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The case for community-based approaches to integrated governance of climate change and health: perspectives from Lagos, Nigeria

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Abstract: In many low- and middle-income countries, urbanisation and urban development are characterised by hazards that conspire with climatic risks and socio-economic vulnerability to influence population health inequality now and in the future. A large part of the epidemiological profile across countries in the 'Global South', has been influenced by a rapid rate of urbanisation and interlinked factors such as climate and ecology. This necessitates an integrated approach to governance for health and climate change. Through three case studies in Lagos, we explore real-life examples that demonstrate these interdependencies, noting approaches taken and missed opportunities. We conclude by reflecting on these experiences, as well as historical examples of comprehensive systems approaches to health, to propose a community-oriented model for integrated climate change and health action in rapidly growing cities.

Notes on the authors: see end of article.

Background

Urbanisation and planetary boundaries

By 2050, about 70 per cent of the global population will be living in urban areas;[1] therefore urban environments will play a pivotal role in the health and wellbeing of people and the planet. Across many low- and middle-income countries (LMICs), the urbanisation process is characterised by rapid population expansion, multi-dimensional precarities in land use and ecology, unequal access to urban resources, limited employment opportunities, the use of biomass fuels for cooking and heating, infrastructural strains, and the proliferation of informal settlements.

Those environmental variables that are impacted by rapid urbanisation, such as air quality, food, and built environments are part of a broader concept of planetary boundaries developed in 2009 to capture the limits within which humanity can live sustainably.[2] Within this concept, nine planetary boundaries have been identified, the exceedance of which increases the risk of large-scale abrupt or irreversible environmental changes. Globally, and particularly in LMICs, four planetary boundaries that have already been exceeded are land-use change due to urbanisation, climate change, biodiversity loss, and nitrogen and phosphorus flows.[3] Urbanisation places significant pressure on these planetary boundaries. For example, population growth pushes the boundaries of human settlements, stimulating ecological disruption and deforestation; increasing air pollution due to industrial activities and the use of polluting fuels for transport, cooking, and heating; and increasing waste pollution from domestic, agricultural, and industrial sources.

Climate change and health in cities

A large part of the epidemiological profile across countries in the 'Global South' has been influenced by a rapid rate of urbanisation and interlinked factors such as climate, ecology, and social and economic constraints. The Planetary Health report 'Safeguarding Human Health in the Anthropocene Epoch'[4] (2015) concluded that population-level gains in life expectancy and under-5 mortality have come at the cost

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[1] https://population.un.org/wup/
[2] https://www.stockholmresilience.org/research/planetary-boundaries/planetary-boundaries/about-the-research/the-nine-planetary-boundaries.html
[3] https://ec.europa.eu/environment/integration/research/newsalert/pdf/four_out_of_nine_planetary_boundaries_exceeded_410na1_en.pdf
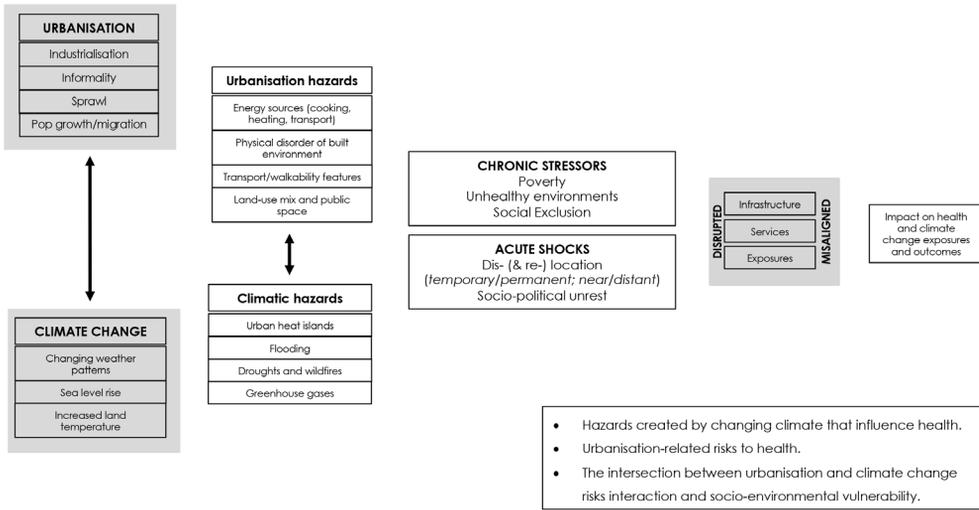[4] Whitmee *et al.* (2015).

Figure 1. Urbanisation, climate change, and health.

of natural ecosystem degradation,[5] which threatens human health and increases the risk of environmental emergencies.

African cities, in particular, are quite vulnerable to chronic stress on water, energy, and food systems, and a growing frequency of acute shocks and chronic stressors due to natural disasters, climate change and weather-related events, and socio-political unrest.[6] When combined with legacies of colonialism and apartheid, along with current ultra-modern development aspirations, urban stressors create inequities in access to health-promoting neighbourhoods, healthy food environments, inclusive transportation, and healthcare systems. Urban sprawl further contributes significantly to climate change through increased motorisation, high vehicle emissions, and heat-sink effects from paved roadways.[7]

The term 'Anthropocene epoch' has been used to describe the impact of human activities accelerated by urbanisation on planetary boundaries. One of these planetary boundaries is climate change, characterised by extreme weather, rising sea levels, and increasing land temperature. The interlinked climatic and health hazards emerging from urbanisation and climate change result in acute shocks and chronic stressors that increase social and economic vulnerabilities and widen health inequalities (Figure 1). The downstream effects of climate change are moderated by characteristics of built

[5] Haines (2019).
[6] Buyana *et al.* (2020).
[7] Gago *et al.* (2013).

environments, such as nearness to water, elevation, and latitude, all of which create differing impacts on health when these environments are disrupted.

Overshooting planetary boundaries can increase the burden of existing injuries, infections, and non-communicable diseases (such as cardiovascular disease and mental illness), while also creating conditions for the emergence of new diseases, flooding, heat islands, droughts, and greenhouse gas emissions. These further affect health through exposure to unhealthy environments and place increased demand on health-care systems. Indirectly, overshooting planetary boundaries affects the ability of communities to adapt and causes long-term consequences of both immediate and sustained disruptions, such as displacement, conflict, and stress.

An illustration (Figure 1) that shows the cascade of interaction between climate, urbanisation, and socio-economic vulnerability in cities is as follows:

i)   rapid population growth and urban sprawl increase climate hazards;
ii) climate change intensifies the risk of conflict driven by the increasing scarcity of resources, especially land, water, and food;
iii) the ensuing socio-political conflict increases the risk of displacement into informal settlements;
iv) inadequate housing conditions associated with informality push the boundaries of human settlements, further increasing exposure to acute shocks (for example, floods) and chronic stressors (for example, thermal discomfort, dampness, flooding, and indoor air pollution) contributing to ill health and biodiversity loss;
v)   biodiversity loss limits the effectiveness of climate mitigation and adaptation action while negatively impacting human health;[8]
vi) dislocation due to acute shocks reduces access to healthcare services and interrupts routine care across the life course (for example, immunisations in children and chronic medication in adults);
vii) the increased regularity of epidemics and extreme weather events increases food insecurity;
viii) natural disasters disrupt the built environment in ways that impact access to conducive spaces for physical activity, particularly for the poor, and interrupt healthcare delivery.

[8] https://www.cbd.int/climate/ and Mills *et al.* (2019).

Action on climate change and health

Recognising these interdependencies, we highlight two considerations for synergistic approaches to addressing climate and health hazards.

1 The 'What?'

The tension and interdependencies between climate and health solutions
Despite interdependencies between health and planetary boundary hazards, it cannot be assumed that interventions to address climate change will positively impact health equity and vice versa. This tension between climate solutions and health solutions highlights the importance of a systems approach[9] considering positive and negative feedback loops, intended and unintended consequences on health and climate.

The importance of focusing on both adaptation and mitigation
Previous measures to address climate hazards have tended to focus on adaptation in the context of very tangible seasonal or regular disruptions caused by climate hazards; this focus is understandable. However, climate adaptation measures need also to consider the health implications of climate solutions and vice versa; and also to explore the opportunity to use one solution to proactively address the other. Beyond adaptation to existing shocks and stressors, mitigation measures must be taken to proactively consider how solutions can also anticipate and prevent future climate and health hazards.

2 The 'How?'

There are several urban phenomena globally, ranging from wildfires to floods, monsoons, and infectious disease outbreaks amongst other things, which highlight the fallacy of a 'stable norm' of urban life, especially for populations that lack access to sufficient preventive resources. For many, day-to-day living requires routinely navigating chronic stressors that represent a state of protracted emergency, even in the absence of acute shocks. Overlaid with the increased frequency of acute shocks due to disruptions in the Earth's life-support systems, a vicious cycle emerges with inequitable exposure and vulnerability within and between countries, accelerating the negative impact of these emergencies on health inequity. This is even more likely in contexts where interventions are imposed on communities without an in-depth knowledge and understanding of how the communities function. This highlights the importance of

[9] Pongsiri *et al.* (2017).

participatory approaches, cognisant of lived experiences and an understanding of assets and resilience points that can be leveraged.

The '*How?*' of integrated governance can be considered along three As:

- *Actors*: It is necessary to consider who is involved, across sectors, in the design, implementation, funding, and evaluation of activities that aim to address climate change and health. To ensure the benefit is accrued fairly, it is also important to consider and include the intended beneficiaries to ensure that interventions are cognisant of lived experiences. This further ensures that interventions are not solely conceptualised from the top down and that dimensions of equity are incorporated, prioritising those with the greatest need and vulnerability.
- *Agency*: This encompasses the features of the systems the actors work within that can facilitate integrated action: for example, alignment of incentives and perform-ance indicators with the desired impact, and to support participation by grassroots actors.
- *Accountability*: This involves evaluation of the activities of the actors and how they can be held accountable for short-term and long-term impacts on both health and the environment, cognisant of the disconnect in time and space between interventions in the urban environment and health and climate hazards and outcomes.

This question of '*How?*' also includes ensuring that training and skills are aligned to ensure there is capacity to effect integrated action. For example, training on resilience, systems thinking, and climate change action should be incorporated into the training of healthcare professionals to enable them to understand the climatic impacts of healthcare service delivery as well as opportunities for health to mitigate against climate hazards,[10] and opportunities for climate action to improve health.

In this article, we set out how integrated governance for climate and health action could work in practice. From the nature of actions taken to improve climate hazards, the degree to which health implications are considered in climate solutions, and climate considerations in both preventive and care-oriented health solutions, we illustrate how integrated governance can be applied. We follow this with case studies from Lagos, Nigeria—one of the fastest growing cities in Africa.[11] These case studies apply the '*What?*' and '*How?*' framework to a real-life urban setting. Lastly, reflecting on these experiences and historical examples of comprehensive systems approaches to health, we propose a community-oriented model for integrated climate change and health action in rapidly growing cities.

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[10] Mogo *et al.* (2020).
[11] https://www.bbc.co.uk/news/resources/idt-sh/lagos

Integrated governance for climate and health action

Integrating climate and health

Integrated urban governance approaches that incorporate a focus on '*What?*' and '*How?*' governance decisions will allow for more effective responses to interrelated health and climate risks. We define integrated governance approaches as those that apply a systems lens to understanding the current and emergent risks in the city, work with multiple sectors for sustainable planning and implementation, and incorporate both future-oriented and reflexive capabilities.

In operationalising this approach in a city like Lagos, consideration needs to be given to various interdependencies, as Figure 1 demonstrates, rather than using siloed approaches. Some of these interdependencies include consequences such as rapid sea-level rise, heat risks, displacement, changing food supplies, and poor access to needed social services, to mention but a few.[12,13] These crises can place additional pressures on the existing built, social, and natural infrastructure, often compounding deficits in the supply of resources,[14] which in turn place stress on existing social, ethnic, religious, and economic fault lines.[15] In the case of Lagos, these fault lines result in socio-economic inequalities, the influx of displaced migrants from conflict-prone parts of the country, ethnic and religious tensions, gender-based violence, and lack of access to housing and waste management.[16]

A related component of the design of initiatives on the climate and health nexus is the '*How?*' of initiatives, which encompasses whose needs these interventions cater to, and who is leading in initiative design, execution, and evaluation. Initiatives also need to give consideration to the agency of communities, and work to leverage assets or resilience points, rather than simply copying and pasting solutions with fixed components from elsewhere. The efficacy of culture and indigenous knowledge systems in climate change adaptation is well recognised.[17] Approaches that understand the scope of community capacity, knowledge, assets, and needs, and which take into consideration tangible assets, such as finance and tools, as well as intangible assets, such as relational capital, will allow for the design of more appropriate interventions.

Another component of the '*How?*' is the nature of accountability systems being used to design, implement, and evaluate proposed initiatives. Accountability

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[12] USAID (2013).

[13] https://scholar.google.com/scholar?hl=en&as_sdt=0%2C14&q=lagos+climate+agriculture&btnG=

[14] Mogo *et al.* (2017).

[15] https://www.reuters.com/article/us-nigeria-security-idUSKBN2AF0DZ
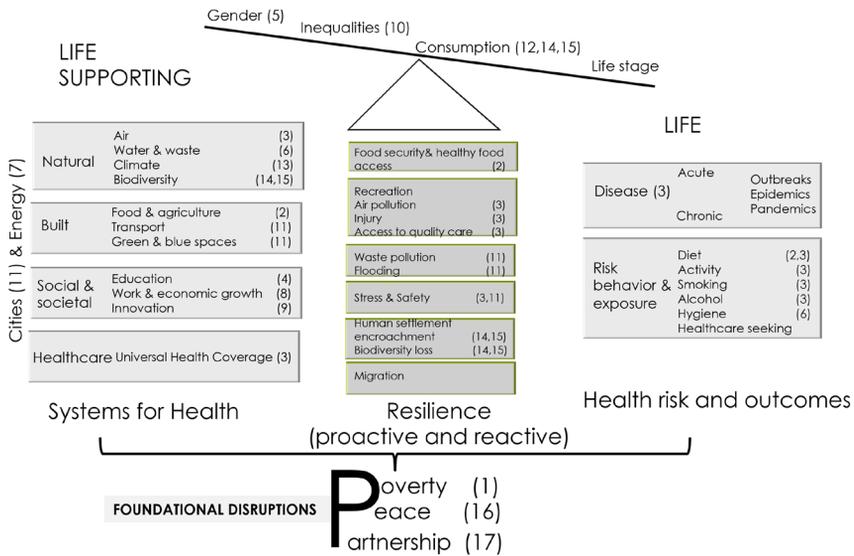
[16] USAID (2013).

[17] Kaya (2016).

Figure 2. Addressing Sustainable Development Goals and global health challenges: a systems approach. Source: Mogo *et al.* (2020).

mechanisms require data systems and institutional processes that facilitate the holding to account of sectors that protect or undermine health. Such a process is well served by tools for intersectoral data collection in cities, such as the Urban Heart Equity Action and Response Tool (Urban HEART).[19] Previous applications of the Urban HEART in African and Asian cities have indicated that it allowed for the engagement of multiple departments, including city councils, budget and planning departments, education, urban planning, and the office of the mayor. It facilitated the application of equity-oriented interventions, allowed city representatives to build greater confidence in their ability to use intersectoral data to guide decision making, and made them more likely to act on the data.[18]

Sub-populations should be considered with a view to understanding age, gender, and life-course among other cross-cutting considerations (Figure 2). For example, during an outbreak of an infectious disease, immediate considerations for the elderly may include access to medical treatments, disruption of routine care for chronic conditions, as well as age-related accessibility concerns about public spaces for exercise, socialisation, and mental health promotion. Again, the design of a housing project may best serve high-income members of the population, while displacing low-income members of the population into ecologically vulnerable settlements. This spread of risks and benefits will need to be considered as part of health impact assessment to evaluate the impact of interventions.

[18] Kano (2015).

The '*How?*' of response and prevention activities will determine whether there is adequate consideration of the unequal needs of various sub-populations, and whether adequate measures have been designed, that fit their needs and also incorporate their existing assets. As mentioned earlier, the '*How?*' will be greatly supported by approaches that are inclusive, participatory, and community oriented. Table 1 is an example of the multifaceted considerations that could be raised by a single set of policy decisions to address a health emergency—in this case the coronavirus outbreak—cognisant of coexisting climate risks. It also shows the multi-sectoral considerations that could be necessary to ensure that the policy direction is appropriate and feasible within the constraints of the context. The policy decisions include an immediate crisis response as well as aspects of the response that build resilience to future challenges in which health could intersect with the climate crisis. Also, it gives robust consideration to the implications of this decision for various segments of the population and other sectors, as well as non-state actors who can support implementation.

Finally, governance of the '*What?*' of the climate and health nexus equally requires comprehensive consideration, capturing some of the tensions and interdependencies that exist between the issues. Integrated data should be able to inform interventions, capturing current baseline climate and health risks to the city. In a city like Lagos, this can include its location as a low-lying coastal city, its vulnerability to floods, seasonal variation in demand for services, and its rising population, including the influx of migrants from conflict-prone parts of the country, amongst other things. Data systems should also keep abreast of emergent trends that may suggest future needs in the city: for example, projected sea-level rise in the city, potential service needs in the instance of future outbreaks of infectious disease, and the deficits between projected population increases and the infrastructural capacity.

As mentioned earlier, consideration should be given to immediate adaptation efforts; however, sustainable responses require additional consideration of mitigative efforts. Efforts should be informed by the nature of the impacts they engender. These include:

1) immediate efforts that have short-lived impacts: for example, drainage clearance to allow quick run-off of flash floods;
2) immediate efforts with sustained impacts: for example, drainage expansion as part of flood response to reduce the risk of future floods as well as reducing vector breeding grounds;
3) long-term efforts with sustained impacts—an example of a long-term effort with sustained impact is investment in safe housing and greenspaces which can both mitigate against climate risk and help reduce disease, in the short term (for instance, interrupting disease transmission) and in the longer term (such as increased physical activity and access to greenspaces reducing cardiovascular disease risk and improving mental health).

Table 1. A proposed integrated (climate and health) governance approach to addressing coronavirus in Lagos.

Potential policy directions to address a coronavirus outbreak: Impose a national lockdown	Goal of this direction	Interface with other sectors	Who may be the most vulnerable to the impact of this decision?	Potential unintended consequences of this decision and proactive measures to adapt them	Potential mitigation measures
Short-term facing components of this policy decision	**Short term considerations**				**Reactive adaptation measures**
Restrict movement to narrow periods in the day	Limit the spread of the infection	Work with the housing sector to improve capacity to provide shelter for displaced populations	Refugee communities may receive less support given diversion of funds to emergency responses, placing them at heightened medical and economic risk	Increased gender-based violence and crime	Impose a phased lockdown based on the spread of the infection
Close major expressways and toll gates	Protect the economy	Work with community-based groups to provide sanitation services for informal settlements	Informal settlements will be unable to implement social distance and maintain the needed hygiene standards	Reduced exercise	Scale-up access to diagnostics to limit disease spread and enable rapid containment
	Reduce the burden on the healthcare system	Work with the environment sector to ensure the availability of safe green spaces	Access to women's health services may be disrupted	Discriminatory implementation and the potential abuse of human rights in enforcement	Map relational capital in communities to distribute food, social resources and communicate information during lockdown
		Work with the agricultural sector to ensure that food supplies are accessible while people are on lockdown	The elderly will be more at risk of outbreaks, interruptions in services for chronic health conditions and medical procedures	Poor access to information and needed services for low income and displaced communities during the lockdown	Strengthen primary healthcare facilities to improve preventive and community-based care
		Work with the transport sector to diversify mobility options	Children may face limited access to routine services e.g., vaccination, education	Increased religious and ethnic tensions in deprived communities	Build rights and gender-sensitive training for government arms that enforce lockdown conditions
			People with disabilities	Increased malnutrition	
			People in the informal sector & without stable employment	Increased economic precarity and inequality	
				Reduced access to other important healthcare services	
				Limited income-generating activities	

Table 1. *Cont.*

Potential policy directions to address a coronavirus outbreak: Impose a national lockdown	Goal of this direction	Interface with other sectors	Who may be the most vulnerable to the impact of this decision?	Potential unintended consequences of this decision and proactive measures to adapt them	Potential mitigation measures
			Low-income communities will face higher food insecurity, safety concerns, and less access to resources needed to stay in lock-down conditions		Build two-way information systems to improve access to information and to capture public feedback
					Improve access to the internet to enable remote work and reduce pressure on transport systems and reduce air pollution and greenhouse emissions

Future-oriented components of this policy decision	Embedded future considerations	Long term mitigative measures
Build crisis response mechanisms	Build the resilience of the state to future outbreaks	Understand community assets and agency on the nexus of health and climate risks e.g., economic coping strategies, flood response strategies
Build participatory tracking systems	Improve access to information and resources for vulnerable communities	preventive health practices that can support in building resilience to future ecological and health risks
Ensure walking and cycling infrastructure are available and safe	Improve access to multi-modal and climate-friendly forms of transportation	
Improve access to parks and green spaces	Reduce local supply-chain vulnerabilities in access to healthy food	Build capacity for digital healthcare services to reduce the

Table 1. *Cont.*

Potential policy directions to address a coronavirus outbreak: Impose a national lockdown	*Goal of this direction*	*Interface with other sectors*	*Who may be the most vulnerable to the impact of this decision?*	*Potential unintended consequences of this decision and proactive measures to adapt them*	*Potential mitigation measures*
					need for non-urgent in-person healthcare services and to reduce
					disruptions in access to care in the event of future pandemics
Create incentives for informal suppliers of fresh and healthy foods	Make it easier for people to socialise and exercise in place				Create multi-sector parastatal to disaggregate outcomes and de-centralise access to services across sectors e.g., food, healthcare, housing. Identify population inequities and interruptions in access to service with an emphasis on identified at-risk groups
					Land-use allocation to ensure access to healthy housing, public spaces, safe walking/cycling for the growing population, and reduce ecological disruption from expanded boundaries of human settlements thus triggering future pandemics

While interventions are often viewed linearly, it is also possible that interventions can work up to a point but cannot be sustained: for example, the promotion of hand-washing that has been implemented during the COVID-19 pandemic may or may not be a sustained behaviour. It is also possible that the assumptions behind the implementation of a project may work successfully in one place but not work for the new constraints of a new setting.[19] Therefore, careful consideration of these impacts can help identify partners that can support interventions to ensure more positive and sustained impacts while laying the ground for addressing future vulnerabilities to similar issues.

Considering the '*What?*' and '*How?*' of climate and health governance encourages a move beyond siloed, short-term approaches to long-ranging, cross-cutting approaches. Transdisciplinary research processes can build the data systems and governance capability to make such robust and evidence-informed approaches possible. Transdisciplinary research ensures the generation of scientific inquiry in a way that considers the needs of multiple stakeholders, and it is especially suited to the sorts of complex challenges posed by climate and health.[20] Such processes allow for collaborative co-production of research questions, identification of appropriate tools and methodologies, mobilisation of existing community actors and assets,[21] and integration of knowledge into context-specific action. They also make room for continual learning about current challenges, emergent trends, the impact of interventions, and identification of opportunities for improvement.

We discuss some emerging developments in Lagos that traverse climate and health through the lens of integrated governance. They include flooding responses in the Ajegunle-Ikorodu community, the development of the Eko Atlantic city project, and healthcare infrastructure provision in the context of climate change. We draw attention to the '*What?*' and '*How?*' of intervention design and implementation, and discuss opportunities for developing responses more likely to improve health, address climate risks, and promote resilience in line with the Lagos State Development Plan.[22]

Case studies on climate and health action in Lagos, Nigeria

In Nigeria, extreme weather conditions exacerbated by climate change have led to colossal damage to businesses, infrastructure, and properties, and also increased

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[19] Neely (2019).
[20] Weimann *et al.* (2020).
[21] Mogo & Andersen (2019).
[22] http://www.sparc-nigeria.com/RC/files/5.4.11-Introducing-the-Lagos-State-Development-Plan.html

vulnerability to the risk of disease.[23] Lagos, due to its low-lying topography and unregulated urbanisation over the years is highly susceptible to flooding, and, more recently, to excessive heat.[24] Perennial flooding is common across the city, from the high-income Victoria Island–Lekki axis to the low-income Ikorodu axis, and some flooding incidents that resulted in extensive damage to property and loss of life were recorded in 2011, 2012, and 2017.[25]

The Lagos State Government has applied a series of engineering solutions ranging from the construction of a sea wall at Eko Atlantic to the placement of groynes, as well as the use of sand savers, sand reclamation, X-blocs, sandbags, and floodgates[26] to protect more affluent neighbourhoods, while residents in low-income flood-prone communities have tended to adopt a range of coping mechanisms in recent years.[27] The trend for cities to adopt top-down solutions in resolving climate-induced challenges is common.[28] Lagos, for example, developed a Resilience Strategy that clearly outlines the city's challenges, and an institutional framework for addressing them, with little consideration for nuanced localised strategies or indigenous knowledge systems already being deployed.[29]

Using three case studies, we illustrate the different seized and missed opportunities for participatory and integrated action to address climate and health challenges in Lagos.

Case Study 1: Ajegunle-Ikorodu community resilience action plan

Ajegunle-Ikorodu Community, an informal settlement, is the location for the first community resilience action plan in Lagos.[30] The community is primarily populated by low-income informal-sector workers. The community suffers annual flooding, with attendant health risks. Hence, at the inception of the resilience action plan, the objective was to develop early warning systems, flood mitigation measures, and community participation in flood adaptation, because news reports, available data, and satellite imagery of the area point to high flood vulnerability.[31]

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[23] http://floodlist.com/tag/nigeria

[24] https://thinkhazard.org/en/report/2230-nigeria-lagos/EH

[25] Akande *et al.* (2017).

[26] https://www.ekoatlantic.com/latestnews/broadcast-media/lagos-requires-n440bn-for-shoreline-protection-project/

[27] Olajide & Lawanson (2014).

[28] https://www.environewsnigeria.com/lagos-flood-beyond-panic-control-but-high-tech-engineering-solutions/

[29] Sutherland *et al.* (2019).

[30] http://chsunilag.com/Research-and-reports/ajegunle-ikorodu-community-resilience-action-plan

[31] https://ludi.org.ng/wp-content/uploads/2020/06/FLOOD-VULNERABILITY-ASSESSMENT-AND-MAPPING-OF-LAGOS-STATE.pdf.pdf

While the residents acknowledged that flooding was a perennial issue and that an embankment was required for long-term stormwater control, it was interesting to note that they did not consider the flooding challenge to be an immediate priority. According to residents, several government agencies and even the president had visited the community and made promises of institutional interventions without any action.[32] They had therefore learnt to live with the floods by preparing for the annual season (usually September–October) and adopting several coping mechanisms. These include moving assets to places in the community less prone to flooding, seasonal migration or family relocation out of the community, the use of canoes for navigation, the use of cement/sandbags to reduce stormwater intensity, the construction of local bridges to serve as walkways, and even the construction of drainage paths for the water to flow.

The Lagos Resilience Strategy[33] includes a Community Participatory Flood Management initiative, with an objective 'to develop proactive actions to build the capacity of local communities to predict and respond to flash flood occurrences, without necessarily waiting for government intervention'. One of the four components of this initiative involves training community members on how to carry out a flood risk assessment and prepare and implement flood hazard plans. Of note, this initiative did not acknowledge or recognise the extant indigenous knowledge systems and coping capacities that are already being deployed in the absence of government interventions.[34]

In Ajegunle-Ikorodu, we observed that the flood coping strategies were cooperatively implemented through pooling resources (cash and kind), pointing to the importance of social capital and the agency of community-led interventions as key ingredients for success.[35] These reinforce the ground-level resilience and effective capacities that are often ignored in large-scale urban planning and climate change plans. For Ajegunle-Ikorodu residents, interventions for addressing water poverty, expanding community health services, and access to secondary education were expressed as urgent priorities. While these were captured in the resilience action plan for institutional interventions, we noted the community was already brainstorming how to address these challenges through collective action.

In this case study, the '*What?*' of integrated governance reveals a high interdependency between the flooding and health hazards the community is exposed to, and the adaptive practices the community invariably implements to cope with vulnerability.

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[32] http://www.tundefashola.com/archives/news/2010/10/20/20101020N01.html
[33] http://www.lagosresilience.net/Downloads/Lagos_Resilience_Strategy.pdf
[34] Ugonna (2016).
[35] Lawanson (2015).

While, like other Lagos informal settlements, the community is underserved, the agency—the '*How?*'—being manifested through collective action is not sufficiently recognised nor integrated into health services, in part due to the centralised nature of governance. An integrated approach to climate and health resilience would consider the ways that flooding as a climate hazard impacts health: for example, through an increase in diarrhoea in children due to interrupted sanitation, contaminated drinking water, or interruptions in healthcare delivery. In partnership with the community, action plans to improve resilience would seek to adapt and mitigate against these health impacts: for example, through early warning systems to identify early increases in diarrhoeal incidence and increasing service capacity accordingly; or through ensuring residents have an extended supply of chronic medications in case service interruptions occur.

Case Study 2: Climate issues and healthcare infrastructure

In Nigeria, issues around morbidity and mortality linked with climate change have emerged. They include periodic outbreaks of water-borne and vector-borne infectious diseases (for example, cholera and Lassa fever), as well as injuries that follow severe climate events, like floods and heatwaves. As these often occur at the neighbourhood level where people primarily seek care, primary healthcare facilities situated in these neighbourhoods must be strengthened.

The Ward Minimum Healthcare Package of 2007 prescribes a set of minimum standards for health infrastructure, personnel, drugs, and other medical consumables. Part of the stipulated standards provides for hierarchical distribution of health facilities according to population. According to the document, a population between 10,000 and 20,000 is entitled to a Primary Healthcare Centre, in addition to adequate land area, provision for a clean water source, electricity provision, and even residential apartments for staff.[36] However, there are currently 288 primary health centres[37] in Lagos catering for a population of over 20 million, and many of them are poorly equipped and lack the requisite staffing to provide quality healthcare.

In the case of Ajegunle-Ikorodu, the health centre is understaffed, underequipped, and provides very limited services. Furthermore, it is subject to flooding during the September–October season, and hence health services are often disrupted when needed most. The community members have thus improvised by placing sandbags

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[36] National Primary Health Care Development Agency (NPHCDA): Minimum standards for primary health care in Nigeria.
[37] https://primaryhealthcare.lagosstate.gov.ng/

around the surrounding area of the health centre and constructing a makeshift bridge to enable physical access to the facility.

Self-reported variations in healthcare demand revealed more cases of water-related diseases (typhoid and malaria) during the rainy season, and maternity and paediatric issues during the dry season due to higher levels of dust air pollution, an exposure associated with adverse birth outcomes[38] and increased risk or exacerbation of respiratory conditions like asthma.[39] Residents complained of the fact that the health centre runs only during the week between the hours of 9AM and 4PM with only a nurse and medical attendant, with climate-induced disruptions further compounding already inadequate access. Thus, community members in medical distress often have to cross by canoe to the main general hospital a few kilometres away to access medical services This has increased the rate of pregnancy-related deaths as many resort to self-care, patronising patent medicine sellers (*chemists*), or traditional medicine practitioners—*elewe omo*—who operate in poor hygienic conditions. While community health volunteer services exist, these are limited to polio vaccination (funded by Rotary International) and mother–child care issues (funded by the Federal Sustainable Development Goals office).

In discussing the '*How?*' approach in Ajegunle-Ikorodu, the health governance framework is directly impacted by the climate change situation with seasonal interruption of services, the nature of prevalent illnesses, and even access to the health centre itself. While the residents of Ajegunle-Ikorodu only have access to skeletal medical services at this level, it is obvious that more needs to be done with regards to the capacity of the community to mitigate the hazards, increase the medical personnel stationed at the centre and amplify the implementation of the Community Health Volunteers beyond the current donor-led siloed vaccination and maternal–child care that they cover.

Anticipating the climate risks faced, an integrated governance approach would consider the situation of health centres to ensure that where possible they are at less risk of flooding. From a mitigation perspective, such healthcare centres would also consider their waste management protocols to ensure waste disposal practices do not contribute to increased risk of flooding or air pollution exposure in the short term and to increasing greenhouse gas emissions that accelerate climate change in the long term. Accordingly, healthcare staff would need to be trained to recognise the climate impacts of their actions and to ensure services are responsive to anticipated fluctuations in healthcare need as well as to mitigate against the risk of climate change.

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[38] Šrám *et al.* (2005).
[39] Kanatani *et al.* (2010).

Case Study 3: Eko Atlantic City

Eko Atlantic City, one of Lagos's iconic megaprojects is touted as a smart-city, and an innovative engineering and climate change solution. It promises sustainability, energy efficiency with minimal carbon emissions, job prospects, prosperity, and a new land for Nigerians. It also serves as a bulwark in the fight against the impacts of climate change.[40] Built on land reclaimed from the Atlantic Ocean and protected by the sea revetment—the 'Great Wall of Lagos'—it has been acclaimed[41] for its eco-friendliness as well as the opportunities it affords as West Africa's new financial hub and its ultra-wealthy inhabitants.[42] The Lagos State Government proudly endorses the project as evidence of its aspiration to be 'Africa's model mega-city' and its readiness for a global investment destination.

Interestingly, the city which has been called the African Dubai has also been criticised as an apparatus for 'climate apartheid'[43]—a situation in which the super-rich buy off their vulnerability to climate change effects while excluding the rest of the city from protection against rising sea levels.[44] According to a piece by Onuoha,[45] 'the same wall that will protect Eko Atlantic could worsen the situation for neighbouring areas not protected by it, which includes much of Lagos'. Given that communities to the east of the city, along the Lekki–Epe axis—including Okun Alfa, Crown Estate, and Abraham Adesanya—have suffered increase flooding incidents in the last two decades,[46] any factors that further increase flooding risk could prove disastrous for residents of these neighbourhoods. The ensuing increased frequency of flooding in these communities has already resulted in higher rates of water-related illnesses.[47]

Beyond these environmental consequences of Eko Atlantic City are social impacts that also have implications for health. The development of Eko Atlantic City has resulted in the privatisation of the erstwhile Lagos Bar Beach—a major public space frequented by generations of Lagosians, thus robbing the city's residents of their commonwealth, their natural resource heritage, as well as the physical and mental health benefits derivable from recreational activities in natural open space.[48]

[40] Lukacs (2015).

[41] Eko Atlantic Sales Office. (2012). Eko Atlantic Brochure. http://www.ekoatlantic.com/media/

[42] Odutan (2015) and Winsor (2015).

[43] Lukacs (2015).

[44] Caprotti (2014) and Obiefuna *et al.* (2017).

[45] Onuoha (2017).

[46] Ajibade (2017).

[47] Oyekale (2013), Atufu & Holt (2018), and Olanrewaju *et al.* (2019).

[48] Fernelius (2020).

This points to a clear gap in the public health–urban planning nexus, which should be the fulcrum of urban development.[49] While the history of urban planning in Lagos in the early 1900s explicitly focused on addressing public health concerns, albeit for the minority,[50] modern planning in Lagos does not recognise the interface between the city's urban development trajectory and the wellbeing of all its citizens.

In this situation, the '*How?*' context shows that a clear climate mitigation intervention has resulted in unintended negative health and wellbeing consequences. While the Lagos Sea wall as an engineering intervention may have been necessary, the best way to construct this for population health was not taken into account, representing a missed opportunity for an integrated governance which would have adopted a participatory community-based approach to understand community concerns, health needs, and assets. Such an approach would have considered the feedback loops with the socio-environmental consequences and health impacts on the wider population to identify opportunities to mitigate against and adapt to the realities of climate change and urbanisation risk and hazards, today and in the future, to future-proof health and health-proof the future of the city.[51]

Polela 2.0: Future-proofing health and health-proofing the future of cities in an era of climate change

The case studies presented draw attention to the importance of integrated governance approaches to inform the tailoring of integrated climate and health solutions. In particular, they highlight the importance of adopting the innovation of community-based co-produced solutions, recognising their needs, perception of risks, and their expertise, including tools and coping mechanisms.

There is precedence for more comprehensive models of health. In 1945, an experiment in innovative community-based comprehensive healthcare was implemented in Polela, South Africa.[52] In contrast to the dominant curative model of care of the time, the Polela experiment combined curative, preventive, and promotive health. Notably, this system was focused on maintaining health, training health assistants from the community to visit homes allocated to them to collect social, economic, and environmental data in order to identify imminent threats to health and wellbeing and to intervene to prevent preventable health threats. To address nutritious

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[49] Lawanson & Fadare (2015).
[50] Lawanson (2021).
[51] Oni (2020).
[52] Phillips (2014).

food security, community residents were given practical training and advice using the health centre as a demonstration site: for example, advice on crops to plant using a demonstration vegetable garden in the health centre. Households with preschoolers were also closely monitored for malnutrition or food insecurity (for example, crops failing) and given supplemental nutrition.

We propose a Polela 2.0: an integrated community-oriented primary health and climate care (PHCC) system that integrates climate resilience with primordial/primary prevention of disease, addressing socio-economic and environmental determinants of health and delivery of healthcare.

The proposed Polela 2.0 '*What?*' would consider the urban infrastructure and services at risk of disruption due to climate and urbanisation hazards (Figure 3). This integrated surveillance of disease, socio-economic determinants of health, and environmental risks would monitor exposures and behaviours to act as an early warning system for imminent health threats from acute shocks and chronic stressors alike. Interventions would leverage community expertise and experience to inform solutions that protect health while mitigating against climatic hazards. In so doing, the business of protecting, maintaining health, and treating disease would not be single-disease focused, but instead take a holistic approach.

URBAN INFRASTRUCTURE	SERVICE	EXPOSURES/RISK	BEHAVIOURS / EXPERIENCE	HEALTH + ENVIRONMENTAL OUTCOMES
Energy	Heating, Cooling, Cooking	Air pollution (indoor+outdoor)	Diet: quality + quantity	Diarrhoea
		Greenhouse gas emissions		Respiratory infections
	Food system	Healthy foods	Physical activity (leisure and travel)	Stunting
Land Use	Human settlements	Injury		Malaria
	Healthcare	Safety		Obesity
			Hygiene	
Water	Social infrastructure: Blue/green/shared public space	Waste + water pollution		Hypertension
			Healthcare seeking behavior + access	Diabetes / Heart disease / Stroke
		Healthcare system		
Transport	Water and Waste		Stress + isolation	Asthma/COPD
		Social cohesion / connectedness		Mental illness
	Mobility		Biodiversity loss	Extreme weather events
		Safe housing (thermal comfort, ventilation, damp, overcrowding)		Flooding
		Ecological disruption		Emerging new infections e.g., SARS-CoV-2

Figure 3. Primary health and climate care system: components of an integrated community-based health and climate system.

The '*How?*' of this PHCC system would consider community actors and leverage existing community health worker structures, going beyond their narrow single-disease focus to collect data on households within their allocated communities, including health status, food security, livelihoods, and the education status of children within the household. They would also note changes to their home environments, including water and sanitation, energy sources used, and community assets (for example, public/play space). One important critique of existing community health worker approaches is the overdependence on involvement of people who are either unpaid or poorly paid. Given the preponderance of women in this role, adaptations of existing community health worker structures for integrated climate and health action would need to address this to avoid perpetuating or widening gender inequality.

The '*How?*' lessons from the Polela experiment are worth considering. At the time, key challenges experienced included resistance from the medical dogma of curative centric care, pressures of high disease burdens that consume all resources, and political resistance in the face of an apartheid government. In addition to these challenges, a critical constraint is the fact that the majority of community health worker initiatives are funded by siloed projects funded by external agencies, resulting in community health workers for HIV, malaria, and polio vaccination all operating in siloes with narrow remits. As a result, even though these health assistants visit the homes of residents, they do so blinkered by their disease focus, missing the opportunity to identify potential health (much less climate) hazards that can be addressed. In the context of resource-constrained settings, this is both wasteful and inefficient. Addressing the imbalances and inequities in how healthcare is financed would be critical, necessitating local and foreign actors to work together with communities to determine priorities and co-design solutions. Notably, this would need to entail creating the conditions for power to be transferred to the communities, the work of diverse actors working in communities would need to be coordinated to share influence and expertise, and indigenous knowledge would need to be centred as part of the expertise landscape. This requires wide-scale medical, social, economic, and political commitment and sacrifice to align community systems of health towards achieving population health and climate resilience, protected from future shocks and stressors.

Increasingly, the health sector is recognising the role that the healthcare system can and should play in addressing the climate crisis.[53] However, approaches to address health and climate emergencies, as well as urban planning continue to remain largely siloed. Primary healthcare revitalisation has been proposed as an approach to

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[53] The Lancet Countdown on Health and Climate Change. https://www.thelancet.com/countdown-health-climate/about

achieving universal health coverage,[54] but largely misses the opportunity to take a holistic approach to addressing the urban and climate hazards that influence health outcomes. Our proposed community-oriented PHCC system, a model for integrated climate change and health action in rapidly growing cities, is focused on intergenerational health as well as on the health of the planet, designed to address and not perpetuate inequity.

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