metropolitan Assembly, 2021. Medium term development plan 2022-2025.