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Climate Change, Public Health and Wellbeing

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Climate change, public health and wellbeing: introduction

Simon Goldhill and Georgie Fitzgibbon

Abstract: Climate change presents a serious threat to global public health and requires an immediate, internationally coordinated, response. There may be considerable value in introducing a public health frame into the ongoing public—and policy—dialogue about climate change. The articles presented here explore the connections between climate change, public health and wellbeing.

Keywords: Climate change, public health, wellbeing, access, equity.

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Climate change presents a serious threat to global public health and requires an immediate, internationally coordinated, response (Harmer *et al.* 2020). An effective public health response to climate requires an enhanced public health awareness and preparedness. Climate change, together with other natural and human-made health stressors, affects human health and disease in numerous ways. Some existing health threats will intensify, and new health threats will emerge. Risks do not affect all communities equally: salient factors for such vulnerability include age, economic resources, geographical location, and political process.

Globally, the human health impacts of climate change will continue differentially to challenge the world's poorest nations, where populations endemically suffer myriad health burdens associated with extreme poverty that are being further exacerbated by the changing climate. In 2009, a *British Medical Journal* editorial argued that a global commitment was necessary to reduce carbon dioxide emissions and prevent further impacts on health (Jay & Marmot 2009). The climate crisis is a threat multiplier, particularly for communities suffering from environmental injustice. These threats include exposure to air pollutants (such as particulate matter and soot produced from burning fossil fuels) or soil and water contamination (caused by dumping coal ash or lead in the water supply).

There may be considerable value in introducing a public health frame into the ongoing public—and policy—dialogue about climate change. Rapid and potentially irreversible climate change poses a direct threat to global public health. Andrew Harmer and colleagues (2020) argue that the World Health Organization (WHO) should recognise this in the same way as global threats from specific diseases. WHO could respond to that threat through its mechanism for declaring a health threat a public health emergency of international concern, which would strengthen a coordinated, international response by mobilising political will and funding.

The articles presented here explore the connections between climate change, public health, and wellbeing. Throughout, there is a common thread of concerns surrounding access and equity. In the first article, Tolu Oni *et al.* (2021) consider the benefits of community-based approaches to integrated governance for climate change and health, focusing on Lagos. In many low- and middle-income countries, urbanisation and urban development are characterised by hazards that conspire with climatic hazards and socio-economic vulnerability to influence population health inequality now and increasingly so 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 the interlinked impacts of climate and ecology. This necessitates an integrated approach to governance for health and climate change. Through three case studies in Lagos, which analyse approaches taken and missed opportunities, they explore examples that demonstrate these interdependencies. They 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.

In the second article, Stephanie Wilkie and Nicola Davinson (2021) explore whether nature-based interventions improved individual public health outcomes and health behaviours, using a conceptual framework that included pathways and pathway domains, mechanisms, and behaviour change techniques derived from environmental social science theory and health behaviour change models. A two-stage scoping methodology was used to identified studies published between 2000 and 2021. Peer reviewed, English-language reports of nature-based interventions with adults ($N = 9$) were included if the study met the definition of a health–behaviour change intervention and reported at least one measured physical/mental health outcome. Interventions focused on the restoring or building capacities pathway domains as part of the nature contact/experience pathway; varied health behaviour change mechanisms and techniques were present but environmental social-science-derived mechanisms to influence health outcomes were used less. Practical recommendations for future interventions include explicit statement of the targeted level of causation, as well as utilisation of both environmental social science and health behaviour change theories and varied public health outcomes to allow simultaneously testing of theoretical predictions.

Morten Byskov *et al.* (2021a) take a broad view on the politics of climate change. Recent years have seen a shift in focus from research that asks how adaptation to climate change can be achieved, to research that asks how *fair and equitable* adaptation to climate change can be achieved. This reflects a more general turn in the climate literature towards pathways for *just transitions* in the face of the climate crisis. Such an agenda requires not only empirical research, but also engagement with philosophical theories of justice (Byskov *et al.* 2021b). What, for example, are people owed as a matter of justice such that adaptation can be said to be fair? And how do structural inequalities affect what people are owed as a matter of justice in adaptation? In this article, the authors introduce the Multi-Dimensional Injustice Framework (MDIF). The MDIF provides a normative framework for understanding, articulating, and tackling issues of justice and fairness in climate impacts and climate adaptation. The MDIF holds (i) that the ethical challenges posed by many development issues are multi-dimensional in nature, in the sense that they cannot be reduced to a single primary indicator; (ii) that these dimensions are best conceptualised using the language of (in)justice; and (iii) that resolving development challenges requires recognising and addressing the underlying issues of injustice and inequality. Consequently, the MDIF introduces a set of indicators to identify distributive and procedural injustices that can be utilised within development and adaptation policy and planning. The authors show how the MDIF can be applied in

practice using the case study of climate-related health risks in the informal settlements of Lusaka, Zambia.

In the final article (which will be added to the issue a few weeks after the other articles), Anne Schiffer (2021) explores energy justice through the lens of collective capabilities. It is increasingly recognised that sustainable energy is a social or energy justice challenge. Here, community energy is seen an umbrella for collective participation in more democratic or just models that enable bridging of the energy access gap. This paper explores community participation and by extension energy justice through the lens of collective capabilities in relation to everyday sharing practices, tensions, and energy conflict. The research is based on a range of qualitative methods, including participant observations, semi-structured interviews, and participatory design workshops to facilitate discussion about the future of energy in a rural Gambian community. The findings suggest that everyday sharing practices help reduce energy injustices (for example, unequal infrastructure distribution), but that there are limits as to how far this translates into developing and sustaining community infrastructure. Here collective capability provides a useful tool to explore potential future modes of participation in energy democracy, such as shared ownership.

This issue forms part of the British Academy's COP26 series, which aims to raise awareness of the importance of the humanities and the social sciences in understanding the complex human and social dimensions to environmental challenges and their solutions. The authors are drawn from a range of Academy programmes, including the *Sustainable Development Programme*, which funds researchers working on the UN's Sustainable Development Goals, *Urban Infrastructures of Wellbeing*, which supports interdisciplinary research that explores how formal and informal infrastructures interact to affect the wellbeing of people in cities across the Global South, and the *Knowledge Frontiers* scheme, which aims to enable different communities of knowledge and practice to illustrate the unique added value of international and interdisciplinary collaboration.

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

Tolu Oni, Taibat Lawanson and Ebele Mogo

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.

Keywords: Lagos, urban development, population health, climate change, community, governance, cities, primary healthcare.

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

[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).

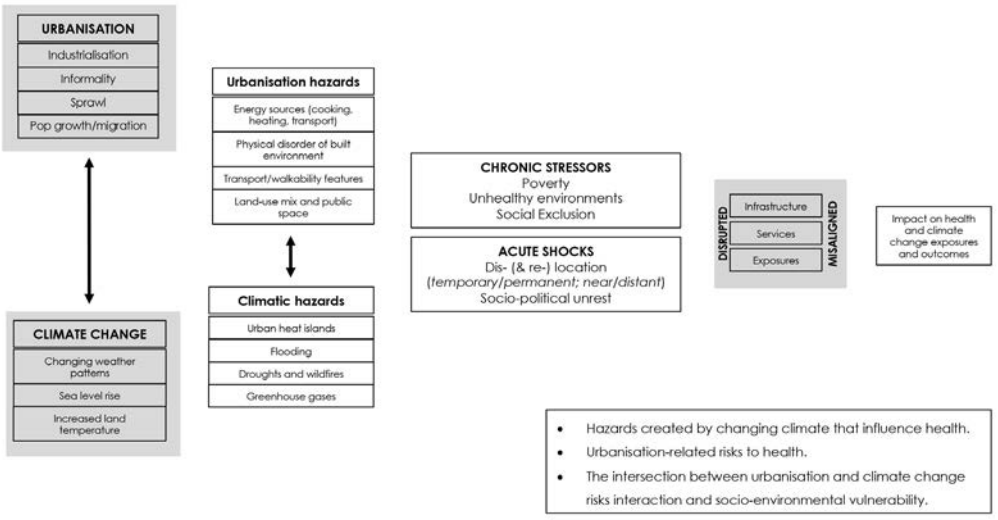

Figure 1. Urbanisation, climate change, and health.

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 performance 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.

[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

[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).

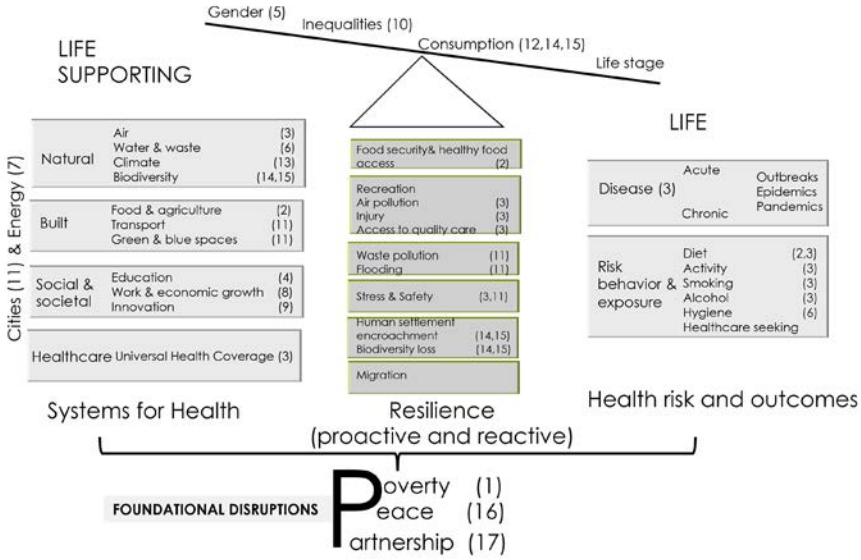

Figure 2. Addressing Sustainable Development Goals and global health challenges: a systems approach. Source: Mogo *et al.* (2020).

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

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 **Build crisis response mechanisms** **Build participatory tracking systems** **Ensure walking and cycling infrastructure are available and safe** **Improve access to parks and green spaces**	**Embedded future considerations** Build the resilience of the state to future outbreaks Improve access to information and resources for vulnerable communities Improve access to multi-modal and climate-friendly forms of transportation Reduce local supply-chain vulnerabilities in access to healthy food				**Long term mitigative measures** Understand community assets and agency on the nexus of health and climate risks e.g., economic coping strategies, flood response strategies preventive health practices that can support in building resilience to future ecological and health risks 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*
Create incentives for informal suppliers of fresh and healthy foods	Make it easier for people to socialise and exercise in place				need for non-urgent in-person healthcare services and to reduce disruptions in access to care in the event of future pandemics 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 handwashing 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

[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]

[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.

[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

[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.

[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

[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.

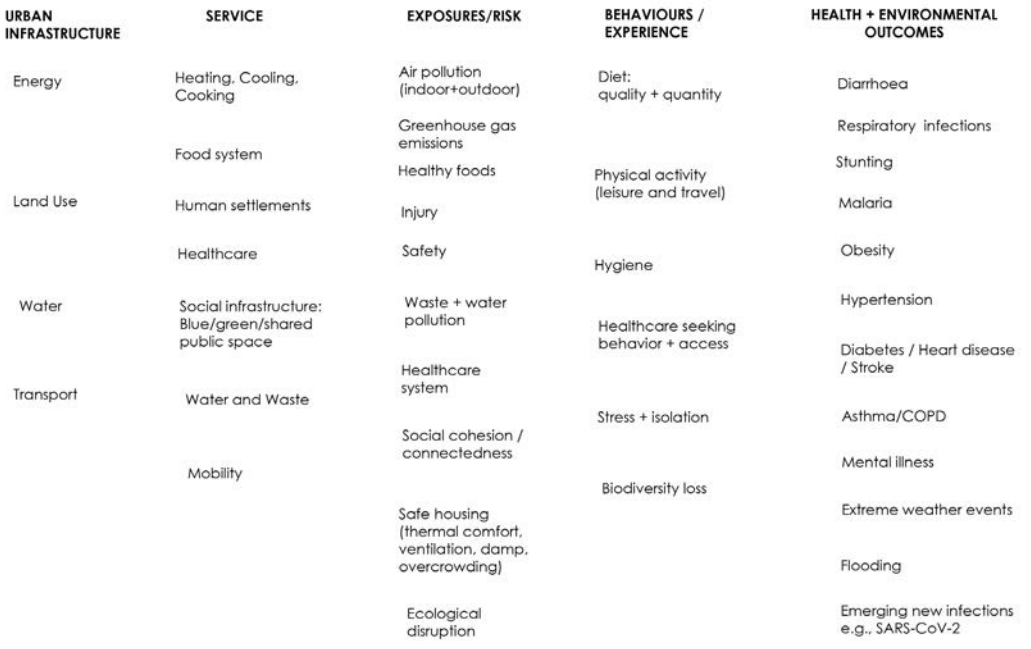

Figure 3. Primary health and climate care system: components of an integrated community-based health and climate system.

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

[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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The impact of nature-based interventions on public health: a review using pathways, mechanisms and behaviour change techniques from environmental social science and health behaviour change

Stephanie Wilkie and Nicola Davinson

Abstract: The aim of this narrative review is to explore whether nature-based interventions improved individual public health outcomes and health behaviours, using a conceptual framework that included pathways and pathway domains, mechanisms, and behaviour change techniques derived from environmental social science theory and health behaviour change models. A two-stage scoping methodology was used to identified studies published between 2000 and 2021. Peer reviewed, English-language reports of nature-based interventions with adults ($N = 9$) were included if the study met the definition of a health–behaviour change intervention and reported at least one measured physical/mental health outcome. Interventions focused on the restoring or building capacities pathway domains as part of the nature contact/experience pathway; varied health behaviour change mechanisms and techniques were present but environmental social-science-derived mechanisms to influence health outcomes were used less. Practical recommendations for future interventions include explicit statement of the targeted level of causation, as well as utilisation of both environmental social science and health behaviour change theories and varied public health outcomes to allow simultaneously testing of theoretical predictions.

Keywords: Urban greenspace, intervention, pathways, mechanisms, public health, behaviour change, wellbeing.

Notes on the authors: see end of article.

Urban nature impacts public and climate health

When effectively designed, urban nature has significant potential to contribute to public and climate health. The World Health Organization (WHO 2018a 2020) recognises the interplay between urban environments and varied public health outcomes, stating 'health and wellbeing is essential to achieving sustainable development' (WHO 2018b: 8). A key component of healthy, sustainable urban environments is that they support individuals in leading a healthy lifestyle (WHO 2020). Therefore, it is important to understand the complex interrelationships between people, their health and wellbeing, and nature.

Evidence supports a positive relationship between nature generally and health outcomes, including improved life expectancy (Gidlow *et al.* 2016, Kondo *et al.* 2018, van den Berg *et al.* 2015, van den Bosch & Ode Sang 2017, WHO 2016), blood lipids and blood pressure (Twohig-Bennett & Jones 2018), and immune functioning (WHO 2016), as well as lower physiological stress biomarkers (Hunter *et al.* 2019, Keniger *et al.* 2013, Kondo *et al.* 2018, Thompson *et al.* 2012) and weight (WHO 2016). Mental health and wellbeing outcomes associated with nature include better life satisfaction, mood, and cognition (Houlden *et al.* 2018, Kondo *et al.* 2018, McMahan & Estes 2015, Rogerson *et al.* 2016). Urban nature also provides societal benefits, including increased social cohesion and social interaction (Jennings & Bamkole 2019) and has the clear potential to improve air quality and biodiversity (Aronson *et al.* 2017). Additionally, contact with nature may promote pro-environmental behaviours beneficial to climate health (Halpenny 2010, Scannell & Gifford 2010, WHO 2016).

Due to the evidence supporting individual, societal, and climate-related benefits, calls have been made to investigate how nature-based interventions (NBIs) can improve public health and, specifically, to quantify their impact on a range of health outcomes (PHE 2014, Shanahan *et al.* 2015), defined as 'the impact that a test, treatment, policy, programme or other intervention has on a person, group or population' (NICE 2019). NBIs, whether occurring in urban nature or more wild/less managed nature, are defined as 'programmes, activities, or strategies that aim to engage people in nature-based experiences with the specific goal of achieving health and wellbeing' (Shanahan *et al.* 2019: 142). The challenge lies in designing NBIs that are able to: 1) improve public health outcomes and change individual health behaviours, 2) explain the pathways underlying any identified nature–health linkages, and 3) use theory to test the mechanisms through which pathways function. Our aim was to explore whether these three challenges were being met in published accounts of NBIs.

To achieve this aim, we present a narrative synthesis review of urban NBIs grounded in environmental social science and health behaviour change. We believe NBI design will be enhanced if health behaviour change is systematically recognised

in causal frameworks linking nature to health. This is a unique contribution of the review. First, we explore the ways in which terms of causation, such as pathways and mechanisms, are being used to link nature and health. From this, a conceptual framework consisting of pathways, mechanisms, and behaviour change techniques is presented in the next section. This conceptual framework is used to map NBI studies and generate a narrative synthesis of urban NBI impacts on health and wellbeing. In the final section, future directions and practical recommendations for NBI design based on the review findings are presented.

A conceptual framework of the pathways and mechanisms linking urban nature and health

Several authors have recently proposed frameworks to identify and organise the causal pathways and mechanisms that produce nature's effects on a range of health outcomes (for example, Bratman *et al.* 2019, Hartig *et al.* 2014, Marselle *et al.* 2021, Shanahan *et al.* 2015). In this section, these frameworks are further developed to address two perceived limitations and provide some clarification for the wider NBI discourse.

One limitation of these frameworks and the wider NBI evidence base is a lack of consensus regarding definitions of pathways and mechanisms. Many studies do not clearly define either term (Bratman *et al.* 2019, Hartig *et al.* 2014, Kruize *et al.* 2019, Markevych *et al.* 2017, Masterton *et al.* 2002, Prins *et al.* 2016, Shanahan *et al.* 2015, Silva *et al.* 2018). Others use these terms interchangeably (Husk *et al.* 2016, Kuo 2015, Lovell *et al.* 2016, Triguero-Mas *et al.* 2015). Although terminology use has not always been clear, several key similarities exist. First, there is a recognition of hierarchical structures in the causal relationship (Hedström & Ylikoski 2010). Pathways typically refer to broad, higher-order constructs (Frank 2019, Hartig 2014, Jennings & Bamkole 2019, Kruize *et al.* 2019, Kuo 2015, Lachowyz & Jones 2013, McNeill *et al.* 2006, Prins *et al.* 2016, Shanahan *et al.* 2015, Silva *et al.* 2018), and mechanism is used as the 'action' word to explain how the pathway evokes an effect (Frank *et al.* 2019, Hartig *et al.* 2014, Jennings & Bamkole 2019, Kabisch *et al.* 2017) or the mediator through which the outcome occurs (Frumpkin *et al.* 2017, Lachowyz & Jones 2013, Prins *et al.* 2016). Another limitation is a lack of clarity regarding which term has priority in the causal chain between nature and health. In one case, pathways were considered part of a mechanism (Frumpkin *et al.* 2017) but, more commonly, mechanisms were referred to as part of a pathway as the mediating influence *through which* the pathway affected the outcome of interest (Frank *et al.* 2019, Hartig *et al.* 2014, Kruize *et al.* 2019, Prins *et al.* 2016).

To some extent, these limitations mirror wider scientific debate around the 'black box' of causality (Astbury & Leeuw 2010, Gerring 2007, Hedström & Ylikosky 2010, Imai *et al.* 2011, Ross 2018, Shapiro 2017). The 'black box' typically refers to a general causal relationship between two variables (X, Y) and *whether* X impacts Y (Astbury & Leeuw 2010, Gerring 2007, Imai *et al.* 2011, Shapiro 2017). However, researchers also need to understand *how* X influences Y to fully understand this causal relationship. In the wider debate, *how* is referred to as exploring the 'white box' (or boxes) in causal relationships (Baron & Kenny 1986, Gerring 2007, Imai *et al.* 2011). In other words, it is important to understand both *whether* and *how* X creates any change in Y (Tate *et al.* 2016).

In an attempt to provide some clarification about the causal relationship between variables in NBI research, we propose that pathway (X) aligns with the 'black box' and mechanism refers to one or more 'white boxes' within the black box.[1] This distinction is consistent with the *Oxford English Dictionary* definitions of pathway and mechanism (*OED* 2021), as well as some of the biological science discourse where pathways refer to '*whether*' or '*that*' X causes a change in Y, while mechanisms explain '*how*' (Ross 2018: 15). We suggest this distinction is also consistent with the general spirit (if not execution) in the existing literature exploring the links between nature and health.

Based on this distinction and drawing on earlier work, we propose a conceptual framework of pathways and the mechanisms that underly them (see Table 1). This framework consists of two levels of pathways: superordinate pathways and subordinate pathway domains.[2] At the highest level, the nature–health link results from two superordinate pathways: *nature exposure* and *nature contact/experience* (Bratman *et al.* 2019, Hartig *et al.* 2014, Marselle *et al.* 2021). Nature exposure refers primarily to direct ecological benefits of nature, including the amount, proximity, and quality of nearby greenspace (Hartig *et al.* 2014, Lachowyz & Jones 2013, Shanahan *et al.* 2015). Nature exposure does not require an individual to be present in nature to receive benefits (for example, Shanahan *et al.* 2015). For example, local area greenspace operates in a zone around the home even though residents may not necessarily 'partake' in this greenspace (Marselles *et al.* 2021). Exposure is differentiated from nature contact or experience, because people's contact with and experience of nature vary

[1] We are not advising that NBIs should be inherently biologically focused and/or excessively *mechanistic* in their design. Instead, we borrowed this distinction from Ross (2018) to contribute to discussions amongst nature–health researchers, particularly to facilitate determining how NBIs work (or do not) and for whom.

[2] Superordinate pathways and their subordinate domains can (and likely do) operate simultaneously in urban greenspace (UGS) NBIs. For example, nature experience and restoring capacities can operate simultaneously with nature exposure and biodiversity during that experience.

Table 1. Proposed pathways, pathway domains, mechanisms, and public health outcomes of nature-based interventions.

Pathway[a]	*Pathway Domains*[b]	*Mechanisms*	*Public Health Outcomes*
	Reducing Harm[b]		Physical Health Indicators
		Air pollution mitigation	Adrenaline
	Air quality	Heat and noise abatement	Aerobic fitness
	Biodiversity	Beneficial microbiota	Blood pressure
Nature Exposure	Ecological quality	Phytoncides	Body mass index
		Sunlight	Cholesterol
			Cortisol (salivary, serum)
	Restoring Capacities[b]		Dopamine
			Heart rate/heart rate variability
	Restoration of depleted psychological capacity	Cognitive restoration[1]	Immune function
		Positive emotion[2]	Mortality
			Recommended MVPA[e] met
			Respiratory symptoms
			Vitamin D absorbtion
	Building Capacities[b]		Weight/weight loss
	Physical activity and other health behaviours	Behavioural regulation[3] (C)	Wellbeing Indicators
		Beliefs about capabilities[3] (M)	
		Beliefs about consequences[3] (M)	
		Environmental context/ resources[3] (O)	Affect/mood
Nature Contact/ Experience		Goals[3] (M)	Anxiety
		Intentions[3] (M)	Burnout
		Knowledge[3] (C)	Depression
	Social contact/ interaction	Memory, attention, decision making[3] (C)	Fatigue
		Skills[3] (C)	Health-related quality of life
		Social influence[3] (O)	Restoration
			Rumination
			Psychosomatic complaints
			Self-reported health
	Causing Harm[b]		Self-reported stress
			Social cohesion
	Air quality	Allergens	Social isolation
	Ecological quality	Harmful microbiota	
		Zoonotic or infectious disease	

Table 1. *Cont*.

[a] The order of pathways in the table is not meant to imply that one is of greater importance that the other. Pathways are the X in the link between nature and health and wellbeing.

[b]Pathway domains are considered part of a hierarchical structure, where pathways are superordinate and domains are several possible ways in which the pathway (X) can be operationlised. Pathway domains may link to one or both pathways, so do not necessarily follow on from the first column.

[c]However, the proposed mechanisms are linked to specific pathway domains based on prior evidence and/or theoretically derived processes that should produce an effect.

[d]Public health indicators may also be affected by one or more pathway, pathway domain, or mechanism. Therefore they do not directly follow on from the previous column.

[e]MVPA = moderate-to-vigorous physical activity. Adults are recommended to engage in a minimum of 150 minutes/week (WHO 2018b).

[1]Attention restoration theory (Kaplan 1995, Kaplan & Kaplan 1989).

[2]Stress reduction theory (Ulrich *et al.* 1991).

[3]Theoretical domains framework (Cane *et al.* 2012) which represents constructs from 33 theories of behaviour.

C = capability, O = opportunity, M = motivation (Cane *et al.* 2012, Michie *et al.*. 2011).

Sources: This table is based on conceptual models by Marselle *et al.* (2021), Hartig *et al.* (2014), Shanahan *et al.* (2015) and, to a lesser extent, Bratman *et al.* (2019) and was guided by a framework of causal explanation in the biological sciences proposed by Ross (2018).

within the same greenspace (Bratman *et al.* 2019). Nature experience has been referred to as the 'subjective experience of nature' (Hartig *et al.* 2014: 209) and includes both the way in which people interact with nature and the 'dose' or duration of this interaction (Bratman *et al.* 2019).

In several nature–health frameworks, nature exposure and nature contact/experience are linked, directly or indirectly, to additional factors to provide a more nuanced explanation '*whether*' nature produces changes to health and wellbeing (for example, Marselles *et al.* 2021). These pathway-related factors include air/ecological quality, biodiversity, physical activity, psychological processes, social interaction (Bratman *et al.* 2019, Hartig *et al.* 2014, Shanahan *et al.* 2015, Zhou *et al.* 2020), and immune functioning (Kruize *et al.*. 2019, Kuo 2015, Silva *et al.* 2018). These factors provide an additional level of detail within the 'black boxes' (pathways) of nature exposure and contact/experience. Unfortunately, these factors are often also referred to as pathways. Instead, the two superordinate pathways should be distinguished from these factors to avoid confusion. In our conceptual framework, we refer to the latter as four subordinate pathway domains proposed by others (Dzambov *et al.* 2020, Markevych *et al.* 2017, Marselle *et al.* 2021): *reducing harm* (air quality), *restoring capacities* (psychological processes), *building capacities* (physical activity, social interaction), and *causing harm* (exposure to allergens, disease). We suggest that pathway domain is an appropriate term because it is consistent with the definition of a domain

as 'a set of possible values of the independent variable or variables of a function' (*OED* 2021).

Mechanisms (*how*) operate within pathway domains; and multiple mechanisms can also be in action simultaneously both within and across pathway domains. In this review, direct and indirect causal pathways via possible mechanisms will not be addressed, as other authors have proposed structurally different models for this (Hartig *et al.* 2014, Lachowyz & Jones 2013, Marselle *et al.* 2021). Instead, our aim was to unpack the 'black boxes' of pathways and their domains from the 'white boxes' within, representing the possible mechanisms of each (see Table 1). This also allows theoretical explanations for different mechanisms to be incorporated into the conceptual framework, so competing or complementary theoretical predictions may be tested.

In the review presented here, the focus was on the two *capacities* pathway domains. *Restoring capacities* refers to the improvement or restoration of depleted psychologic--al processes adversely impacted from daily life and urban living. This pathway domain is linked to the nature contact/experience pathway and has foundations in two theoretical positions from environmental psychology and environmental social science. Stress reduction theory (SRT: Ulrich, 1983, Ulrich *et al.* 1991) proposes that the mechanism by which nature experience restores depleted psychological capacities is through unconscious positive emotions, evoked by nature, which generate a reduction in physiological stress responses. In attention restoration theory (ART: Kaplan, 1995, Kaplan & Kaplan, 1989), the recovery of depleted cognitive resources is the central mechanism by which nature exposure restores capacities to produce a myriad of health and wellbeing benefits.

The *building capacity* pathway domain is also linked with the nature contact/experience and focused on health-related behaviours. Physical activity is one of the most widely researched health behaviours in the context of urban and nature-based interventions (Wilkie & Davinson 2021, Wilkie *et al.* 2018). Building capacity may also encompass other health-related behaviours, such as active transportation for work/daily tasks (Lachowyz & Jones 2013) and social contact (Jennings & Bamkole 2019). The mechanisms by which these capacities are built can be viewed through health behaviour change theory (Cane *et al.* 2012), which generally aims to understand health behaviour in order to design interventions that can produce desired positive behavioural outcomes (Cane *et al.* 2012, Davis, *et al.* 2015). Our review includes mechanisms identified through the theoretical domains framework (TDF: Cane *et al.* 2012) and capability–opportunity–motivation (COM-B) system of behaviour (COM-B: Michie *et al.* 2011, 2014). Examples include individual beliefs about their capabilities and confidence to engage in health behaviours, setting goals to complete behaviours, and regulating behaviours through self-monitoring.

This approach provides a strong foundation for NBI design because there are over ninety different behaviour change techniques targeting a variety of mechanisms to elicit health behaviour change (Carey *et al.* 2019, Michie *et al.* 2013) and improve the desired health and wellbeing outcomes.

The addition of health behaviour change as part of the *building capacities* pathway domain was a unique aspect of our conceptual framework. NBIs aim to improve health, but only a few studies have explored their impact through this lens (for example, Pretty & Barton 2021). The inclusion of a health behaviour change as a pathway domain also addresses a limitation of existing frameworks, which speculate on theoretical mechanisms through which pathways/domains might operate. However, they do not consider how interventions produce the desired behaviours needed to ensure NBIs are successful (Pretty & Barton 2021). In short, there is an important aspect of NBIs that has yet to be investigated, based on many existing frameworks.[3]

Behaviour change techniques (BCTs) are the active components of a behaviour change interventions. They have been used to change health behaviours, such as promoting physical activity (Howlett *et al.* 2015) and improving diet (Cradock *et al.* 2017) and should be clearly defined, observable, and replicable (Human Behaviour Change Project 2021, Michie *et al.* 2013). BCTs are important because they are the essential components of health–behaviour interventions, defined as a 'coordinated set of activities designed to change specified behaviour patterns' (Michie *et al.* 2011: 1). One critique of existing NBIs is that many lack the necessary detail to assess whether the intervention was successful (Prestwich *et al.* 2015, Roberts *et al.* 2016). In the current review, we explored whether NBIs were utilising BCTs and, if so, whether NBI activities corresponded with intervention techniques commonly used to elicit behaviour change (Human Behaviour Change Project 2021, Michie *et al.* 2013).

A narrative synthesis of pathways, mechanisms, behaviour change techniques, and health outcomes in urban greenspace NBIs

The study selection process followed general guidance for scoping reviews (Arksey & O'Malley 2005, Colquhoun *et al.* 2014). The urban greenspace (UGS) NBIs included in this review were selected using the following inclusion criteria: 1) they had at least one measured physical or mental health public health outcome (PHE 2016, WHO 2018b), 2) they were conducted with adults, 3) the full text is available in English, 3) they are peer reviewed, 4) they were published between January 2000 and September 2021, and 5) they used the term 'intervention' in a manner consistent with health

[3] An exception was Frank *et al.* (2019), who included behaviour in their causal diagram.

behaviour change (Michie *et al.* 2011). Studies with children, mixed methods, and qualitative studies were excluded.

Nine studies were identified from Web of Science, PubMed, and Science Direct databases during the census period. Five studies (1–4, 9 in the Appendix) were identified in a scoping review of 52 studies focused on the terms, methods, and public health indicators used in NBIs (Wilkie & Davinson 2021). Although not a requirement of the initial scoping review, these five studies used 'intervention' in the required way. Building on that review, a similar search procedure was implemented in Science Direct and Web of Science (September 2019–January 2021). This involved using combinations of search terms: for example, greenspace AND intervention AND wellbeing. Identified abstracts (N = 33) were reviewed against inclusion/exclusion criteria from the prior study, as well as an additional criterion to meet the health behaviour change intervention definition. After abstract review, nine were reviewed in full-text; five were excluded because they did not use intervention as required. This resulted in four additional studies for the narrative synthesis that follows, along with the five from the prior review.

There was some challenge in developing the narrative synthesis. It was often necessary to deduce the intended pathways, pathway domains, mechanisms, and behaviour change techniques from study descriptions, despite meeting the definition specified for this review. This challenge was compounded by three studies that did not provide a clear theoretical position guiding the NBI. Therefore, in many ways, the narrative findings to follow are also a case study of whether and (if so) how the mapping approach based on our conceptual framework could be used to assess published accounts of NBIs. The Appendix provides a summary of pathways/pathway domains, mechanisms, behaviour change techniques, and public health outcomes for each included study, as well as descriptions of study samples, settings, and methods.

Results

Although the census period began in 2000, all included studies were published between 2016 and 2020. Four studies were with samples at risk or diagnosed with physical or mental health conditions (Beute & de Kort 2018, Dolling *et al.* 2017, Maund, *et al.* 2019, Plotnikoff *et al.* 2017). Most studies implemented between-subject or randomised control trial designs (Bang *et al.* 2017, Caloguiri *et al.* 2016, Dolling *et al.* 2017, Muller-Riemenschneider *et al.* 2020, Payne *et al.* 2020, Plotnikoff *et al.* 2017). The remainder were within-subject designs. NBI settings ranged from grass yards and wetlands, from parks, to managed forests and university settings near mountains; however, one study asked participants to engage with a nature setting of their choosing

(Payne *et al.* 2020). In another, participants were presented with varied images of natural scenes (Beute & de Kort 2018).

First, we explored any positive impacts of the NBIs on health, wellbeing, and individual health behaviours. Evidence-supported NBIs had a positive influence on physiological health indicators, including aerobic fitness (Plotnikoff *et al.* 2017), body composition and fitness (Bang *et al.* 2017, Plotnikoff *et al.* 2017), heart rate (Bang *et al.* 2017, Beute & de Kort 2018), blood pressure (Caloguiri, *et al.* 2016, Plotnikoff *et al.* 2017), and cortisol (Caloguiri, *et al.* 2016). Three studies reported improved health promoting behaviour or physical activity (Bang *et al.* 2017, Muller-Riemenschneider *et al.* 2020, Plotnikoff *et al.* 2017). Collectively, there was also support for improvements to perceived general health (Dolling *et al.* 2017), mood (Beute & de Kort 2018, Caloguiri, *et al.* 2016, Dolling *et al.* 2017, Maund *et al.* 2019, McEwan *et al.* 2019), perceived stress (Dolling *et al.* 2017, Maund *et al.* 2019, Payne *et al.* 2020), quality of life (McEwan *et al.* 2019) and reduced rumination (Beute & de Kort 2018), burnout, and fatigue (Dolling *et al.* 2017).

Next, the pathways underlying any identified nature–health linkages were mapped using our conceptual framework. All were focused on the *nature contact and experience* pathway. Three studies (Bang *et al.* 2017, Müeller-Riemenschneider *et al.* 2020, Plotnikoff *et al.* 2017) focused only on the *building capacities* pathway domain, while one targeted this domain and *restoring capacities* (Calogiuri *et al.* 2016). The five remaining studies focused only on the *restoring capacities* pathway domain. No studies utilised the *nature exposure* pathway or the *reducing/causing harm* pathway domains.

Another challenge was to determine whether theories and the associated mechanisms through which these pathways functioned were being reported and/or tested. Encouragingly, a range of mechanisms and behaviour change techniques aligned with health behaviour change theories were present in all the NBIs we reviewed. Across the included NBIs, mechanisms associated with *psychological* and *physical capabilities* were the most prevalent aspects of the COM-B (Michie *et al.* 2011), followed by *reflective* and *automatic motivation*, and provision of *physical* and/or *social opportunities*. Commonly used health behaviour change mechanisms present in the NBIs included knowledge, environmental contexts and resources, and memory, attention, and decision processes (TDF: Cane *et al.* 2012). In terms of BCTs implemented, self-monitoring of behaviour, consequences of behaviour, or emotional consequences of behaviour were widely used, as well as prompts or cues, biofeedback, and instruction on how to complete the behaviour (BCTTv1: Human Behaviour Change Project 2021, Michie *et al.* 2013).

Links between environmental social science theories and their possible mechanisms were less clear. Four studies referred to either or both ART (Kaplan 1995, Kaplan & Kaplan 1989) and SRT (Ulrich 1983, Ulrich *et al.* 1991) as the theoretical basis.

From study descriptions, the mechanism of positive emotion (SRT) was present in six studies (Beute & de Kort 2018, Caligiuri *et al.* 2016, Dolling *et al.* 2017, Maund *et al.* 2019, McEwan *et al.* 2019, Payne *et al* 2020). Of these, five measured perceived stress or stress biomarkers. It was not clear from task descriptions whether they also targeted positive emotion as a technique to reduce stress, also consistent with SRT. An exception was a study by McEwan and colleagues (2019) prompting participants to note one good thing about their allocated environment. The phrase 'good' suggests the intention was to invoke the positive emotion mechanism; however, no stress-related outcome was measured. Conversely, noticing one good thing could also have been a cognitive restoration mechanism (ART). In ART, depleted cognitive resources recover by focusing one's attention to nature's softly fascinating (that is, good) characteristics to allow directed attention to restored (Kaplan 1995, Kaplan & Kaplan 1989). The study appeared more closely aligned to ART than SRT based on measured outcomes, including mood, nature engagement, and nature-related identity. Three other studies likely utilised the cognitive restoration mechanism, based on the inclusion of ART in the study rationale or the general intervention description (Caloguiri *et al.* 2016, Dolling *et al.* 2017, Payne *et al.* 2020). Yet, there was no apparent targeting of cognitive restoration techniques in the study designs. Without stated links between theoretically derived mechanisms and clearly described NBI techniques, testing the pathway between nature and health-related outcomes is limited; nor can the mechanisms be assessed for their relative contributions to any impact nature may have on public health.

However, two interventions were considered examples of best practice both in NBI design and reporting due to the clear use of health behaviour change theory. The first was a group forest walking NBI targeting the *building capacity* pathway domain through physical activity and using the information–motivation–behavioral skills model (IMB: Fisher *et al.* 1994, as cited in Bang *et al.* 2017). It was clear which IMB mechanisms were targeted. As a result, TDF mechanisms (Cane *et al.* 2012) and BCTs from the BCTTv1 (Michie *et al.* 2013) could be mapped. Similarly, a randomised control trial NBI (Plotnikoff *et al.* 2017) used two health behaviour theories and the Health Action Process Approach behaviour change model (Schwarzer & Luszcynksa 2015, as cited in Plotnikoff *et al.* 2017) which allowed straightforward mapping to BCTs. This study also had a published protocol providing more extensive intervention design details and was considered another example of best practice (Jansson *et al.* 2019).

Finally, there were some additional findings of relevance to wider climate health. In one NBI, park use improved (Müller-Riemenshneider *et al.* 2020). Park use is considered a way to improve an individual's attitudes towards nature. This was also evidenced in another NBI, where nature relatedness increased (McEwan *et al.* 2019). Nature relatedness and connectedness are constructs referring to an individual's desire

to be in nature and feelings of attachment/belonging to nature (Tam 2013). These concepts are linked with higher levels of pro-environmental behaviours (Mackay & Schmitt 2019, Martin *et al.* 2020, Whitburn *et al.* 2018).

Future directions and recommendations for urban nature-based interventions

The aim of this narrative review was to explore whether nature-based interventions improved individual public health outcomes and health behaviours. Prior work influential to our endeavour bridged environmental social science, environmental science, and public health (for example, Bratman *et al.* 2019, Hartig *et al.* 2014, Marselle *et al.* 2021, Shanahan *et al.* 2015); but the concepts and frameworks used to explore causal pathways between nature and health first needed to be disentangled. In this regard, one unintended (and hopefully beneficial) contribution of this review was the use of literature on causal pathways in the biological and social sciences to better understand the link between nature and health. Guided by Ross (2018), we proposed clear distinctions between pathways as the higher-order, superordinate causal variables (X), their subordinate pathway domains linked to theory, and the mechanisms by which both operate to influence a specific outcome (Y).

A conceptual framework consisting of two pathways linking nature and public health was proposed: *nature exposure* and *nature contact/experience*. Consistent with Marselle and colleagues (2021), we suggested these pathways had four pathway domains: *reducing harm, causing harm*, *restoring capacities*, and *building capacities*. As such, our framework was a reconceptualisation of prior frameworks that used the terms pathways, domains, and mechanisms in different ways or, in some cases, interchangeably.

Although numerous NBIs exist, very few explicitly drew on health behaviour research. We synthesised the findings of nine NBIs targeting measured public health outcomes. Specifically, we found these NBIs focused only on the *nature contact/exposure* pathway and the *building* and/or *restoring capacities* pathway domains. Pathway domains were aligned to mechanisms derived from environmental social science and health behaviour theories and behaviour change techniques widely used in health behaviour change interventions. In that regard, as a case study of the application of the proposed conceptual framework for NBI evaluation, the narrative synthesis was broadly successful.

Physiological health benefits were almost exclusively through the *building capacities* pathway domain. Positive subjective wellbeing outcomes were mostly a consequence of the *restoring capacities* pathway domain. This division between pathway domains of public health outcomes was not wholly unexpected and, in some cases, theoretically based. Building capacities through physical activity and other health behaviours more

naturally align with physiological public health indicators, while subjective wellbeing outcomes align with restoring capabilities. Yet, it also suggests an opportunity to improve urban NBI design and evaluation with the inclusion of indicators from other pathway domains. This could provide a better understanding of how pathways and pathway domains work independently, as well as synergistically.

It was encouraging to find several instances where health behaviour change theories, as well as mechanisms and behaviour change techniques from the COM-B (Michie *et al.* 2011), TDF (Cane *et al.* 2012), and BCTTv1 (Michie *et al.* 2013) were present in existing NBIs. Our synthesis also indicated that urban greenspace NBIs can positively impact some key physical health and wellbeing outcomes utilised as national and international public health indicators.

However, the fundamental aim of conducting this review was to provide recommendations for future NBI design to improve their potential to positively impact public health. Perhaps unsurprisingly, the first recommendation is that researchers should be explicit about which level(s) of causation they are targeting. Is the focus on the 'black box' (that is, *whether*) and a specific pathway or pathway domain? Or is it on the 'white box(es)' and *how* any effects occur by investigating the mechanisms?

This clarity also facilitates another recommendation: for researchers to use concepts and terminology consistently. We readily acknowledge the complexity of this task given that different disciplines contribute to NBI design, use, and evaluation. However, *within projects*, it is important to be clear in the terms used; this was often not the case in the included studies. As a caveat to these recommendations, we are not suggesting that NBIs become overly mechanistic or biology based. NBIs exist in a complex interplay between person, place, community, and wider societal influences (Barton & Grant 2006, Sallis *et al.* 2006); but NBIs typically operate at the individual level and could benefit from the application of pathways and mechanisms that correspond with biological principles of causal inquiry.

One challenge we experienced in our review was the lack of essential detail in some NBIs, a criticism also common to health behaviour change interventions. Concerns have been raised about the importance of identifying links between theories, pathways, and outcomes to better understand the efficacy of interventions (Prestwich *et al.* 2014). In Prestwich and colleagues' (2014) meta-analysis, only half of 190 exercise and diet interventions utilised at least one specified theory. More concerning, only 10 per cent of those linked intervention techniques to theory. Of the nine studies included in our review, one could be considered best practice because it addressed many of these concerns (Plotnikoff *et al.* 2017). Its strengths included clear use of health behaviour change theory to inform NBI design and detailed intervention descriptions in both a published protocol and the reporting of study findings. A limitation was that it focused only on physical health outcomes. We believe, with minimal burden to participants, there was an opportunity to capture data related to the *nature exposure* pathway and

the *reduction/causation of harm* pathway domains through air quality, allergens, or exposure to different microbiota.

The omission of the *nature exposure* pathway and *reducing or causing harm* pathway domains in the included studies indicates there may be some disconnect between environmental scientists, who focus on these pathways and domains, and researchers in environmental/other social sciences who are more likely to investigate the pathway and domains aligned to their disciplinary interest. Yet to fully understand their public and climate health impact, it is important to evaluate NBIs using complementary data across all pathways and pathway domains. This will ensure that the full health impacts of interventions designed to improve public health are captured, as well as also determine whether NBIs may inadvertently and simultaneously cause harm through exposure.

Across studies, it was also evident that NBIs were proposing pathway domains and mechanisms aligned with environmental social science theory; but interventions were not utilising techniques to invoke those mechanisms. Therefore, another recommendation, albeit a challenging one, is to consider how NBIs can potentially provide evidence to allow different pathways and mechanism to be tested simultaneously. Better NBI design, particularly in urban contexts, has the clear potential to make a positive contribution to public health. These interventions may also foster a change in positive environmental attitudes through the *nature contact/experience* pathway: for example, through mechanisms of nature connectedness or nature-related identity that are linked to pro-environmental behaviours. In that sense, improving urban greenspace NBIs provides an opportunity to improve both public and environmental health simultaneously.

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Appendix. Summary of study urban greenspace nature-based interventions mapped to pathways, pathway domains, mechanisms, and behaviour change techniques.

Sample	*Urban Greenspace*	*Theoretical Description*	*Intervention Framework*	*Pathway Description*	*Pathway Domain*	*Mechanism*	*Target Behaviour*	*BCT*	*Health & Wellbeing Outcomes*
1. Bang, Lee, Kim, Lim, Joh, Park & Song (2017), ***International Journal of Environmental Research and Public Health***									
N = 99 University students Mean age 24.3 47.5% male	University campus near mountain range, tree cover, forest roads and trails	Information–motivation–behavioral skills	**Between subjects design.** **Intervention group**: Group forest walking program 1 × weekly for 6 weeks during lunch Stress management lectures, mental & physical health leaflets including forest therapy effects, correct walking method, self-efficacy for walking, stress & depression management Text message prompt during week Provided activity tracker **Control group:** Daily routine; not provided leaflets, lecture, or activity tracker	Nature contact & experience	**Building capacities** Physical activity/ other health behaviours	Behavioural regulation; Beliefs about capabilities Beliefs about consequences Knowledge Memory, attention & decision- making processes Skills	Physical activity	Biofeedback Self-monitoring of behaviour Instruction on how to perform behaviour Information about health consequences Prompts/cues Reduce negative emotions	Bone density Blood cholesterol Blood Pressure (BP) Body Mass Index (BMI) Body composition + Depression + Health promoting behaviour + Heart rate variability (HRV) + Physical Activity (PA) Total metabolic equivalent of tasks (MET)

Appendix. *Cont.*

Sample	*Urban Greenspace*	*Theoretical Description*	*Intervention Framework*	*Pathway Description*	*Pathway Domain*	*Mechanism*	*Target Behaviour*	*BCT*	*Health & Wellbeing Outcomes*
2. Beute & de Kort (2018), ***Apllied Psychology: Health and Well-Being***									
N = 15 students; Mean age 21.6 80% female High level of depression, anxiety and/or stress levels	Images of varied local urban or natural scenes in southern regions of Netherlands	None listed	**Cross-over design** Viewed images on tablet at home 2 × daily (AM, PM) Prompted 6 consecutive days/4 × daily to complete outcome measures Four weeks after the 1st 1-week intervention, repeated participation in other conditions	Nature contact & experience	**Restoring capacities** Psychological	Positive emotion (stress) Memory, attention & decision processes	Reduce negative thinking & rumination	Monitoring of emotional consequences Prompts/cues	Depression Mood + HR + Mental wellbeing; Psychosomatic complaints Perceived stress Rumination + Stress level and worry
3. Caloguiri, Evensen, Weydahl, Andersson, Patil, Ihlebaelk, & Raanaas (2016), ***Work***									
N = 14 Mean age 49 50% female Healthy employees inactive to moderately active	**Outdoor:** forest area and grass-yard **Indoor:** gymnasium with no nature	ART SRT	**Randomised control trial** Baseline measures taken at an informa-tion meeting (day 1) 2.5-hour exercise session (day 2 & 3) spaced over 2 weeks *Cycling:* Instruction on workout intensity and	Nature contact & experience	**Restoring capacities** Psychological **Building capacity** Physical activity	Cognitive restoration Positive emotion Behavioural regulation Belief about capabilities Emotion Environmental context & resources Knowledge Skills	Green exercise	Biofeedback Demonstration of the behaviour Instruction on how to perform a behaviour Monitoring of emotional consequences Restructuring the physical environment Self-monitoring of outcome(s) of behaviour	Affect (mood) + Environment perceived restoration potential (EPRS) + Blood pressure (diastolic +) Cortisol (salivary awakening +; serum)

			monitored during activity *Strength training:* 8 exercises Led by experienced instructors Heart rate monitor belt provided						

4. Dolling, Nilsson & Lundell (2017), ***Urban Forestry and Urban Greening***

N = 46 Mean age 48 69% female Individuals with high stress levels	**Outdoor:** Forest environment in northern Sweden **Indoor:** Basement room in a town in Sweden	None listed	**Between-subject design** Randomly assigned to forest or handicraft condition Group participation, 2 hours × twice weekly over 3 months Instructed to engage in a range of activities in the setting Group leader was either a qualified forest ranger or occupational therapist Small meal, activities, group discussion Wearable tracker for sleep monitoring	Nature contact & experience	**Restoring capacities** Psychological	Cognitive restoration Positive emotion (stress) Behavioural regulation Beliefs about capabilities Emotion Knowledge	Relaxation Restoration	Biofeedback Demonstration of the behaviour Instruction on how to perform a behaviour Monitoring of emotional consequences Self-monitoring of outcome(s) of behaviour	Burnout + EPRS Fatigue + Mood + Perceived general health + Physical functioning + Stress + Sleep pattern Social functioning + (Note: + effect in both conditions)

Appendix. *Cont.*

Sample	*Urban Greenspace*	*Theoretical Description*	*Intervention Framework*	*Pathway Description*	*Pathway Domain*	*Mechanism*	*Target Behaviour*	*BCT*	*Health & Wellbeing Outcomes*
5. Maund, Irvine, Reeves, Strong, Cromie, Dallimer & Davies (2019), ***International Journal of Environmental Research and Public Health***									
N =16 Most between 30 and 64 50% male Registered with community wellbeing service & diagnosed with anxiety/ depression	Wetlands Trust site in UK nearby to participants	ART	**Pre-post intervention design** 1 × weekly trip to wetland Structured group activities guided by wetland & mental health professionals Each week the activity included some physical activity, introduction to the task, assisted task completion	Nature contact & experience	**Restoring capacities** Psychological	Positive emotion (stress) Behavioural regulation Environmental context & resources Knowledge	Nature engagement	Instruction on how to perform a behaviour Restructuring the physical environment Self-monitoring of outcome(s) of behaviour	Affect (mood) + Generalised anxiety disorder symptoms + Mental wellbeing + Perceived stress +
6. McEwan, Richarson, Sheffield, Ferguson & Brindley (2019), ***International Journal of Environmental Research and Public Health***									
N = 164 (all three timepoints) Mean age 27–30 42–44% male General public but most with mental health conditions	Urban green and built spaces in Sheffield UK	ART SRT 3 Good Things	**Repeated measures time-series design** Randomly allocated to green space or built space condition (70% to greenspace) GPS recorded location initiates prompt to 'enter one good thing	Nature contact & experience	**Restoring capacities** Psychological	Behavioural regulation Cognitive restoration Environmental context & resources Memory, attention & decision processes Positive emotion (stress)	Nature connectedness	Prompt/cues Monitoring of emotional consequences Self-monitoring of outcome(s) of behaviour	Positive affect + Nature engagement Nature identity + Nature relatedness + Quality of life + (Note: + effect in both conditions)

			they noticed' for greenspace condition Built space condition prompted at random during the day Study ran for 7 days Promoted as a social prescription						

7. Muller-Riemenschneider, Petrunoff, Yao, Ng, Sia, Ramiah, Wong, Han, Tai & Uijtdewilligen (2020), ***International Journal of Behavioral Nutrition and Physical Activity***

N = 126 Mean age 51 9% female Recruited through hospital health screening programme	Varied urban parks in/ surrounding Singapore	None listed	**Two-arm, parallel group randomised control trial** **Park prescrip-tion condition:** In-person information session on physical activity & importance of meeting minimum recommended amount Completed a park prescrip-tion sheet with trained counsellor & committed to a goal (frequency, intensity, time, location) Materials to plan weekly	Nature contact & experience	**Building Capacities** Physical activity Other health behaviour	Behavioural regulation Goals Environmental context & resources Knowledge Memory attention & decision processes Social influence	MVPA Other health behaviours	Action planning Behavioural contract Discrepancy between current behaviour & goal Feedback on behaviour Goal setting (behaviour) Information about health consequences Review behaviour goal(s) Prompts/ cues Self-monitoring of behaviour Self-monitoring of outcome(s) of behaviour Social support (unspecified)	Blood pressure BMI Glucose Height Lipoprotein Mental wellbeing MVPA Park use + Physical activity in park + Sedentary time Self-reported physical activity Triglycerides Weight

Appendix. *Cont.*

Sample	*Urban Greenspace*	*Theoretical Description*	*Intervention Framework*	*Pathway Description*	*Pathway Domain*	*Mechanism*	*Target Behaviour*	*BCT*	*Health & Wellbeing Outcomes*
			physical activity Information brochures about parks Mid-intervention phone call to assess goal progress/ modification & invitation to group outdoor physical activity sessions Text prompt before sessions **Control group:** Daily routine followed Information brochures about physical activity, brochures provided to intervention condition, invitation to group activity sessions after study completed Accelerometery used to measure activity over 7 days						

8. Payne, Loi & Thorsteinsson (2020), ***Journal of Environmental and Public Health***

N = 200 Mean age 31 78–85% female University students	ART SRT	**Between-subjects design** **Intervention group:** Read vignette about a girl who achieved benefits from engaging with nature Intended to provide information and motivation Instructions to spend 20 min. weekly × 3 weeks between 7 AM and 4 PM in chosen green/ nature setting, encouraged to create a personal reminder (e.g., note or e-alert) Complete alone, take in surrounds, no physical activity during 20 min. **Control group**: Put on a 'waitlist' to be contacted in 3 weeks In 3 weeks, contacted with link to post-study questionnaire	Nature contact & experience	**Restoring capacities** Psychological	Cognitive restoration Positive emotion (stress) Behavioural regulation Beliefs about consequence Goals Knowledge Memory, attention & decision processes Social influence	Increase time spent in nature	Action planning Information about health consequence Goal setting Prompt/cues Social comparison	Burnout Perceived stress + Life satisfaction

Appendix. *Cont.*

Sample	*Urban Greenspace*	*Theoretical Description*	*Intervention Framework*	*Pathway Description*	*Pathway Domain*	*Mechanism*	*Target Behaviour*	*BCT*	*Health & Wellbeing Outcomes*
9. Plotnikoff, Wilczynska, Cohen, Smith & Lubans (2017), ***Preventive Medicine***									
N = 84 Mean age 48 70% female At risk or diagnosed with T2 diabetes Obese or overweight = 64%.	Outdoor park setting not described	Social cognitive theory Cognitive behavior theory Health action approach model	**Randomised control trial:** Randomly assigned to waitlist control group or eCoFit intervention group **Intervention phase 1:** Group sessions (30 min. mentoring + 60 minutes outdoor training) Mentoring included strategies to overcome barriers, goal setting, motivational styles, time management, action planning, problem solving Outdoor training included instruction, modelling, learning proper techniques Social support from group	Nature contact & experience	**Building capacities** Physical activity Other health behaviour	Beliefs about capabilities Emotion Goals Knowledge Memory, attention & decision processes Optimism Environmental context & resources Skills Social influences	Improve physical activity and fitness	**Phase 1:** Action planning Biofeedback Body changes Demonstration of behaviour Feedback on behaviour Goal setting (outcome) Instruction on how to perform behaviour Problem solving Restructuring physical environment Self-talk Self-monitoring of behaviour Self-monitoring of outcome(s) of behaviour Social support (unspecified) **Phase 2:** Action planning Demonstration of behaviour Generalisation of target behaviour	Aerobic fitness + BPlood pressure (systolic +) BMI Lower body fitness + Physical activity + Waist circumference + Weight

	Intervention phase 2: eCoFit smartphone app App included outdoor workout circuits, instructions on use (visual), challenges, goal setting, self-monitoring, social media link	Goal setting; Prompts/cues Self-monitoring of behaviour Self-monitoring of outcome(s) of behaviour

ART = attention restoration theory
BCT = behaviour change technique
BMI = body mass index
MVPA = moderate-to-vigorous physical activity
SRT = stress reduction theory
+ indicates that the intervention had a significant, positive impact on that outcome.

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Introducing the Multi-Dimensional Injustice Framework: a case study in climate-related health risks

Morten Fibieger Byskov, Keith Hyams and Oyinlola Oyebode

Abstract: Recent years have seen a shift in focus from research that asks how adaptation to climate change can be achieved, to research that asks how *fair and equitable* adaptation to climate change can be achieved, reflecting a broader turn in the climate literature towards pathways for *just transitions* in the face of the climate crisis. This paper introduces the Multi-Dimensional Injustice Framework (MDIF) as a normative framework for understanding, articulating, and tackling issues of justice and fairness in complex development challenges such as climate adaptation. The MDIF provides a set of indicators to identify distributive and procedural injustices that can be utilised within development and adaptation policy and planning. The paper further demonstrates how the MDIF can be applied in practice using a case study of climate-related health risks in the informal settlements of Lusaka, Zambia.

Keywords: Climate adaptation, equity, fairness, just transitions, climate justice, health risks, informal settlements, multi-dimensional injustice.

Notes on the authors: see end of article.

Recent years have seen a shift in focus from research that asks how adaptation to climate change can be achieved, to research that asks how *fair and equitable* adaptation to climate change can be achieved. This reflects a broader turn in the climate literature towards pathways for *just transitions* in the face of the climate crisis. Such an agenda requires not only empirical research, but also engagement with philosophical theories of justice (Byskov *et al.* 2019). What, for example, are people owed as a matter of justice, such that adaptation can be said to be fair? And how do structural inequalities affect what people are owed as a matter of justice in adaptation?

In this article, we introduce the Multi-Dimensional Injustice Framework (MDIF). The MDIF provides a normative framework for understanding, articulating, and tackling issues of justice and fairness in complex development challenges, such as, in particular, in regards to climate impacts and climate adaptation. The MDIF holds (i) that the ethical challenges posed by many development issues are multi-dimensional in nature, in the sense that they cannot be reduced to a single primary indicator; (ii) that these dimensions are best conceptualised using the language of (in)justice; and (iii) that resolving development challenges requires recognising and addressing the underlying issues of injustice and inequality. Consequently, the MDIF introduces a set of indicators to identify distributive and procedural injustices that can be utilised within development and adaptation policy and planning. We show how the MDIF can be applied in practice using a case study of climate-related health risks in the informal settlements of Lusaka, Zambia.

The article is structured as follows. In the first section, we briefly discuss the need for a structured framework to capture (in)justice issues in adaptation and evaluate the existing literature in that regard. In the second section, we introduce the MDIF and its three propositions. We further detail how the MDIF can help categorise and identify injustices through a set of distributive and procedural injustice indicators. In the third section, we explore climate-related health risks in the informal settlements of Lusaka, Zambia, through the lens of the MDIF.

1 A framework for (in)justice in adaptation?

Climate change will negatively impact the lives, livelihoods, and wellbeing of individuals and communities around the world. In many cases, especially in low- and middle-income countries, changes to the local environment due to the negative effects of climate change are already being experienced by the most vulnerable and climate-exposed communities. Moreover, research has shown that climate vulnerabilities and adaptive capacities can vary greatly depending on a number of factors (Carmin *et al.* 2015, Downing *et al.* 2005, Harlan *et al.* 2015, IPCC 2014, chapter 13,

R.E. Kasperson & Kasperson 2005, J.X. Kasperson *et al.* 2005), such as gender (Andrijevic *et al.* 2020, Demetriades & Esplen 2008, Denton 2002, Edvardsson Björnberg & Hansson 2013), physical and mental health (Ford 2012, Ford *et al.* 2014, Paavola 2017), race and ethnicity (Ford *et al.* 2016, Johnson *et al.* 2021, Loughran & Elliott 2021, Phadke *et al.* 2015, Whyte 2013a), and socio-economic and legal status (Eriksen & O'Brien 2007, Hallegatte *et al.* 2018, Harrold *et al.* 2002). Given these inequalities in terms of adaptive capacities and adaptive outcomes, it is necessary to examine how fair and equitable adaptation can be ensured, including what obstacles stand in the way. This requires engagement with normative theoretical discussions about what people are owed as a matter of justice in adaptation and how structural inequalities affect their adaptive capacities (Adger 2006, Byskov *et al.* 2021). Consequently, we aim to present a clear and comprehensive framework for understanding how the different forms of injustice interact to exacerbate climate vulnerabilities, compromise adaptive capacities, and undermine adaptation efforts.

Justice issues in climate adaptation have received increased attention in recent years. Researchers have highlighted the need to address inequalities and injustices both in terms of the distribution of resources and capabilities (Edwards *et al.* 2016, Holland 2017, Hughes 2013, Schlosberg 2012, Schlosberg *et al.* 2017) as well as in terms of the inclusion (Schlosberg *et al.* 2017, Yang *et al.* 2021), participation (Shi *et al.* 2016), and recognition (Anguelovski *et al.* 2016, Chu & Kavya 2019, Massarella *et al.* 2020) of vulnerable communities in climate adaptation planning. This literature makes a valuable contribution to highlighting specific justice issues within adaptation. It is important, however, also to capture the multi-dimensional nature of justice in adaptation and the interconnectedness that exists between different forms and dimensions of (in)justice.

A nascent literature acknowledges that maladaptation is underpinned by *multiple* forms of injustice. For example, Schlosberg (2012) argues that we need an account of how misrecognition leads to maldistribution and how people are able to convert a given set of resources into capabilities. Byskov *et al.* (2021) also highlight six justice issues that adaptation and resilience planning must take into account, including its distributive (the just distribution of resources and responsibilities), compensatory (for example, remedying unjustified losses by restoring people to their positions *ex ante*), and procedural concerns (equitable representation and effective participation in decision-making). Malloy and Ashcraft (2020) argue that just adaptation planning requires inclusion of vulnerable populations, recognition of systematic injustices, and a focus on incremental evaluations of implementation.

Building on these approaches, the MDIF aims to provide a framework that not only acknowledges the different aspects of justice but also shows how they reinforce each other and how they should be categorised in practice. As such, our focus is not

so much on providing a method for analysing differences in adaptative capacities and outcomes (Coggins *et al.* 2021, Harlan *et al.* 2015, Shi *et al.* 2016, Ziervogel *et al.* 2017), but on building on, and extending, existing literature on this topic in two novel ways.

First of all, it brings the disparate literature together to provide an overarching framework that not only expands on the existing multidimensional justice in adaptation theories, but also shows how these distinct injustices connect to and reinforce each other. For example, the framework considers lack of recognition as a distinct injustice from a lack of opportunity for participation within development planning in order to highlight the fact that it is possible to create pathways for participation in development planning, yet fail to give sufficient recognition to relevant stakeholders, such as climate-vulnerable communities. By making this distinction, the framework can help show how the full inclusion of vulnerable groups requires not only pathways for participation but also recognition of their values, reasons, and knowledge. Although we will not be able to explore each connection across dimensions in detail, similar connections between distinct dimensions of justice exist between, for example, resources and capabilities; representation and recognition; resources/goods and participation; capabilities and participation; and recognition and goods/resources. Using the language of justice can help illuminate how different forms of (in)justice can undermine and/or reinforce each other.

Second, as we further argue in the next section, the reference to justice provides a *normative* basis that goes beyond the merely descriptive analysis of inequality in adaptation. From a normative philosophical perspective, inequality is not necessarily unjust. For example, inequalities in the recognition of people's knowledge are not necessarily unjust: we routinely recognise the knowledge of experts as better informed in a particular area than the knowledge of non-experts. However, mis- and under-recognition of knowledge *can* be unjust, such as in the case of Indigenous knowledge, which is often unfairly dismissed, in favour of 'Western' scientific knowledge, despite it carrying insights into local socio-economic and environmental aspects that are important for the successful implementation of development plans (Byskov 2020, Ludwig & Poliseli 2018, Whyte 2013b). The language of justice—in this case epistemic injustice—specifically refers to inequality that is unfair and why that makes it unjust, something that cannot be achieved by appealing to related concepts, such as inequality.

2 The Multi-Dimensional Injustice Framework

The MDIF is a normative framework that offers a structured way of thinking about justice issues in climate impacts and adaptation, as well as development policy and practice more broadly. The MDIF holds three propositions.

First, it notes that most development challenges, including climate adaptation, are multi-dimensional in nature in the sense that they engage several different factors, which interact with each other. For example, health risks in urban slums are the result of an interaction between socio-economic factors, healthcare provision, individual health choices, and climate-related factors including droughts and rainfall. The MDIF offers a way to conceptualise such challenges as interlinkages across analytically distinct dimensions.[1]

The second proposition is that normative aspects of the interlinkages across dimensions can be conceptualised using the language of (in)justice. Such language provides a way to describe the fundamental wrongs and harms that lie at the root of most development challenges. For example, the issue of climate-related health risks in urban slums is underpinned by socio-economic factors that are not directly health- or climate-related, and which cannot be adequately captured without highlighting their normative dimensions. The MDIF provides a language to describe the ways in which such factors constitute interacting injustices by virtue of being arbitrary and unjustified, and by virtue of their unequally and unfairly exposing some populations to greater health risks than others.

Third, the MDIF holds that resolving development challenges requires recognition of, and policy that aims to address, the underlying issues of injustice and inequality highlighted by the framework. Development solutions that do not address the underlying injustices will fail to address the root of the problem and are thus likely to reproduce existing injustices and create new injustices further downstream. Consider, for example, how Indigenous peoples are often socio-economically disadvantaged (a distributive injustice) and politically marginalised (a procedural injustice) within a given society. As Satyal *et al.* (2021) show, this has frequently led to a lack of consultation of Indigenous peoples—in this case, the Batwa people of Uganda—in national climate planning, resulting in adaptation policies that have further disadvantaged and marginalised the Batwa people within society.

[1] Within philosophy, the term 'analytically distinct' is used to refer to two (or more) concepts that can be *theoretically* distinguished at least, although not often in practice. For example, social justice and economic justice are theoretically (that is, analytically) distinct from each other as they concern two different aspects of justice, yet in practice achieving social justice will often depend on achieving economic justice and vice versa.

The MDIF divides injustice into two main categories, namely distributive and procedural indicators of injustice, each of which is separated into sub-indicators. In the following, we explain each of these main and sub-categories of injustice indicators in more detail. An overview of the MDIF can be found in Table 1.

Table 1. An overview of the multi-dimensional injustice framework. Adapted from Satyal *et al.* (2020).

Indicator	*Description*	*Possible issues*
Distributive justice indicators		
Goods and resources	To what extent are goods and resources required to live a minimally decent life, such as adequate housing, landownership, health care, and education, distributed in a fair and equal manner?	Basic needs for human development and functioning (food, clothing, shelter, access to education and health) are lacking. Distribution is affected by discrimination.
Capabilities	To what extent is the substantive opportunity to achieve certain doings and beings, such as the rights to food and development, distributed in a fair and equal manner?	Personal, socio-economic, and/or environmental factors affect the extent to which someone can convert a good, resource, or right into substantive opportunities.
Procedural justice indicators		
Recognition	To what extent are the knowledge, interests, and needs of communities recognised within policy and planning processes?	Knowledges and interests are treated differently based on prejudices about race, gender, social status, etc.
Representation	To what extent are local communities (substantively) represented within the policy and planning process: for example, through interest organisations?	Elected or chosen representatives do not have the best interest of communities at heart. Social marginalisation leads to under-representation within public and political discourse.
Participation	To what extent do local communities participate in and have the opportunity to participate in policy and planning processes?	There are limited opportunities for and possible restrictions on participation in decision-making.

2.1 Distributive injustice indicators

Distributive injustice concerns whether everyone is given their fair share of the overall distribution, according to what they are owed as a matter of justice (Lamont & Favor 2017). If someone receives less (or more) than what they are owed, this is a distributive injustice. Note, this does not necessarily imply that a distribution gives everyone an *equal* share. Who gets how much depends on the theory of justice that we adopt. Rawls (1999, 2001), for example, allows that inequalities are justifiable when they benefit the worst off. Dworkin (2002) and other luck egalitarians claim that inequalities due to differential choices are sometimes permissible. Prioritarians (Parfit 1997) argue that the focus should not be on equality per se, but on prioritising improvements to the worst off over (comparably large) improvements to the better off. Sufficientarians, such as Frankfurt (2000), hold that what matters is just ensuring that everyone has *enough*.

According to the MDIF, distributive injustices can usefully be divided into those that concern the distribution of goods and resources, and those that concern the distribution of capabilities.[2]

The *goods and resources* injustice indicator is concerned with whether the distribution of goods and resources is fair (Dworkin 1981). Resources here denote more tangible things that can be (re)distributed, such as land, building materials, and money, while goods denote more intangible things, such as services, certain types of legal rights, and the environment. Consider, for example, how many informal settlement communities use communal water taps that often run dry during seasons of drought, limiting the supply of water than can be shared. If everyone is owed water as a matter of justice, it is necessary to consider how the limited supply of water can be distributed such that everyone receive their fair share.

An unjust distribution of goods and resources can have a major impact on people's lives. Those who receive more than that which they are owed gain an unfair advantage over people who have less than what they are owed. For example, an unfair distribution of property rights means that communities lacking such rights have

[2] It might be argued that a third distributive category should be concerned with the distribution of harm. It is important to take into consideration within climate adaptation planning who will suffer the negative effects of climate change and to what extent the risk of harm from climate change is fairly distributed. While this is certainly true and a relevant normative concern, we have decided not to include the distribution of harm as an indicator because the distribution of harm is a direct function of the two other kinds of distribution, namely of goods and resources, and capabilities and functionings. Climate vulnerabilities and adaptive capacities—and thus the extent to which someone is exposed to risks of harm from climate change—are highly determined by the goods, resources, and capabilities that one has, and the unequal distribution of these directly leads to the unequal distribution of harm.

diminished opportunities to invest in resilient housing and infrastructures as a way of adapting to climate risk.

The second dimension of distributive justice looks beyond what goods and resources people have, to what they are able to do with these goods and resources. This is what is denoted by the terms of *capabilities* and *functionings*. Capabilities are the real, or substantive, opportunities that people have: for example, to be educated, to have a job and income, to be well nourished and well sheltered, and to be healthy and secure. Relatedly, functionings are capabilities that have been realised (Robeyns & Byskov 2020). The extent to which people are able to convert goods and resources into such substantive opportunities differs between people.

The distribution of goods and resources can be seen as being concerned with what people have at their disposal as they navigate their daily lives, while capabilities and functionings can be conceived of as the outcome for their lives of using those goods and resources (Robeyns 2017: 83). A discrepancy between the input and the output—for example, where someone is given their fair share of goods and resources yet is unable to convert them into capabilities and functionings—can be an indicator of structural injustices that keep some people from achieving their fair share of capabilities and functionings.

2.2 Procedural injustice indicators

One of the ways in which structural injustices are created and perpetuated within policy is due to the lack of consideration of how different policies affect different people, as well as the extent to which their claims are recognised as valid within the decision-making process. As Fraser (1996, 2007, Fraser & Honneth 2003) has argued, (in)justice cannot be reduced to a concern with fair redistribution. What Fraser here highlights is that the procedure by which policies are developed can itself be unjust, independently of any distributive injustice arising from the policy. The procedure may be unjust, for example, because the claims of certain groups are not recognised as equally valid, or their interests are not adequately or fairly represented.[3]

The MDIF divides procedural injustice into three indicators: *recognition*, *representation*, and *participation*. The first, *recognition*, concerns the extent to which the knowledges, interests, and needs of communities are recognised. Recognition serves both a democratic and an epistemic purpose within procedural justice, and misrecognition can, accordingly, lead to both democratic and epistemic forms of injustice. In the first case, the equal recognition of other people's claims is a fundamental

[3] This influence also goes the other way: socio-economic inequality is also a determinant of political influence (Christiano 2010).

principle of democracy (Fraser & Honneth 2003). As Fraser (Fraser & Honneth 2003, chapter 1) argues, unless everyone recognises each other as equals—for example, if I do not think that your claim to receive a share of some resource or good is equally valid to my claim to that good or resource—then a fair procedure (and, in many cases, a fair distribution) is unlikely to be achieved. In the second case, the recognition of knowledges and experiences can provide a better and more in-depth view of how different policies impact different people, including the structural constraints that influence the extent to which someone can achieve the same capabilities and functionings with the same goods and resources. Yet, knowledges and experiences are often treated differently based on prejudices about race, gender, social status, and so on. This leads to instances of epistemic injustice (Fricker 2007), in which the knowledges and experiences of those who are subject to these prejudices are not recognised as valid input to the procedure, and their holders have less epistemic power to influence the decision-making process.

Recognition alone—although a fundamental prerequisite for both representation and participation to be just—is insufficient for just policymaking in the absence of some mechanism by which recognition can be translated into substantive influence. Such influence can be exercised indirectly through representation and/or directly through active participation. *Representation* happens when someone claims to speak for—to represent the interests of—a particular group of individuals (Saward 2010). As such, representation is an indirect way of ensuring that the interests of communities are represented within development policy. The lack of such representation is an injustice because it means that the interests of those communities are not represented within the process, in turn increasing the risk of creating and reproducing socio-economic inequalities and injustices. As Saward notes, the claim of a representative to represent a particular group or community can be stronger or weaker, depending on the extent to which the represented community agrees with the way that their interests are represented. Representation that does not align with the represented community's actual interests is misrepresentation and is an injustice to the affected communities insofar as it leads to their interests being unfairly under-prioritised, resulting in the reproduction and exacerbation of socio-economic inequalities and injustices.

One way for vulnerable communities to influence development policy and planning more directly is through their active *participation* in the procedure. Measuring participatory justice cannot be reduced to whether communities participate in the procedure, because participation also depends on whether there exist substantive opportunities for them to participate in the first place. This is so in two ways. First, opportunities for participation may be unfairly and unequally distributed between communities, such that members of some communities are more able to participate in and, by extension, influence the decision-making process. Consider, for example, how someone might be

interested in participating in a community development programme, yet be prevented from participating due to circumstances such as having to work during the meeting hours, or having no means of transportation to get to the meeting venue. Second, even if substantive opportunities for participation exist, there is no guarantee that participation will translate into actual influence. This connects to the issue of recognition above, in which the knowledge and interests of different communities are, for no justified reason, given different weight within the process, such that their influence is unfairly unequal, resulting in an unjust procedure and subsequent distribution.

It is tempting to think of the three procedural injustice indicators as moving from less to more substantive involvement in social policy, with recognition being the weakest commitment to taking the concerns of communities into account and participation being the active involvement of communities in policymaking. However, this would be a mistake because recognition is fundamental to the other two justice indicators. For example, participation is meaningless unless the concerns and knowledge of participants are actively being recognised, while indirect representation of communities might be more just insofar as representatives recognise these concerns and knowledges.

In sum, the MDIF provides a way to capture the multi-dimensional nature of development challenges, how they are rooted in issues of injustice, and how these different forms of injustice are interconnected and reinforce each other. In the following section, we show how the MDIF can be applied in practice by using it to analyse a particular development issue, namely the case of climate-related health risk in urban slums.

3 A case study of multi-dimensional injustice: urban slum health and climate change

The right to a healthy mind and body is recognised as an important aspect of social justice (Ruger 2004). Not only is a good health valuable in itself—it is also necessary to be healthy in order to pursue other goals in life (Nielsen 2014). In turn, in order for people to be healthy, they must have the necessary means and services to lead healthy lives, including access to decent health care, nutritional food, clean water, adequate education and information, working sanitation, resilient housing, and protection from the environment. If people are owed the right to a healthy life as a matter of justice, they also have a right to the conditions that enable them to lead a healthy life and denying these amounts to an injustice. Yet global and local socio-economic inequalities mean people in different parts of the world—especially in low- and middle-income countries—have widely different health opportunities (Marmot 2005).

One of the most vulnerable populations in terms of health are urban slum communities. The term 'slums' is used to denote urban areas with a high concentration of poor people, often with inadequate access to safe water, inadequate access to sanitation and other infrastructure, poor structural quality of housing, overcrowding, and insecure residential status (UN-Habitat 2007). 'Slums' and 'informal settlements' are often used interchangeably, but they are analytically different despite often overlapping in practice: Slums are urban areas of poverty, yet they do not necessarily consist of informal housing that has been developed outside of the formal and legal planning regulations. Conversely, informal settlements are developed outside of formal housing plans, but they are not necessarily poor and do thus not necessarily constitute slums. Lusaka's informal settlements are all slums. Hence, in the following, we talk about informal settlements in the context of Lusaka (with the understanding that they are also slums) and about slums in the context of climate-related health risks in general.

It is estimated that one in every three individuals in Sub-Saharan Africa lives in urban slums. As a result of poor access to services, urban slum populations are especially vulnerable to health risks. These include infections, injuries, malnutrition, diarrheal diseases, and respiratory diseases (Ezeh *et al.* 2017). Changes to the local and global climate threaten to exacerbate these health risks. For example, increased risks of flooding as a result of longer and heavier rainy seasons increase exposure to infectious diseases through the contamination of drinking water; physical injuries as a result of collapsing housing structures or landslides; and respiratory diseases due to indoor cooking with charcoal. Meanwhile, droughts threaten food supplies and access to clean and safe water.

In the following, we use the MDIF to analyse the case of climate-related health risks in Lusaka's informal settlement communities. With an urban population of 2.4 million individuals, an estimated 70 per cent of whom live in one of the 37 informal settlements (UN-Habitat 2021), Lusaka is a prime example of an urban area that is prone to and at risk of increasing health risks in the face of climate change. Lusaka's informal settlement population faces a number of climate- and health-related risks. In general, they have poor access to adequate water and sanitation (Ministry of Local Government and Housing 2017: vi): For example, water within the informal settlements is accessed through centralised wells that are shared between several households and often dry out during prolonged dry-spells, while most households in the informal settlements only have access to shallow wells and pit latrines that, in addition to being shared between households, often overflow during rainy seasons, spreading fecal matter.

Each year the rainy season threatens to flood and destroy the poorly constructed homes, many of which are built from makeshift materials, in addition to increasing

breeding grounds for communicable diseases: in 2018–17, Lusaka experienced an outbreak of cholera, which led to 547 infected and 15 deaths (WHO 2017), and which originated in and was primarily spread throughout the informal settlements. Additionally, Lusaka faces perennial water shortage, leading to issues of hygiene and security and lack of electricity and food security. Lusaka's residents also experience a lack of electricity with frequent power outages when the water levels in rivers are too low for the hydroelectric generators.[4] These power outages in turn lead to increased health risks, such as respiratory diseases and burn injuries due to charcoal cooking as well as safety issues as homes and streets in the informal settlements are poorly lit.

3.1. The multi-dimensional causes of climate-related health risks in urban slums

Many of the health risks faced by the residents of Lusaka's informal settlements have several causes; some are interrelated; and most are exacerbated in one way or another by climate change. Respiratory disease, for example, is in itself a non-climate-related health risks caused by general air pollution, poor housing, and the use of charcoal for cooking. All three causes, however, are exacerbated by climatic factors: air pollution lingers in times of high temperature and little wind; poor housing means that inhabitants are exposed to bad weather, such as cold, heat, and rainfall; while bad weather forces inhabitants to cook inside, further exposing them to dangerous charcoal smoke. As climate change increases the risk of extreme weather events, such as extreme heat, prolonged cold periods, and increased rainfall, cases of respiratory complications are likely to follow. Likewise, waterborne communicable diseases, including malaria, dengue fever, hepatitis A, yellow fever, and diarrheal diseases such as cholera, are climate-related diseases that affect inhabitants of Lusaka's informal settlements. Increased and prolonged rainfall as a result of climate change leads to floods that in turn increase breeding sites for mosquitoes carrying diseases, such as malaria, yellow fever, and dengue fever. Increased rainfall combined with poor sanitation structures, such as shallow wells, lack of piped water, and pit latrines, and poor disposal of waste also means that water reservoirs get frequently flooded with fecal matter and waste during rainy seasons, leading to an increase in diarrheal diseases.

The causes of climate-related health risks in urban slums have both distributive and procedural justice dimensions along the five indicators set out by the MDIF. That is, climate-related health risks are often further aggravated by *socio-economic and*

[4] Zambia relies on hydroelectric power. However, although its rivers should produce enough power for everyone, a botched privatisation of Zambia's copper mines, which promised to provide the mines with cheap electricity, means that 70 per cenrt of the national electric grid capacity goes to the mines with only 20 per cent to consumers.

political factors. In particular, in addition to the more general issue of poverty, the lack of basic services, such as waste disposal, alternative energy sources, access to piped drinking water, and poor sanitation structures; poor education and a lack of knowledge of proper hygiene; a lack of landownership and land tenure; and a lack of political will to address health risks in the informal settlements are all factors that exacerbate climate-related health risks.

In terms of the distribution of goods and resources (for example, the lack of access to basic services) affects the health prospects of Lusaka's urban poor in several ways. Many inhabitants cannot afford to have their waste picked up and instead they dump it on the street during the night, which in turn leads to an increase in breeding grounds for diseases as well as increased risk of contamination of groundwater during rainy seasons. Moreover, poor sanitation facilities, such as shallow wells and pit latrines, also increase the risk that groundwater becomes contaminated during rainy seasons as latrines spill over into the wells.

Likewise, in terms of capabilities, the lack of substantive educational opportunities and access to information compounds a lack of knowledge about (climate-related) health risks in Lusaka's slums: many people are simply unaware of how the spread of disease can be prevented through proper hygienic measures. A lack of education is also often tied to unemployment, in turn reproducing poverty and a lack of resources to purchase basic services and goods, such as healthy and nutritious food, building materials, clean drinking water, and health care access.

One of the main distributive factors creating vulnerability to climate-related health risks is the lack of *landownership rights and land.* That is, because inhabitants of Lusaka's informal settlements lack ownership of their land, they lack the legal freedom to improve their houses and yards as well as the incentive to do so since they risk losing the money and resources they put into the improvements if the government decides to clear the houses. Land tenure can help inhabitants to build more resilient houses, using sturdier building materials, and to plant vegetable patches in their garden, thus improving access to healthy and nutritious food and decreasing reliance on rural agricultural output. Without the right to improve their houses and land, residents not only face the perennial threat of eviction, but also lack the capability to create a more climate-resilient environment for themselves, their families, and neighbours.

On a procedural level, climate-related health risks in urban slums are partly caused by a lack of recognition of local practices and knowledge and poor representation of the interests of local communities, which is compounded by the lack of clear pathways for participation of local stakeholders in policy and planning. The lack of political will and urgency to address socio-economic and health issues in the informal settlements is tied in with the issue of landownership. For example, it is widely believed

among the informal settlement communities that the only reason why the city authorities acted on the cholera outbreak of 2018 was that on this occasion cases had been detected in Lusaka's more affluent neighbourhoods. In other words, the lack of democratic power of the inhabitants of the informal settlements—partly due to a lack of landownership; partly due to a perceived lack of economic contribution—makes them easy to ignore by those who are meant to represent their interests.

The lack of recognition of local knowledge, interests, and needs is moreover compounded by poor representation of slum communities and the lack of opportunities for participation in climate and health planning. In general, the issue of urban slums does not feature very highly among political priorities. Urban slum populations often have little political power and are therefore easy for policymakers to ignore, such as in the case of the cholera outbreak above. While participation in political processes is often impossible for slum communities due to constraints of time and resources, Lusaka's informal settlements are each represented by a local representative. However, the relationship to this representative is often marred by political clientelism in which the represented communities are 'indebted' to their representative—that is, his representation is regarded as a favour to the communities—and creating a power asymmetry between representative and represented. This can be regarded as a procedural injustice because the fair representation of the communities is contingent on the favour of the representative (Lovett 2010, Pettit 2012). As a result, already vulnerable slum communities lack robust representation, even if *on paper* they are represented.

In sum, analysing the causes of climate-related health risks in urban slums through the lens of the MDIF shows how they are rooted in justice-related issues, such as the unfair distribution of resources, structural constraints on opportunities, and the lack of fair representation and recognition. In the following section, we show how the MDIF can help clarify efforts to prevent and address these issues.

3.2. The multi-dimensional challenges to tackling climate-related health risks in urban slums

Climate-related health risk is a multi-dimensional issue that requires input and action from many different stakeholders, including policymakers; city authorities on health and sanitation; service providers of water, sanitation, and health; community- and faith-based organisations; researchers; and international NGOs (non-governmental organisations).

For example, community- and faith-based organisations (CBOs and FBOs) are crucial to addressing climate-related health risks in informal settlements: these organisations can provide the nexus for tasks, such as identification of problems, identification of solutions, community mobilisation, awareness creation, and

information dissemination. Moreover, involving local communities is a way of creating ownership of the implemented plans. CBOs and FBOs also act as interest organisations through which the slum and informal settlement communities can communicate their needs and knowledge to each other and to authorities and policymakers: because CBOs and FBOs work directly with these communities, they are well placed to identify the needs and interests of the communities and to gather knowledge about any challenges to addressing these. Within the local communities, schools and local businesses are also resources. Schools can most obviously be tasked with capacity building and awareness raising through education, while local businesses provide informal service provision, such as access to food. There is a need for the implementation of a corporate social responsibility framework to leverage the capacities of local businesses to help address issues in their local community through assisting in programme implementation.

However, distributive and procedural inequalities and injustices complicate this coordination and in particular the involvement of local communities. Despite the need to integrate the efforts of multiple stakeholders, this prospect is impeded by a lack of resources and services (distributive injustices) as well as corruption, clientelism, and a lack of political will (procedural injustices). As a result, efforts are often siloed off from each other; replicated by different actors; and/or lack a clear division of responsibilities: city authorities, service providers, and policymakers often lack awareness of local circumstances, with the result that policies are top-down and unresponsive to local realities, thus leading to maldevelopment.

In terms of distribution, global socio-economic inequality plays a big factor in the lack of response to climate-related health risks in urban slums (Moellendorf 2009, 2012). Committing resources to tackling health risks in urban slums—whether climate related or not—is complicated by the fact that climate-related health risks in urban slums are mainly an issue in low- and middle-income countries where economic resources are often scarce (Acemoglu & Robinson 2013). At the local level, the lack of resources, caused by poor global redistribution, is compounded by a set of procedural injustices. There is often a lack of political will and motivation to address these issues, with local citizens, authorities, and policymakers all expecting compensation for their participation. Thus, there is a need to address political corruption and clientelism, which sees the interests of the politically marginalised population in the informal slums often being sidelined in favour of more affluent population groups, as in the case of the cholera outbreak, but also in terms of the provision of basic needs and rights, including landownership and access to services, such as running water, electricity, and nutritious food.

The result is a distributive injustice at the local level in which slum communities often lack the resources and services to create more resilient infrastructures, which

limits their capabilities in life. This includes piped water to decrease reliance on centralised water taps that may run dry; access to safe stoves to decrease reliance on wood and charcoal and, hence, decrease risks of burn injuries and respiratory diseases; installation of covered latrines, in place of pit latrines, to reduce the risk of contamination; housing constructed from permanent building materials to reduce exposure to bad weather, such as rain and wind; access to the city's electrical grid to increase safety on the streets as well as to enable children to study; and access to affordable nutritious food, for example, through the promotion of peri-urban farming. In absence of the necessary resources and services, urban slum communities are unequally exposed to health risks—whether climate-related or not—in ways that more affluent communities are not. The unequal distribution of resources is unjust because it threatens to undermine one of the most basic capabilities necessary for human survival and flourishing, namely bodily health (Venkatapuram 2011).

4 Concluding remarks

Recent literature on climate adaptation has shifted to a focus on how to ensure the fair and equal adaptation to climate change. Efforts to minimise climate vulnerabilities and to build adaptive capacities among climate-affected communities, this literature argues, are often frustrated by existing inequalities and injustices. Yet, the existing literature lacks a clear and comprehensive framework for understanding how the different forms of injustice interact to exacerbate climate vulnerabilities, compromise adaptive capacities, and undermine adaptation efforts. In this paper, we have introduced the Multi-Dimensional Injustice Framework (MDIF) as a normative framework for understanding, articulating, and tackling issues of justice and fairness in climate impacts and climate adaptation. The MDIF introduces a set of indicators to identify distributive and procedural injustices that can be utilised within development and adaptation policy and planning. We further showed how the MDIF can be applied in practice by analysing a case study of climate-related health risks in the informal settlements of Lusaka, Zambia. Just as climate-related health risks in urban slums are caused by multi-dimensional injustices, efforts to address them are undermined by distributive and procedural inequalities and injustices. Consequently, tackling climate-related health risks in urban slums requires not only the redistribution of resources and goods, but also efforts to address deep-rooted structural inequalities that keep urban slum populations in poverty and outside of political power. The MDIF, we hold, can be useful for analytically and structurally approaching other climate- and development-related issues, such as gentrification through urban development; COVID-19 impact and recovery; food insecurity and food sovereignty

(Huambachano 2015, Patel 2009); displacement due to large-scale development projects (Penz *et al.* 2011); social and political exclusion of vulnerable and marginalised communities, including Indigenous peoples, disabled people, and LGBTQ+ people; epistemic discrimination; and gender inequalities in the household, at work, and in society at large.

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Collective capabilities: overcoming energy scarcity through power sharing

Anne Schiffer

Abstract: The research explores the intersection of social relations and energy capabilities in the Global South. Specifically, it provides insight into everyday 'sharing practices' in overcoming electricity scarcity. This is based on a decade of regular immersions in a rural Gambian community which was supported by a range of qualitative methods including observations and semi-structured interviews. Findings suggest that energy capabilities can be improved at different scales in the community through sharing practices that are historically rooted in social norms and values. This is conceptualised here as collective energy capabilities for mitigating energy scarcity. However, currently sharing practices do not easily translate into sustainable and bottom-up management of collectively used or owned energy assets to achieve more systemic shifts towards democratic models of energy for all.

Keywords: Energy poverty; energy access, energy democracy, Global South, SDG7, capability approach, energy and wellbeing, West Africa.

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1. Introduction

1.1. Electricity access, health and wellbeing

The International Energy Agency (IEA) estimates that globally around 770 million people live without access to electricity (IEA 2021a). Over the past decade approximately a billion people have gained first-time access; however, the electricity access gap is set to rise by 2 per cent, with a concentration of that increase on the African continent (IEA 2021a). Even prior to Covid-19, the energy access gap was predicted to concentrate in Africa over the coming decade (IEA 2019). Nonetheless, it is widely recognised that the pandemic has slowed or even reversed progress towards increasing electricity access as well as transitioning to renewable energy (IEA 2021a; IEA *et al.* 2022; Jensen 2021). Since the beginning of Covid-19 '15 million sub-Saharan Africans who recently gained basic electricity access lost the ability to pay for it. An additional 10 million customers who had gradually upgraded and expanded their energy supply can no longer afford this level of consumption' (IEA 2021b). In addition, the pandemic has disrupted supply chains of renewable energy technologies such as solar panels, further exacerbating the energy access gap (Gebreslassie 2020).

The above paints a useful if bleak picture of energy poverty on a global scale. However, Munro & Schiffer (2019) argue that the binary model of electricity access posed by the IEA and others is problematic for understanding the lived experience of energy poverty. Situated ethnographic research highlights complex socio-cultural, -political, -economic, and -environmental dynamics that shape energy poverty in the context of everyday life which do not simply divide people into those that have access and those that do not. In turn, this has implications for the intersection between energy access, healthcare, and wellbeing.

Access to energy is firmly enshrined in the United Nation's Sustainable Development Goals (SDGs) through SDG 7 which aims to 'Ensure access to affordable, reliable, sustainable and modern energy for all'. Strong interlinkages exist between SDG 7, which is focused on electricity and cooking fuels, and SDG 3 – Good Health and Well-being – which aims to 'ensure healthy lives and promote well-being for all at all ages'.

Firstly, there is a link to SDG 3 Target 3.9 which covers reducing the impact on human health from air pollution which is commonly associated with a lack of access to 'clean' cooking fuels. An estimated 3.2 million premature deaths are attributed to the burning of solid fuels such as charcoal and firewood in household environments where they contribute to a host of illnesses including respiratory infections, ischaemic heart and chronic obstructive pulmonary disease (WHO 2022). This paper focuses on electricity access and, while a case can be made for transitions to electric modes of

cooking (Lombardi *et al.* 2019), other energy sources (biomass, gas) are more common in energy scarce areas of low- and middle-income countries, especially rural and remote contexts (Mazorra *et al.* 2020).

Secondly, electricity access has direct implications for health care services (SDG 3 Target 3.8). This includes the response to Covid-19, where a lack of access to electricity poses a barrier to containing its spread (Broto & Kirshner 2020), and more generally in off-grid healthcare facilities where refrigeration is needed to store vaccines or run equipment (Franco *et al.* 2017).

Thirdly, everyday electricity needs, including domestic lighting, charging appliances, heating and cooling, etc., have far-reaching implications for people's wellbeing, quality of and ability to lead a dignified life (Samarakoon 2019; Tarekegne 2020). It is in the context of everyday electricity scarcity that this article explores collective capabilities for improving equitable energy access and wellbeing.

1.2. Capability and energy poverty

Melin *et al.* (2021: 188) suggest that 'providing energy access is not enough in itself to ensure positive outcomes, or that outcomes will be equal and fair'. The emergence of 'energy services' goes some way in demonstrating a shift in focus from energy access delivery and energy fuels to emphasising the specific needs this access helps to meet (e.g., Bouzarovski & Petrova 2015), but it does not suffice in understanding implications for wellbeing.

The 'capability approach' pioneered by Sen and developed further by Nussbaum and others has been widely adopted in understanding wellbeing and human development. This includes, in relation to product and service design (Steen 2016), community gardens (Clavin 2011), and education (Walker & Unterhalter 2007), to name but a few. However, it is only recently that the capabilities approach has been expanded to studying energy poverty, thereby creating a better link between energy access and wellbeing outcomes (Day *et al.* 2016; Malakar 2018; Middlemiss *et al.* 2019).

In the capability approach, the concept of 'functionings' is used to describe 'beings' and 'doings' such as being in good physical health or going to school (Nussbaum & Sen 1993). Here, capabilities refer to the opportunities a person has to realise functionings they value. In turn, a person's capabilities are a key component of what Sen (1993) conceptualises as 'freedom'. However, in addition to opportunities, a person must also have agency in achieving desired functionings. A lack of either capabilities (e.g., lack of grid infrastructure to connect to) or agency (lack of capacity to raise finance to pay for a household grid connection) can be described as energy-related 'unfreedom' (Samuels 2005).

Kalt *et al.* (2019) observe that what is often described as energy access-related benefits tend to be simply 'functions provided by energy use' such as cooking or communication. Building on Nussbaum & Sen (1993) as well as Smith & Seward (2009), Day *et al.* (2016) distinguish between levels of essential or 'basic' capabilities such as good relations and more specific 'secondary' capabilities that help achieve the former basic ones. For example, these would include energy services such as mobile communication (secondary capability) to sustain said relationships (basic/essential capability). They define energy poverty as 'an inability to realise essential capabilities as a direct or indirect result of insufficient access to affordable, reliable and safe energy services …', making explicit reference to SDG 7.

Studying the intersection between energy and social relations capabilities in the UK, Middlemiss *et al.* (2019: 229) question the appropriateness of what they interpret as 'sequential' capability levels proposed by Day *et al.* (2016) – where energy services enable more essential/basic capabilities. They argue that social relations such as sustained friendships can be what others view as essential and can also enable secondary capabilities (such as mobile communication), thereby suggesting a more dynamic or at least 'bi-directional' relationship.

This article further explores the crossover between social relations and energy poverty but with a focus on a Global South instead of a Global North context. Specifically, the research uses a capability lens to analyse 'sharing practices' (Schiffer 2020) in overcoming energy poverty in a rural Gambian community.

It is recognised that collective practices can achieve individual freedom (Samuels 2005: 39) and as such may recognise 'responsibility for the community' and generally 'taking other people's well-being into consideration' (Pelenc *et al.* 2013). Though Day *et al.* (2016) do not make explicit reference to the notion of 'collective capabilities', they use the capabilities frame to examine both individual and household levels. Nonetheless, the capability approach is largely focused on individual instead of groups of people. Sen argues that: 'it would be absurd to say that no one's life is getting better, but it is a better society. If society is better then in some way somebody's life must be getting better' (Samuels 2005: 39-41). However, despite much debate, the capabilities approach has been opened up to the notion of 'collective capability' (e.g., Pelenc *et al.* 2015; Griewald & Rauschmayer 2014; Ibrahim 2011a).

In the context of grassroots organisations, Pelenc *et al.* (2013) explore 'collective capability' and 'collective agency' including tensions between individual and collective scales. It is suggested that exercising collective agency, which they define as 'capacity for collective action', means a group of people will gain collective capabilities (Pelenc *et al.* 2013).

In contrast to this, I will demonstrate that, when it comes to negotiating energy access, social relations translate into differentiated capabilities and agency across

individual, household and community scales depending on what type of essential and secondary functionings are to be achieved. This does not necessarily follow the sequential order of exercising collective agency to enable collective capability proposed by others (Pelenc *et al.* 2013). The article thereby contributes additional perspectives on the opportunities and tensions between individual and collective capabilities in the context of energy poverty in the Global South.

The remainder of the article is structured to provide a brief methodological overview, followed by a presentation of historic sharing practices as basis for values that shape collective capabilities in relation to electricity scarcity today. The article then examines some of the barriers to sharing practices including tensions between individual and collective capabilities including to collectively sustain electricity assets such as electric gadgets and infrastructure. This is followed by a discussion that draws out wider implications for democratising energy access and a brief conclusion.

2. Methodology and study context

The article is based on research carried out within the rural community of Kartong, which is located in the southern-most part of The Gambia in West Africa.[1] Through initial field excursions to the area in 2008, 2009 and 2010, I was able to build relationships with members of the community which subsequently enabled me to stay with a local family for annual visits of 1-3 weeks up to the point of the global Covid-19 pandemic. Field trips took place during different times of the year to avoid 'season blindness', which is the limited or skewed understanding of a place and people's practices based on experiences of only one (and typically the dry) season (Chambers 2012: 38).

Through these regular immersions I was able to observe and participate in everyday life including a broad range of changing energy practices related to food, communication, lighting and transport. In turn, this enabled me to witness energy transitions including the arrival of grid infrastructure and electricity-sharing practices focused on here and initially described in Schiffer (2020). The predominately ethnographic and qualitative research was supported by a range of methods, including semi-structured interviews, mapping infrastructure distribution, the facilitation of excursions to renewable energy projects, and co-design workshops to explore perceptions of local energy challenges and future aspirations. Past energy transitions were explored through biographic interviews inspired by and in part carried out collaboratively with Dr Mary Greene at Wageningen University (see Greene & Schiffer 2021; 2018).

[1] The last census was carried out in 2013 and suggested a population of around 3,300 (GBOS 2013).

3. Everyday sharing practices and collective capabilities

Based on a more detailed description of everyday energy consumption presented in 'Reframing Energy Access: Insights from The Gambia' (Schiffer 2020), the following explores energy related sharing practices in Kartong through the lens of collective capabilities discussed above.

3.1. Historic sharing practices

To understand current energy related practices, it is useful to first briefly examine historic sharing practices in the community. Elders remember when Kartong was largely self-sufficient in terms of food. As Mohammed[2] and others recall, 'we grow what we eat, and we eat what we grow' (Schiffer 2020: 13). During the rainy season, groups of same aged boys or girls worked together to help each other's parents to grow rice. Mariama recalls '[boys will go] from father to father [to plough fields] and we will go and transplant [rice] from mother to mother' (Schiffer 2020: 16). This example of a historic sharing practice speaks to the notion of groups exercising agency by participating in collective action and thereby enabling collective food growing capabilities (Pelenc *et al.* 2013).

When food shortages did occur, people who struggled to feed themselves would have been stigmatised as 'lazy' for not having worked hard enough to produce rice during the rainy season. However, others in the community shared their surplus food with the households affected by hunger. To avoid causing members of these to feel ashamed, food was shared after dark. In other words, these particular sharing practices were carried out in secret to preserve people's dignity. 'We want to be equal, we don't want to demote anyone', explains Mariama (Schiffer 2020: 14).

Here, the collective capability to feed others in the wider community in a dignified manner enabled individual and household functionings of being sufficiently nourished, as well as leading a public life without shame (Sen 1993).

In Kartong, it was also common for children to grow up with childless relatives, thereby providing additional household labour. Hawa, one of the oldest women in the village, says that what she remembers as a child is that she worked. When she was around twelve, she transferred to another compound in Kartong to live with a relative who could not have children of her own. She cooked, fished for oysters in the river, and worked on the rice fields during the rainy season. She stayed in this home until she got married in her early twenties.

[2] All names have been changed to preserve the anonymity of interviewees.

Similarly, Fatou, explains that she transferred to her grandmother's place at around the age of ten. She helped her relative with vegetable gardening and carried out chores around the house including cooking and washing clothes.

While moving in with relatives to provide additional labour was reported by interviewees as a matter of fact and not as a negative, it does raise questions about tensions between individual freedoms and collective resilience and wellbeing of extended family networks. In the context of a patriarchal society where women and girls were responsible for the bulk of household chores, a conflict between the individual and the collective also takes on a power dimension along gendered lines.

What I have broadly described as 'sharing practices' are clearly based on historically collective values and social relations in this rural community which continue to shape life in Kartong today. As such it is still common for children to live for prolonged periods of time with relatives, sometimes to attend school or strengthen family ties including relationships that span the Gambia–Casamance (southern Senegal) border. Similarly, sharing of food continues to be an important socio-cultural practice that may include supporting those experiencing hardship, as well as simply sharing a meal gathered around the same vessel and greeting passers-by with 'na kontong' – 'come eat lunch'.

Building on the historic sharing context described above, the following explores how collective capabilities translate to everyday consumption of and access to electricity.

3.2. Overcoming electricity through sharing practices

In 2013 the first households in Kartong were connected to grid electricity. Prior to this, some electricity was available, including through diesel generators, battery powered gadgets and small solar panels. When grid infrastructure reached the village, it was only partially covered, favouring the more established and densely populated areas of the settlement area. Years later, some extensions have been made, but significant parts of Kartong remain without access[3] to the electricity grid (Schiffer 2020), or on what Golubchikov & O'Sullivan (2020) refer to as the 'energy periphery'. As such, there is a spatial divide between those that have the capability to access grid electricity and share energy, and those that energy may be shared with and to whom electricity access is thereby extended.

In an attempt to overcome this continued spatial divide across parts of the settlement area, some households have created permanent or temporary extensions to support neighbours and friends. During a family celebration in an off-grid cluster of

[3] See Schiffer (2020) for maps depicting changes in the level of grid electricity.

buildings, the closest household with a grid connection 'provided access via a series of extension leads lying in the grass along the edge of the [local] football field. For the short period of time that electricity was especially needed, it was sufficiently met through this temporary connection' (Schiffer 2020: 85). Here, the collective capability to meet energy needs (achieve energy related functionings) depends on the social relations with one grid-connected household.

Similarly, a Kartong man shared a spare permanent connection with his neighbours. Through his employment, the individual is entitled to a grid extension to his home, and the National Water and Electricity Company subsequently extended the local grid accordingly. Several meters were installed in the man's family compound, which is comprised of several extended households as is the norm. However, one such meter was not going to be used and the individual therefore offered to build a private extension to his neighbours where the meter is now installed instead. He 'put in an underground cable to connect the spare meter to a neighbour's compound who would otherwise not have benefitted from grid electricity' (Schiffer 2020: 86). In this example, social relations helped improve the energy capabilities of the neighbouring household to enable valued functionings associated with access to electricity, including lighting, charging equipment and access to electricity for entertainment purposes.

Prior to grid electricity reaching Kartong, there were a number of locations where people could charge gadgets such as mobile phones. This included so-called video-clubs, a local form of cinema, often powered by a diesel generator. For an extra fee, mobile phones could be charged here. When grid electricity arrived in 2013, 'the mobile phone charging business disappeared almost overnight' (Schiffer 2020: 85). Despite an initial small number of household connections across the settlement, friends and relatives were able to charge phones in households that were grid connected (Munro & Schiffer 2019). This is in line with Middlemiss *et al.*'s (2019) argument against a sequential understanding of capabilities in the context of energy poverty. The example demonstrates how social relations both enable energy services-related functionings (mobile phone charging), and sustain social relations through 'secondary' functions facilitated by this (staying in touch with loved ones further afield using mobile phone communication). Interestingly, 'The charging business […] reappeared recently to serve migrant workers who lack the social ties within the community' (Schiffer 2020: 85), illustrating the socio-spatial dynamics of energy poverty for those that find themselves beyond the grid and outside of local community sharing networks – a socio-cultural instead of spatially induced symptom of being on the energy periphery. The absence of social relations for those newcomers leads to what can be described as a 'capability deficit' (Ibrahim 2011b), a lack of opportunity to benefit from electricity sharing practices.

Energy-related sharing practices also take place at compound level – the extended family home which usually consists of several individual households and communal facilities such as kitchens. Domestic chores such as cooking, cleaning and childcare typically still fall on women and girls living within the compound – wives, co-wives and daughters. Sometimes women share chores such as cooking lunch, taking it in turn to prepare food for the wider family using the aforementioned communal kitchen buildings. For larger gatherings such as naming ceremonies following the birth of a child or religious events, several women may work together to prepare larger quantities of food. As such, the notion of shared labour established historically continues to shape food preparation today, providing a sense of collective capability for women but within the confines of the patriarchal construct.

While cooking still largely relies on biomass, other chores are increasingly linked to the use of electricity, reducing daily drudgery. Electric irons and kettles needed to achieve functionings such as boiling water or ironing clothes are becoming more common. However, not every household within a compound owns electric gadgets, which are therefore shared with extended family members. For example, a single kettle can be observed as it is carried between different parts of the compound throughout the day, used to support an informal business selling hot beverages to passers-by on the roadside during breakfast time, boil water for tea or coffee by one woman after lunch, or to provide water for a hot bath for another at night. Therefore, one household having access to electric gadgets that are seen as convenient, also benefits the extended family, speaking to their collective capability of achieving valued functionings, such as having hot baths during cool evenings.

Larger appliances, for example fridges, are also shared. Women can be observed occasionally using a fridge in another household located in the same or a nearby compound to store and so prolong the shelf life of fresh fish. Only here the fridge does not move within or between compounds, it is the contents that do.

Finally, compounds have installed lightbulbs on exterior walls of their houses 'providing informal street lighting that serves the wider community' (Schiffer 2020: 67). In turn, this benefits people returning late at night or walking to the mosque during the early hours of the day.

The findings presented above demonstrate how social relations facilitate collective capabilities in accessing electricity at individual (e.g. phone charging) and collective scales (household, compound, wider community). The underlying value of care for others in the community which is demonstrated through electricity sharing practices is summed up by Sophiatu:[4] 'the best life is to survive from what you sweat [for] and

[4] Based on semi-structured interview dated 2 February 2018.

to share with people what you have.' This closely aligns with Pelenc *et al.* (2013) in 'responsibility for the community'.

4. Tensions between individual and collective energy freedoms

As demonstrated above, electricity-related sharing practices are facilitated through social relations. These enable overcoming energy scarcity, if not entirely, at least by improving the conditions for people temporarily. However, a more nuanced perspective highlights the fact that social values around sharing also contribute to tensions between people and in relation to individual versus collective freedoms. The following presents ethnographic findings to illustrate this point, again starting by providing a brief historic perspective, before examining tensions in relation to current electricity-related sharing practices.

4.1. The burden of sharing with those on the energy periphery

In Greene & Schiffer (2021) we explore the evolution of local mobility practices or 'mobility careers' based on semi-structured biographic interviews with elders in Kartong. At a time when motorised transport was rare and there were only a few bicycle owners in the community, these were heavily relied on for communication. Lamin recalls, 'Like if there was somebody [who] died and you wanted to communicate to the relatives in the other localities, you would go to that particular person with the bike and borrow it from him' (Greene & Schiffer 2021: 144). Those who owned bicycles faced constant pressure to lend them out for urgent matters faced by members of the wider community.

Similarly, prior to mobile phones becoming widely available in The Gambia, few compounds in Kartong had access to land lines. As Ousman[5] explains: 'The pressure on individuals who had landlines in their compounds to pass on messages or make appointments for other people to receive phone calls was [eventually] mitigated through the introduction of telecentres'[6] (Schiffer 2020: 21). Both examples illustrate how individual freedoms were previously compromised for the benefit of others in the community, and the pressure faced by individuals who had access to perform energy services whether related to mobility or communication.

Today, there is also an expectation or pressure on individuals who no longer live in

[5] Based on semi-structured interview dated 2 February 2018.

[6] Similar to internet cafes, telecentres were 'commercial entities that provided access for those who could not afford the monthly subscription fee of a landline and wanted to pay for single calls instead' (Schiffer 2020: 21)

the community to share resources, including in the form of remittance payments from abroad. Relatives living in the European or USA diaspora have paid for appliances such as washing machines, tablets or television sets, improving communication and other energy services. In fact, in 2020, remittance payments accounted for approximately 16 per cent of the country's Gross National Product (World Bank 2022).

A recurring theme for Gambians travelling back from abroad are complaints about the expectations on them to provide material and financial resources, which even lead some to visit less often than they would like. This highlights the tensions between an individual's agency to provide for others, and freedom to freely choose how and when to spend resources in the context of social norms and pressure to share.

In Kartong remittance payments have even paid for some local extensions to the grid, enabling additional households to get connected:

> a Gambian living abroad made a donation to cover the cost of several [grid] extension poles, benefiting members of his family and nearby neighbours. However, two neighbouring compounds happened to apply for a meter through a different NAWEC [National Water and Electricity Company] branch to the donor's family and it just so happened that these arrived and were installed first. Feeling that this was unfair because it was their family's connection who paid for the poles, the donor's family complained to the point that the neighbours decided to have their meters taken down until the donor's family received their connection (Schiffer 2020: 86).

Unfortunately, the situation further escalated and ultimately resulted in the total breakdown of relationships: 'The neighbours involved all decided to stop sharing their resources' with the donor's family next door, which included a private well (Schiffer 2020: 86). While social relations improved household capabilities to achieve valued functionings requiring electricity access for all, social relations with immediate neighbours suffered.

The above illustrates how sharing practices can lead to disputes, place a burden on or otherwise negatively impact individuals and households. It is a reminder that a 'community' does not consist of a homogeneous group of people where everyone shares the same values or interprets social norms in the same way. Tensions can arise between individual and collective capabilities to access and share energy resources, including larger infrastructure developments such as grid extensions and energy finance associated with this.

4.2. Sharing practice barriers norms in collective infrastructure management

As previously discussed, gadgets such as kettles which are shared across different households support collective capability at compound level. Arguably however, only up to the point where said gadgets breaks down. While there is collective capability to

access electric household equipment through sharing practices, there is not necessarily a sense of shared responsibility for replacement or repair when breakages occur. Instead, women may be forced to revert back to previous practices such as heating water using wood fires or ironing clothes with charcoal irons. In the case of household gadgets, women may lack access to finance and/or repair skills, and instead rely on leveraging social including international relations for replacements. Nonetheless, while sharing practices are used to facilitate energy services, they do not translate into collective capability for maintenance of collectively used gadgets and equipment, as could be reasonably assumed.

Similar issues emerge in relation to community-wide infrastructure projects. Kartong has a history of communal infrastructures that have eventually fallen into disrepair. This includes the example of a street lighting initiative I describe in Schiffer (2020: 23).

> The unstable political situation around the time of the country's 1994 coup d'état had a negative impact on businesses operating in The Gambia including some of which had to close down. Employees of one such business were compensated with equipment that was no longer needed. This included a technician from Kartong who was given a large diesel generator that was too big to be used domestically. He decided to offer it to the community to generate electricity for street lighting.

At the time, even much more densely populated urban areas to the north would have lacked street lighting, speaking once again to the collective capability of the Kartong community, enabled through strong social relations that emphasise the sharing of resources for the benefit of everyone. 'However, fuel and maintenance costs were to be covered by the community, which proved to be challenging and the project eventually collapsed' (Schiffer 2020: 23).

This may be attributed to limited agency to raise finance for ongoing repair. However, an observation by Yankuba reflects on socio-cultural attitudes. Standing under the remains of a broken windmill that was once used to supply water for the settlement he says: 'if everybody owns it, no one cares' (Schiffer 2020: 87). While there are collective capabilities to implement infrastructure projects, these appear to be lacking when it comes to maintenance and the long-term sustainability of these for the benefit and wellbeing of the community as a whole.

5. Discussion

The presentation of ethnographic findings above demonstrates that sharing practices enhance individual and collective capabilities for overcoming electricity scarcity through social relations. This is rooted in historic practices and social values that

shape electricity access today. These shared values are the basis for collective capabilities in achieving both social as well energy service-related functionings.

Those who have the capability and agency to share electricity achieve an essential functioning of demonstrating care for others and social recognition that conforms with socio-cultural norms and values. They facilitate energy-related functionings by sharing grid electricity, electric gadgets and equipment, or energy finance, as individuals (including those who are part of the Gambian diaspora) and households. Those with whom electricity is shared are using their agency to leverage social relations in order to improve their capability as individuals or groups to achieve essential and secondary functionings associated with electricity. I suggest that groups or collectives include households, extended family compounds, as well as the wider community. Unlike Pelenc *et al.* (2013) who examine collective capability and agency through actions of a specific group, collective energy capabilities here combine two groups that act in symbiosis for a common good – those that share electricity-related materials (e.g. gadgets), services (e.g. mobile phone charging) and other resources (e.g. finance), and those that these are shared with. Integral to the concept of collective capabilities to reduce or overcome energy scarcity here are the values and social norms embedded in social relations that facilitate the former through sharing practices.

This form of collective capability is however not a silver bullet, potentially leading to tensions between individuals and/or households as well as placing collective needs before individual freedoms. Importantly, collective capabilities also do not displace government responsibilities of removing 'unfreedoms' (Samuels 2005) by providing electricity to all, ensuring that this is affordable and improves the reliability of electricity access in line with SDG 7. Social relations alone do not constitute capabilities for sharing. Grid electricity needs to be both available and affordable to people in the first place. However, presentably national generating capacity for electricity is limited, resulting in frequent load shedding (planned blackouts), while it is also expensive due to the country's dependence on fossil fuels for electricity generation. Furthermore, electricity sharing practices may support rather than challenge power relations in the context of patriarchal structures and gender norms.

Finally, values associated with sharing practices do not easily translate into successful management and long-term maintenance of household and communal energy assets. This point is important, as systemic energy poverty could theoretically be alleviated from the bottom up. For example, increasing renewable energy sources at household level could be feasible, but countless broken solar household installations suggest otherwise. This point was recently highlighted by Munro *et al.* (2022) who call for a repair research agenda of off-grid solar installations in the Global South. Similarly, energy services such as street lighting could be installed and operated at community level independent of national electricity grids, but have thus far failed to last.

The barriers to sustain assets such as finance and repair economies need further exploration. They are particularly relevant to the wider context of 'energy democracy' (Szulecki 2017) which is increasingly seen as an alternative to centralised mechanisms in developing energy transitions, including first-time energy access and gender equity in energy systems change (MacEwen & Evensen 2021). Here, the Africa Renewable Energy Initiative (AREI),[7] an Africa-owned and Africa-led programme 'to accelerate and scale up the harnessing of the continent's huge renewable energy potential' (AREI 2016: 5), recognises that 'with a highly diversified ownership base compared to that of conventional, centralised energy systems, a vast number of households, communities, cooperatives, small and medium-sized enterprises, as well as larger companies, become both producers and consumers of electricity. This will empower Africa to leapfrog to the energy system of the future' (AREI 2016: 5). Similarly, Hungwe *et al.* (2021: 3) envision a 100 per cent renewable energy system for Africa which 'must be socially-owned and community-based, and not be a pretext for privatising the electricity sector.' Arguably, sharing practices provide a value foundation for this vision of bottom-up energy access transitions. If and how existing practices can be adapted to go beyond mitigating everyday experiences of electricity scarcity requires carefully designed and iterative policy interventions that recognise collective capabilities as an asset on which to build but not solely rely.

6. Conclusion

This article has examined everyday electricity sharing practices in an under-served rural Gambian community. It provides an alternative understanding of collective capabilities in the context of energy scarcity in the Global South, which is based on shared social norms and values that create a symbiosis between those that have the capacity to share and those with whom electricity and related resources are shared. It thereby makes an original contribution to literature exploring the intersection of social relations and energy capabilities at different community scales.

The research demonstrates collective capabilities as a mechanism for overcoming everyday electricity scarcity and thereby contributes to collective wellbeing in line with SDG 7. However, it also highlights the limitations of this, including tensions between individual and collective freedoms, as well as regarding more systemic shifts towards bottom-up mechanisms to achieve electricity access for all.

[7] AREI launched at the Paris Climate Change Conference in 2015 and is funded through the United Nations Green Climate Fund.

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