

## ARTICLE OPEN



# Emergent governance responses to shocks to critical provisioning systems

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The structure and functioning of formal and informal governance arrangements and associated infrastructure prior to major environmental disturbance play a central role in how cities experience and respond to such events. This paper considers how city managers, businesses, and residents responded to two disturbances experienced in the City of Cape Town—a drought-induced water crisis and a pandemic crisis (COVID-19) that followed a year later—and the consequences of these actions for infrastructural assets and governance innovations. Our analysis suggests that efforts aimed at transformative change in these provisioning systems require attention to the existing and potential roles and responsibilities of private and public sector actors, as well as the associated distribution of risks and rewards. Furthermore, polycentric and decentralized governance arrangements, which are often thought to be most flexible in the face of shocks, are not always feasible or desirable to actors with a stake in resource governance.

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## INTRODUCTION

The structure and functioning of formal and informal governance arrangements and associated infrastructure play a central role in shaping how disruptions are experienced<sup>1</sup>, how actors respond, and how such responses influence subsequent system (re) organization and potential transformation<sup>2–5</sup>. When water or food provisioning systems falter or fail, these disruptions not only affect access to critical resources for human wellbeing, but also the political legitimacy, financial viability, or authority of actors involved in resource distribution<sup>6</sup>. Critical goods such as water are typically delivered via a combination of public and private means, which can result in exclusion from access<sup>7–9</sup>. Given the critical nature of such goods for human and ecological wellbeing, there is an ostensive need for ensuring the stability of provisioning arrangements in the face of shocks, and for ensuring rights to access critical resources when entitlements fail<sup>10,11</sup>. More specifically, governance of critical resource flows<sup>12</sup> entails distinct goals, which include ensuring infrastructure reliability, managing rights of access, managing risks of entitlement failures, and distributing the economic, moral, and political rewards associated with the resource<sup>13</sup>.

To realize these varied goals, critical provisioning systems entail complex, often implicit, interactions and interdependencies among private and public actors<sup>14–16</sup>. Sometimes the governance of rights, risks, and rewards associated with a resource may fall within a single decision-making forum; in other cases, these distinct governance objectives are addressed through configurations of actors and institutions across decision forums<sup>17</sup>. The commodification of water, energy, or food, for example, means that economic reward for reliable management of resource provisioning infrastructure will often accrue to private and commercial actors managing distribution systems. To the extent to which such resources are presumed to be public goods associated with human rights, the public sector is inevitably embroiled in the governance of risk of entitlement failures and

would presumably be morally and politically incentivized to ensure such systems are ‘fail safe’<sup>18</sup>.

Shocks to critical provisioning systems can make these interdependencies and complexities visible<sup>19</sup>. Disturbances can serve to highlight the limitations of existing governance arrangements in coping with novel circumstances<sup>20</sup>, illuminating, for example, where governance of some goals (e.g., maintenance of infrastructure) may be working, while other goals (e.g., ensuring access) are failing<sup>21</sup>. Shocks may also reveal the polycentric character of provisioning arrangements including the limits of public sector influence and control over these governing assemblages, as well as the often-unacknowledged role that other actors—civil society, private sector, as well as individuals—play in their functioning<sup>19</sup>. Shocks can also lead to innovations in provisioning arrangements that would not have been possible in ‘normal’ circumstances characterized by path dependencies and institutional inertia<sup>22</sup>.

Nevertheless, there is limited understanding of which actors, and what combination of informal and formal institutions, shape the infrastructural arrangements that enable flows of critical goods and services<sup>12</sup>. Nor do we have an adequate understanding of how responses to disturbances enable, and constrain, novel and innovative shifts in governance arrangements<sup>17</sup>. The responses of these governance assemblages to shocks and stress are complicated when the resources in question are classified as rights of citizenship—as both water and food are in the context of South Africa. While states are obligated to guarantee such rights, in practice, it is common for food and, to a lesser extent, water to be governed as commodities with significant participation by private actors<sup>23,24</sup>. Similar examples of hybrid and polycentric governance assemblages have emerged with respect to the provision of policing services, with implications for equity<sup>25,26</sup>. It is increasingly clear that in the face of growing complexity and uncertainty, the maintenance of critical provisioning systems in the face of disturbances will need to better account for, and equitably leverage, existing interdependencies across the continuum of

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private/public and informal/formal relations<sup>19</sup>. Making these relationships and associated power dynamics more visible is critical if scholars and practitioners are to get a better understanding of why some novel initiatives for governance take hold, while others fail to become established.

In this article, we explore the response of actors to systemic shocks in two different resource provisioning systems—that of water and food—in order to foreground capacities and constraints for transformation in resource governance. We focus on two crises that occurred within a few years in the City of Cape Town, South Africa: the ‘Day Zero’ drought in 2017–2018, which disrupted the city’s water distribution system, and the COVID-19 pandemic lockdown of 2020–2021, which catalyzed a crisis in food access. While adequate access to water and food are guaranteed rights in the South African Constitution, both provisioning systems struggled to provide equitable resource access prior to and during disruptions. We show how resource rights are mediated by the ways in which resource access is institutionally organized, and how rewards for resource management are distributed and accrued through governance arrangements and by the role of physical infrastructure in resource provisioning. Our analysis suggests that efforts aimed at transformative change in these provisioning systems require attention to the existing and potential roles of private and public sector actors who enable distinct governance functions. Such attention will also provide insight into the distribution of risks and rewards in existing governance, highlighting potential barriers as well as points of leverage for enabling actors to be more agile and flexible in responding both effectively and equitably to provisioning crises.

### Food and water governance in the South African context

Governance arrangements determine how actors and institutions are organized around risk, rewards, and rights<sup>13</sup>. Both water and food are codified as constitutional rights in South Africa (Section 27). However, across South Africa, poor households struggle to secure and access both resources, and bear the risks associated with unreliable provisioning. Despite being identified as human rights, food, and water provisioning involve distinct degrees of public sector oversight. The private sector food system, from production through to retail, is characterized by high and growing concentration in a handful of large companies<sup>27</sup>. This concentration has contributed to the displacement of the informal food distribution system, with diverse impacts on residents’ food security<sup>28</sup>. Nevertheless, many of those living in resource-constrained communities rely on an informal food system, which has diverse linkages to the formal system<sup>29,30</sup>. Thus, while food security and safety are a state concern—for example, it has a zero-rated VAT policy for a specified basket of essential food items, monitors prices of critical foods, and manages a school feeding scheme that is a vital source of nutrition for many children—food provisioning is largely a private sector activity<sup>23</sup>. Activists and academics have been working to re-position the city as a leader in food system governance for some time in the City of Cape Town; these efforts, however, have been constrained by internal politics and distrust among civil society and state actors<sup>27,31</sup>.

Water, in contrast, is directly managed by the public sector, and regulated at the national level through the National Water Act and the Water Services Act. The National Department of Water and Sanitation (DWS) is responsible for ensuring that the country’s water resources are protected, managed, used, developed, conserved, and controlled in ways that enable the effective and equitable delivery of water supply and sanitation services. To do so, DWS works with provinces and local governments, including metropolitan municipalities (or ‘metros’) who distribute water to industrial, commercial, and domestic users.

Water in the City of Cape Town is largely sourced from surface water supplies and inter-basin transfers that are highly susceptible

to changing rainfall and evaporation patterns. Groundwater has not been extensively exploited, and, as a result, has been minimally regulated by the DWS. To support the constitutional right, municipalities have the responsibility of ensuring water access and availability of a minimum water allocation of 6000 liters/month for a family of four. For those residents not connected to municipal supply and sanitation infrastructure, water is delivered through communal taps or, in some cases, water tankers. Municipalities aim to recuperate the cost of water delivery through water tariffs that cross-subsidize costs for indigent consumers. To avoid residential debt, Cape Town has installed flow reduction devices on low-income households to restrict consumption to the minimum allocation. Poor households struggle to pay for water and resolving water issues at the household level remains a challenge, sometimes emerging as social unrest<sup>32</sup>.

Recently, both food and water security in Cape Town were subject to shocks. Drought conditions started in 2016 and culminated with the threat of ‘Day Zero’ in 2018, when dangerously low reservoir levels would force the taps of Cape Town to be shut off, sparing some critical health and economic areas and informal settlements. The drought prompted a closer look at water equity for the city government and for residents, highlighting the disruptions that people (of color, predominantly) in informal settlements have dealt with for decades: water cut-offs, queuing at communal taps, risks to sanitation, and personal safety. Following the drought, the City of Cape Town has made efforts to improve water access in low-income areas, as reflected in the City’s Water Strategy of 2019.

The COVID-19 pandemic followed on the heels of the drought, manifesting as an economic and by extension, food security crisis. Poor areas of the city have historically had inadequate access to healthy food, which has significant health consequences<sup>27</sup>. Food from commercial retailers was classified as an essential good during COVID-19 lockdown, but street trader and informal shops were initially closed. Many people in poor areas depend on informal work but this was constrained by the lockdown regulations, depriving many households of their ability to buy food.

Thus, at the initiation of each crisis, while both food and water are guaranteed rights in the South African Constitution, the provisioning systems differed substantially in terms of the roles of private and public actors, the social and economic relations entailed, and the implications for trust and collaboration. As a centrally controlled system, balancing rights of access with cost recovery, the City of Cape Town had a significant political and economic stake in the functioning and resilience of the water sector. In contrast, as an economically segmented market system, dependent on formal and informal commercial interactions and infrastructure, the state had a far less direct stake in the food system’s performance, despite its critical role in public health and social wellbeing.

### The case studies

We discuss how governance innovation in response to the ‘Day Zero’ drought crisis and the COVID-19 hunger crisis made visible, and altered, the involvement of different actors in distinct functions associated with critical resource provisioning governance. In the case of the drought, we focus on the emergence of Water Service Intermediaries (WSI), an institutional mechanism for water provisioning that began to play an important role in the City’s capacity to cope with water scarcity by reducing pressure on municipal water services during the drought. In relation to COVID-19, we focus on the emergence of solidarity networks—Community Action Networks (CANs)—to address food insecurity in precarious communities. These two case studies are derived from independent research initiatives in which the authors of this

paper were differently involved. Nevertheless, both case studies produced compatible qualitative data that separately speak to the governance themes of the present analysis. For each case study, we describe the constellation of actors and their roles and responsibilities in relation to resource distribution, rights, and risk prior to, during, and following the moment of crisis in the provisioning systems (Figs. 1 and 2). In this way, we highlight how the crises made visible implicit or hidden roles and functions of the private sector, public, and civil society actors in the provisioning system, how these actors are enrolled into new or more explicit functions, and what actors are rewarded through these relationships. By focusing on the longer-term developments following the crises, we explore what, if any, change in governance structure appears to have taken hold in each system.

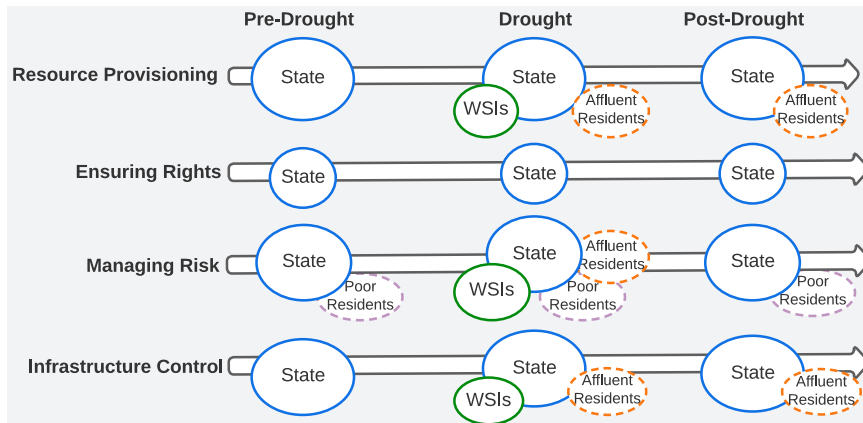
**RESULTS**

**Enrolling private enterprises in water provisioning**

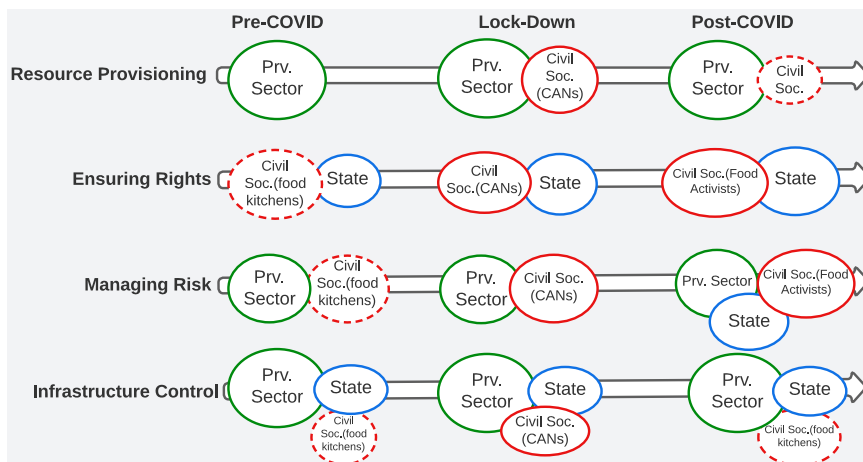
The 2017–2019 drought that led Cape Town’s residents to confront a possible day when municipal taps would be shut off—‘Day Zero’—provides other insights into the role of crisis in governance reconfiguration. Water distribution and access in Cape Town have long been centrally controlled and largely managed out of sight for the city residents on the municipal grid. For those served by

tankers and communal taps, water scarcity was already part of the precarious condition of their settlements. As the drought progressed, water ratepayers began to realize what losing access to the City’s water would mean. Increasingly strict water regulations eventually curtailed domestic use to 50 lts/capita/day; the City also dramatically reduced water pressure across its networks to conserve<sup>33</sup>. Increasing water tariffs sought to target the high users but unintentionally hit poorer households very hard, particularly given that there are often many residents on one housing plot, making it hard to stay within the lower use and tariff band.

In the face of these increasing restrictions, those who had the land and financial resources began to seek alternative supplies. For the city’s affluent residents, this strategy meant drilling boreholes and wellpoints, in addition to installing rainwater collection tanks<sup>34</sup>. The loss of water pressure and access implied an existential threat to the economic viability of many of Cape Town’s businesses, particularly those serving large numbers of employees, clients, tenants, or visitors. Managers of larger commercial properties, particularly those supporting tenants and the hospitality industry, urgently began to seek alternative water, not only from groundwater; some considered mini desalination plants, others found they could install complex systems to recycle water that would otherwise be wasted. These strategies involved



**Fig. 1 Water supply governance.** Actors’ roles in relation to water supply governance functions through the drought crisis. Size of the actor ‘node’ is qualitatively indicative of the prominence of that actor in a specific governance function; dotted lines indicate a lack of formal acknowledgment of actors’ contributions to specific functions.



**Fig. 2 Food governance change.** Actors’ roles in relation to food governance function through the COVID crisis. Size of actor ‘node’ is qualitatively indicative of the prominence of that actor in a specific governance function; dotted lines indicate a lack of formal acknowledgment of actors’ contributions to specific functions.

extracting and treating large volumes of water. To gain authorization for these efforts these entities petitioned the City to be designated as Water Service Intermediaries (WSI): entities formally permitted by the City to source, treat and supply water to end users. Prior to the drought, the WSI was conceived primarily as a mechanism for enabling water supply and treatment by organizations such as hospitals or schools located beyond the reach of the City's infrastructure. The drought allowed the City to repurpose this mechanism to move high-volume consumers off the stressed municipal supply system and into a system of private water provisioning.

This institutional shift was not without significant challenges for the city and for the private actors assuming the new roles. Consultants for the City had warned about the potential financial consequences of larger water ratepayers leaving the municipal supply system; the payments of these consumers were essential for subsidizing the supply of water to low-income and indigent households<sup>35</sup>. The City also worried that the City's supply could become contaminated with the backwash from local supply networks, as well as the possibility that locally sourced water would not be treated to standards, resulting in a health emergency. While the designated WSI would be liable for any such failures, in the public's eye, water, and water infrastructure were still the responsibility of the state.

The WSIs interviewed reported both a sense of growing empowerment and cautious confidence as they ventured into a domain of activity that was, as one interviewee put it, 'outside their core mission.' They faced steep and expensive learning curves to access the necessary technology and geo-hydraulic expertise and to install the appropriate infrastructure and monitoring systems. They considered these investments necessary not only to maintain economic viability, but also to meet the high expectations of care, service, and reliability conveyed to them by their clients, tenants, and employees, while also complying with municipal regulations. As one WSI reported: '... our tenants ... they started approaching us and saying, look you know, this is quite dire! And that is when we started to seriously think...we needed to do something to mitigate so that we could still operate, and our tenants could operate.' They were cognizant that the return on their investments would not likely be for a decade or more, and even then, only under drought-elevated water tariffs. Nevertheless, they also indicated that they had no viable alternative: their obligations to their clients, tenants, and shareholders meant going 'off grid' was the best course of action. One large property manager viewed their strategy for water autonomy as part of a larger strategy to become less reliant on the City for essential services, and thus more able to flexibly respond to future uncertainties: '...let's future proof this and let's get on top of it so that you know if we are in this position again, we've got a resilience plan.'

### Longer-term developments

The creation of WSIs with alternative water supplies undoubtedly served to alleviate demand on the City's system. Nevertheless, as the risk of 'Day Zero' receded, City of Cape Town moved decisively to reclaim control over the water infrastructure and associated revenues it had conceded during the drought. Water demand across the city has not returned to pre-drought levels; the loss of water revenue has motivated the City to instigate a pipe connection fee to ensure a baseline payment regardless of water alternative supplies. The City released a new Water Strategy in 2019 clarifying that all WSI contracts would be limited to those areas where municipal supply is not available, or in emergency contexts of water scarcity/ drought. The majority of the two-year WSI contracts would not be renewed. Water tariffs were readjusted and sanitation compliance monitoring accentuated. With these changes, few entities saw an economic advantage to

continue to provide their own water. With the non-renewal of WSI contracts, the private entities were forced to 'mothball' their novel private water infrastructure (pumps, dual reticulation systems, and water treatment facilities); with a few exceptions, all went back to being reliant on the City's system and supplies (Fig. 1).

Interviewed WSI contract holders expressed ambivalence over their experience in water provisioning. On the one hand, they had managed to innovate in technology and infrastructure in relatively short time frames. This innovation entailed financial and political risks, but significant rewards from their stakeholders in terms of maintaining operations as the city went into crisis around them. On the other hand, they expressed frustration that the City had turned tables so abruptly, articulating the message from the City as 'Yes! We love some people to help us with further supply'... but then when things are back to normal, "You must come back to us!". While empathetic to the City's financial needs and cognizant of the substantive public health risks entailed in their roles as WSI, several interviewees articulated that an opportunity for learning and partnership was lost. They considered their private experimentation in micro-water supply networks to be valuable knowledge that could have public benefits, should the City be amenable to appropriate partnerships. Yet several respondents suggested that there was less interest from the City in such knowledge partnerships and exchanges; they perceived that the City was ultimately more interested in ensuring adequate flows of revenue from ratepayers, and infrastructure control.

### COVID-19 and the community action networks

Food insecurity has long plagued low-income neighborhoods in Cape Town (and many other African cities), interlinked with poverty, unemployment, and lacking access to water and sanitation services<sup>36,37</sup>. The COVID-19 pandemic and associated lockdown regulations radically worsened this already precarious condition of many vulnerable households by curtailing their economic entitlements. The lockdown announced on 23 March 2020 (and enforced four days later) suppressed most formal economic activity, as well as the informal sector, upon which many low-income households depend. Early in the crisis, researchers argued, 'we now face the prospect that the informal sector will suffer a massive setback, further pushing large numbers of people out of economic activity and into desperate poverty and lethal hunger'<sup>38</sup>. A survey found that 47% of respondents reported that their household ran out of money to buy food in April<sup>39</sup>. A resident in such a precarious community wrote: 'When President Cyril Ramaphosa announced the lockdown [... it] sounded like a death sentence for me and other unemployed people... We were expected to stay at home with empty cupboards'<sup>40</sup>.

Notably, the lockdown regulations exempted all activities related to the production and distribution of food, at least in the formal sector. Exemptions were later included for informal food traders, too, following widespread complaints. As a result, there were no actual food shortages—the infrastructure of the formal food supply chains continued to function. Rather, the hunger crisis was almost entirely due to the crisis' impact on low-income households' incomes and hence their ability to buy food. The public sector struggled to formulate an effective response to rising food insecurity, hampered by a lack of coordination as well as a politicization of humanitarian distribution<sup>27</sup>.

In the face of the collapse of economic entitlements, local grassroots groups called 'Community Action Networks' (or CANs) organized over social media, involving dozens of suburbs in Cape Town<sup>41</sup>. The CANs made use of both existing social capital and new relationships to identify households in need, accumulate financial and material resources (from within and beyond the neighborhood), and distribute these resources to those in need in diverse ways, including food vouchers and community kitchens. Such kitchens often fed many hundred people a day, with the

queues becoming a visible expression of growing hunger. During the height of the crisis, between April and June 2020, more than half of all emergency food relief was provided by such civil society emergent response groups<sup>42</sup>.

Though the focus of most of these CANs was on supporting vulnerable people within their own neighborhoods, many of these groups created collaborative linkages—social infrastructure—across privileged and precarious communities. These partnerships not only demonstrated inter-community solidarity but also how the city's residents recognized the highly uneven implications of the pandemic in relation to resource access. Some of these 'pairings' brought together suburbs that were relatively near to each other, while others covered significant distances. For example, the Seaboard CAN partnered with the CAN in Gugulethu, which is some 35 km distant. This latter partnership was described by an activist in Gugulethu as follows:

'While mobilizing among ourselves is the primary purpose of the CANs, the cross-suburb networking did spark the hope that Capetonians might reach out across town in an unprecedented way to stand up to history in this crisis... The breakthrough came Tuesday evening, less than 36 hours before the lockdown... [the] Seaboard CAN was going to pair with us. They wanted to help get our part of Gugulethu a little better prepared... Gugulethu hopes to be able to return their kindness in many ways, including through skills and experience in community organizing that we have gained through having to deal with frequent local crises'<sup>40</sup>.

Given the limited presence of the state in food provisioning prior to the crisis, while some CAN activists accused the state of ignoring its constitutional mandate, most CAN activists had limited expectations of state action in ensuring food security during the lockdown. For the most part, the state struggled to interact with and support the local activist groups. In some cases, there was active opposition by city councilors and others who perceived a threat to their power and legitimacy in local communities emanating from the CANs and their activities. In one neighborhood, for example, local political leaders evicted CAN activists from a building in which they sought to establish a community isolation center; the CAN activists were accused of supporting a competing political party<sup>43</sup>.

### Longer-term developments

As with many such operations, the initial 'emergency feeling' that motivated the CAN activities declined together with donations from locals and foreigners. While the CANs demonstrated the flexibility, responsiveness, and creativity of novel social networks in food provisioning, it was difficult to sustain the investment. As one interviewee said, 'The speed at which we had to move in the first few months and the need to constantly adapt was necessary but exhausting and not sustainable.' Another noted, 'From June, the donor fatigue thing was huge... there was a massive decline.'

Recognizing the likely persistence of food insecurity long beyond the acute phase of the pandemic, activists called for more longer-term, systemic solutions. Some CANs formalized their organizations as non-profits (or allied themselves with more established non-profits) and diversified their activities towards community development efforts; others have invested in community gardens as a means of both community food security and revenue<sup>44</sup>. More established formal civic organizations, including the Western Cape Economic Development Forum, the Western Cape Government, and academic groups established a new dialog around the future of food system governance in the Western Cape region, reinvigorating public sector attention to urban agriculture and food security in relation to urban resilience<sup>27</sup>. The crisis and civil society's response made visible the malfunctions of the existing food system. The Western Cape Province and Cape Town governments are now participating in several food system

initiatives together with civil society, think-tanks, and academic organizations.

The COVID-19 hunger crisis thus foregrounded the severity of food insecurity in low-income communities and the lacking ability of the state in realizing the constitutional right to food. The remarkable collective action that emerged from within local communities sought to fill this gap but could only ever do so for a limited time. The local community activists vocally called for a stronger role for the state in the food system. At the national level, this contributed to the as-yet indefinite extension of a special social grant that is accessible to all applicants, beyond the child and old age grants that were previously the foundation of the welfare system. At the city level, it contributed to the City and Provincial governments dedicating more attention and resources to issues of risk and rights in the food system (even though this is not part of their formal mandate) (Fig. 2). This included some funding for CANs and related civil society efforts. It also included embarking on a participatory strategy-making process to explore targeted interventions for longer-term food security benefits.

### DISCUSSION

The experience of the City of Cape Town with two crises—the pandemic, and the drought—lends credence to the assertion that systemic shocks can and do generate change in the ways that critical resource systems are governed<sup>20</sup>. In some sense, the crisis created the institutional 'turbulence'<sup>22</sup> for the re-appraisal of established ideas and the generation and adoption of new ideas<sup>45</sup>, shaped by path dependencies and associated vested interests. These shocks also illuminate to whom services are delivered within different government arrangements, and how critical resource flows intersect with expectations of risk management and social protection. These two functions—resource provisioning and risk management associated with that resource—are often presumed to be governed by the same actors and institutions; disturbance illustrates how these functions not only may be divergent but how their governance implies different actors and associated expectations. In both cases, non-state actors, within both the private and civil society sectors, stepped into a perceived breach of unattended risks, moving to address the critical humanitarian need on the one hand and, on the other, the prospect of enterprise closure and consequent failures to private constituents. In both cases, urgency fueled creativity and a significant investment of private resources. In doing so, these non-state actors imagined and enacted innovative possibilities, and established new legitimacy and visibility for themselves as service providers by demonstrating their capacity to participate in resource governance. Nevertheless, the emergence of new governance arrangements and associated resource flows inevitably confronts existing sources of power and legitimacy entangled in infrastructure<sup>6,46</sup>, as well as the expectations and social-political relationships that characterize the status quo.

In both cases, the resources in question—food and water—were codified in South Africa's Constitution as constitutional rights and thus obligations of state actors to guarantee and enforce. Nevertheless, the obligations and expectations of the state, private sector, and civil society were quite different in relation to these resources at the start of the drought and COVID-19 pandemic. In the case of water, the City government was significantly vested in the status-quo governance of municipal water via its material investment in physical infrastructure, and its policy of cost recovery through cross-subsidization by ratepayers. The City was forced to 'own' the drought: while the cause of water scarcity was arguably climatic, the water crisis was squarely one of established infrastructure arrangements and the history of decision-making that constituted these arrangements, as well as government disaster management and response<sup>47</sup>. In contrast, while food is a constitutional right, the state—at all levels of

organization—had largely absconded the role in guaranteeing this right, leaving issues of access and rights to the private sector, civil society, and the economy writ large. And while food insecurity is a public health and economic concern, the city and provincial government had not ‘owned’ food insecurity as a direct responsibility for state intervention prior to the onset of the pandemic.

Notably, the infrastructures involved in food provisioning are modular, adaptive, and decentralized<sup>48</sup>. These infrastructures consist of, on the one hand, commercial supply chains and associated formal transport, labor, and energy networks, and, on the other, of social relations, voluntary delivery and distribution systems, and informal spaces of food production and distribution. In part, because they were not constrained by existing controls over the physical infrastructure of food provisioning, the grassroots organizers and community kitchens of the CANs mobilized into governance arenas as sources of sustenance, as well as in voicing the broader needs and rights of the communities they served. Dispersed networks of volunteers organized loosely over social media channels, becoming critical and suddenly visible modes of food provisioning, and vehicles for ensuring rights to food. Their actions highlighted the limitations of public safety nets and the failure of the commercial food distribution system to address functions of rights and risk in the Cape Town context.

WSIs also moved quickly to fill perceived gaps in water resource provisioning as the state faltered in this role. The WSIs experimented with novel technologies and water management systems to maintain their constituents’ expectations and manage risks to their own financial viability. Their investment in physical infrastructure, however, was very capital intensive and unwieldy: outside of the scope of their business models and technical expertise, and ultimately still tied to the City’s water system. This dependence posed complications for their self-governance and challenged the City’s management of risks and rewards, which were embroiled in its infrastructure control. The innovations in governance in both cases can thus be understood as a function of the flexibility and opportunity physical infrastructure configurations provide to actors, and the tensions that emerge as actors assume or threaten distinct governance roles.

While there is significant ambiguity in the longer-term implications for governance of both water and food, the interactions among state and non-state actors in both cases are notable. In the case of food, non-state actors emerged as critical provisioning players, drawing significant attention from the media and public. While some local politicians may have felt their legitimacy threatened, in the aftermath of the pandemic, city and provincial actors appeared poised to leverage the opening up of spaces of both resource and risk governance (e.g., via channeling resources to community kitchens or via policies supporting urban gardening) to reconsider their roles in mediating risk and guaranteeing rights in the food system.

In contrast, the governance arena in water provisioning opened briefly during the acute crisis, but then was rapidly closed to non-state actors. The drought made clear that the functions of risk and provisioning are embedded and entangled in the rigid ‘hard’ infrastructure of the City’s water and sewage system. The drought did provide a short-term incentive for the City to enroll private actors in water provisioning, enabling non-state actors to accumulate knowledge and capacities critical for water governance. They did so, however, at considerable private cost with uncertain longer-term reward. Modularity in provisioning infrastructure in this case did not translate well to the governance of risk: the City still retained responsibility for any public health failures in modular (but still centrally connected) water supply systems. Thus, in practice, achieving more ‘modular, adaptive, decentralized’ water management<sup>48</sup> proved to be financially risky and technically challenging, threatening the City’s financial capacity to maintain its essential physical infrastructure, as well

as adequately control the potential for unintended public health emergencies. While the City of Cape Town’s most recent policy documents addressing water management—its Water Strategy and Resilience Strategy—celebrate the potential of partnerships and collaborative governance, it is unclear what the concept of partnership will mean for larger-scale private actors in the water sector given the drought experience.

Conceptualization of the governance of critical resources typically emphasizes the importance of flexible, adaptive, and collaborative institutional arrangements<sup>49–51</sup>. Indeed, while decentralized and polycentric arrangements are not panaceas, such governance structures are thought useful in face of the complexity and uncertainty associated with resource systems subject to exogenous shocks and stress<sup>17,52,53</sup>. The drought showed how the private sector was able to contribute to a more decentralized, modular provisioning system for water, which would also have likely benefits for resilience to future shocks<sup>48</sup>. But public expectations, conventional roles, and associated path dependencies that position the City government as responsible for water distribution, quality, and safety, coupled with cross-subsidization policies enabled by a centrally managed infrastructure, have meant that such decentralization was ultimately deemed problematic for the City. This points to the important resistance to polycentrism and decentralization among agencies that may experience such strategies as a loss of power and control with potential political implications. It also points to potential tensions between polycentrism for the sake of enhanced resilience, on the one hand, and social equity considerations and distributive justice on the other.

The emergence of widespread community solidarity responses to the COVID-19 hunger crisis also had many hallmarks of polycentric, decentralized organizing. It was both necessitated and enabled by the lack of a central role of the state in realizing the constitutional right to food. This experience points to the importance of emergent civil society organizing in response to social crises, and specifically how such organizing can bridge spatial, class, and racial divides between historically separated communities. At the same time, the inherently decentralized and dispersed character of food provisioning, which relies largely on private actors and their infrastructure, underpinned the social vulnerability to disruptions to food access. There is no silver bullet to responding to this challenge, but the COVID-19 crisis highlighted the need for stronger welfare nets, as well as the opportunity for local government to play a more proactive role in supporting rights to food in the local food system in collaboration with others.

Overall, our comparison of these two crises, manifesting in the same city within a few years of each other, demonstrates how the different characteristics of critical resource provisioning systems need to be taken into consideration when seeking to understand their resilience to shocks and opportunities for governance innovation. Disturbance provides opportunities for innovation in such material flows, but also—critically—makes visible how the realization of rights and anticipation of risk are critical functions of governance. As distinct actors step up to fulfill these functions in moments of crisis, it can be clear that ‘normal’ resource provisioning governance could benefit from such actors’ otherwise untapped capacities. Further, disturbances illustrate how the neglect of some governance functions results in unmet responsibilities and inequitable burdens and benefits. In short, disturbance offers opportunities for learning; yet, as these cases illustrate, the rewards of resource provisioning—whether economic, political, or moral—as well as the flexibility of the physical infrastructure entailed, inevitably shape the realization of significant change.

Resource governance is thus about more than material flow; it is also about rights of access, the control of rewards, and the distribution and management of risks. Ideally, these diverse

functions are considered prior to any disturbance and, through deliberative processes, urban actors have the opportunity to negotiate responsibilities and roles in their realization prior to conditions of crisis. Nevertheless, the physical infrastructure and rewards associated with corresponding roles and expectations among public and private actors can create constellations that constrain or enable innovation. They also point to constraints to the expectation that polycentric, decentralized governance arrangements are always feasible or desirable.

## METHODS

### Data sources for the COVID-19 case study

Data collection for the CANs case study commenced in April 2020 by the second author, when the government's COVID-19 lockdown regulations were announced and then enforced a few days later. Within a few days, 'Community Action Networks' or CANs had established themselves in dozens of suburbs in Cape Town. A metropolitan network of these groups soon had thousands of members representing about 170 CANs on its Facebook page. From the overview of these emergent activities and the second author's existing networks, specific emergent groups were identified for a more detailed study. The selection process was guided by our interest in CANs that were especially prominent in the metropolitan level discussions, that established links across privileged and precarious communities, and where we could gain access to key actors. The final sample included eight CANs from both privileged and precarious communities, as well as two groups that functioned at a metropolitan level to facilitate coordination and communication between neighborhood-level groups, and between such groups and more formal actors, including the City government and other state organizations. Human subjects approval was granted to the second author from the University of Cape Town and interviewees provided consent. Three interviews with one to three activists associated with each of the groups in three rounds of data collection were undertaken, resulting in 42 interviews. The interviews captured the temporal trajectory of the CANs throughout the pandemic (April–June 2020, August–October 2020, and March 2021). The first round was in April–June 2020 and this focused on the onset of the emergency and the most severe government lockdowns. To understand how the crisis and emergent groups' responses evolved, a second round of interviews was conducted in August–October 2020, and then a third round in March 2021. Interviews were augmented by participant observation in many online discussions and seminars.

### Data sources for the drought case study

The research for the WSI case draws from both targeted interviews with five entities that had WSI contracts during the drought, as well as interviews with municipal politicians and a quasi-public economic development agency representative familiar with the WSI program (for a total of 9 interviews) conducted in 2021–22 by the lead author. The human subjects research protocols were approved by the Arizona State University Internal Review Board; all interviewees provided verbal consent. The WSIs were identified from publicly available media reports and leads offered by key informants; a full list of all WSIs was requested from the City of Cape Town but was not made available. One key informant estimated from attending WSI informational meetings convened by the City that there were no more than two dozen entities with contracts at the peak of the drought. These data were supplemented with prior recorded (and publicly available) interviews conducted in 2019 by the Cape Town Drought Response Learning Initiative (Resilience Shift and the African Climate and Development Initiative, University of Cape Town, see Resilience Shift and The African Climate and Development Initiative, University of Cape Town; see: [https://www.drought-response-](https://www.drought-response-learning-initiative.org/full-length-interviews/)

[learning-initiative.org/full-length-interviews/](https://www.drought-response-learning-initiative.org/full-length-interviews/)) and direct observations associated with the drought response that has been documented in the work of co-author G. Ziervogel<sup>33,47</sup>.

## Reporting summary

Further information on research design is available in the Nature Research Reporting Summary linked to this article.

## DATA AVAILABILITY

The interview data collected in both the CANs and WSI case studies are protected by Human Subject protocols and are thus not publicly available. Enquires about the interview data should be directed to the first author (WSI case) and second author (CANs).

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## AUTHOR CONTRIBUTIONS

H.E., R.H., G.Z., and C.S. conceptualized the manuscript; H.E. and R.H. provided empirical data, H.E., R.H., and G.Z. prepared the initial draft, H.E., R.H., G.Z., and C.S. edited the manuscript. All authors read and approved the final manuscript.

## COMPETING INTERESTS

The authors declare no competing interests.

## ADDITIONAL INFORMATION

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