Gridless water configurations in growing cities in India and Kenya

SEI brief
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Key messages

- Rapidly expanding cities such as Bangalore, India, and Nakuru, Kenya, face increased water demand, while limited and deteriorating infrastructure challenges water service providers to secure and distribute water supply evenly and ensure quality.
- Decentralized, informal solutions and systems in the two cities bridge these water provisioning challenges, often as the main method through which populations meet their water needs. These "gridless water configurations" are not thoroughly regulated, exacerbating existing inequalities.
- Leadership from policymakers is needed to address the complexity of urban water challenges and create an enabling environmental for local participation in driving equitable urban water development.
- Urban water planning in Bangalore and Nakuru should document and take into account gridless water configurations, which are currently unmonitored, to avoid depleting critical water resources such as groundwater and to limit inequality in water access as the cities urbanize. Where gridless water configurations are most effective, they should be incorporated into urban water plans.

1. The urban water challenge in emerging cities

Secondary small- and medium-sized cities in Africa and Asia are projected to become home to over 2 billion people in the coming decade (UN-Habitat, 2022). The majority of these cities are increasingly challenged in addressing basic development needs while promoting economic growth (Archer et al., 2016; UNDESA, 2019), in particular when it comes to providing water for their residents. Urbanization in these regions forces municipalities to find ways to expand water supplies in areas without perennial water sources, expand water pipe networks despite funding deficits, and ensure clean and reliable distribution of water when infrastructure is lacking.

Existing urban inequalities in cities, in the form of social marginalization and service discrimination, increase the disparities between those who have access to secure and reliable water and those who do not (Lufumpa et al., 2017). These challenges are compounded by climate risks as well as the insufficiency and deterioration over time of water provisioning infrastructure (IPCC, 2023; Oviedo & Nieto-Combariza, 2021). The problem is further exacerbated by urban migration that is a result of lack of employment opportunities in rural areas and displacements from conflicts, environmental degradation and natural disasters (UN Water, 2021).

Against this background, a variety of innovative "gridless" water solutions have been studied and implemented at neighbourhood and district levels in these rapidly growing cities, to offer cost-effective and sustainable alternatives to centralized water services (Asvanon et al., forthcoming). These alternatives include a broad range of decentralized water configurations, which include complex and simple technological solutions for extracting, distributing, purifying or circulating water, as well as basic informal water practices such as using water pushcarts and rainwater harvesting in inaccessible and neglect areas.

We term this array of informal responses gridless water configurations, sometimes referring to "water configurations" in this brief. Many communities, particularly economically and socially marginalized ones, are dependent on these informal water services. However, these services are unregulated and often exacerbate social inequalities (e.g. according to gender norms, price discrimination and caste inequalities). Socio-technological and governance approaches can mitigate the situation.

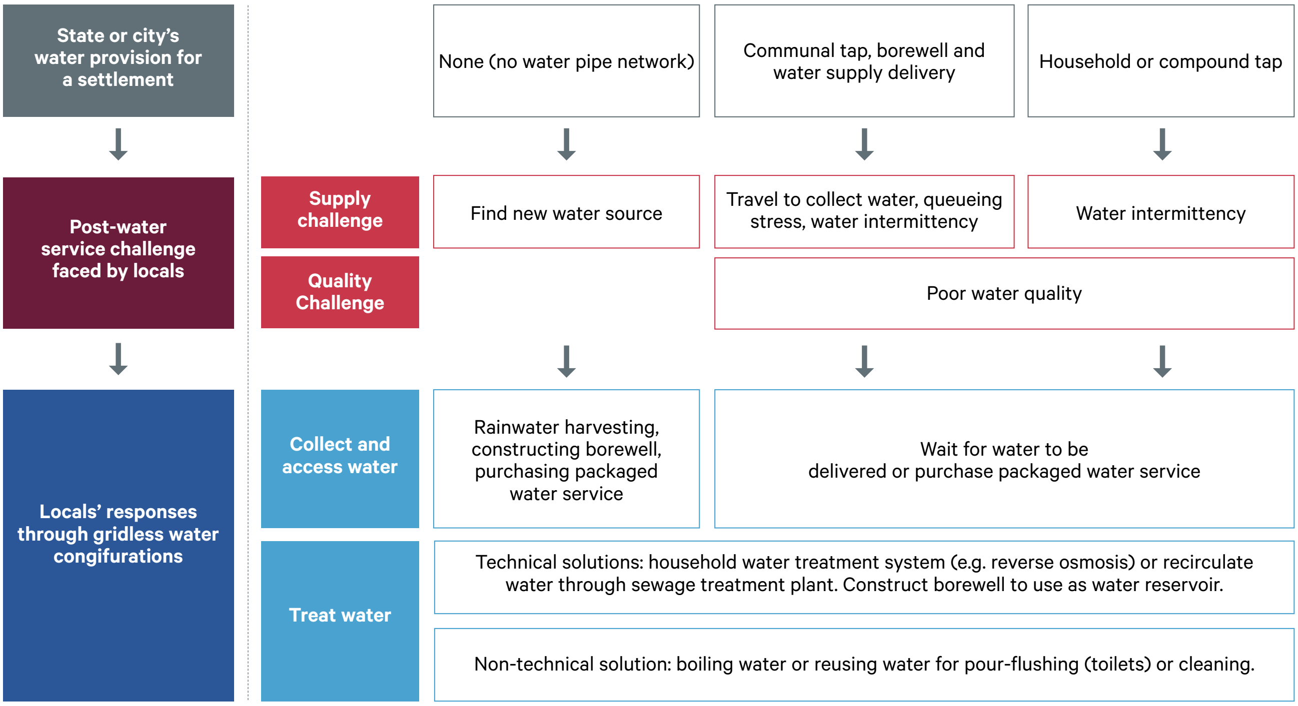
In this brief, which is based on forthcoming research (Asvanon et al., forthcoming), we explore how urban and water planning authorities can consider integrating decentralized and off-grid ("gridless") solutions to improve water services for more sustainable and equitable outcomes. We surveyed sites and conducted in-person semi-formal interviews with both water users (need-driven perspectives) and water providers (regulated and unregulated or state-run; policy-driven perspectives) in Bangalore, India, and Nakuru, Kenya. We assessed the pathways to converge these perspectives to move these and other cities like them toward equitable water provisioning.

2. Water configurations in Bangalore and Nakuru

Bangalore and Nakuru increasingly face water supply, access and quality challenges as they continue to grow (Ondigo et al., 2018; Wisner et al., 2015). With current populations of more than 8.7 million in Bangalore and 570 000 in Nakuru (Bengaluru Urban District, 2023; Nakuru County, 2021), studies have estimated that about 3.5 million (45%) and over 280 000 (50%) of people in each city, respectively, still lack access to proper water services (Chattopadhyay, 2022; NAWASSCO, 2017). Urban migration – driven by lack of job opportunities in rural areas and rapid industrialization of urban areas – to both cities have stressed water resources, leaving a large and growing portion of the urban populations without basic water services.

Both cities face two key challenges: first, planning authorities are unable to meet growing water demands in Bangalore and Nakuru because the cities' water supplies cannot meet the growing demand due to urbanization. Second, the rates of formation and densification of informal settlements in both urban and peri-urban areas outstrips the expansion of central water systems, subjecting settlement dwellers to water scarcity – due to poor supply, access and quality. Finally, these water challenges are further exacerbated by environmental changes and resource degradation. Figure 1 illustrates these water challenges and how local communities are conceiving a variety of ways to respond, using different water configurations, including "off-grid" or "gridless" ones.

Figure 1. Water supply, access and quality challenges, and how locals respond through gridless water configurations.



Source: author's own

Failing to recognize the ranges of water configuration operated by locals can lead to land degradation and water resource depletion. Lack of planning or oversight of community borewell construction can lead to future water supply issues, such as the depletion of groundwater.

In both cities, groundwater being extracted by local borewell constructions have depleted the water table and exacerbated water stress in certain districts. Additionally, these newly built areas prevent water permeation and groundwater replenishment, where concrete blocks water from percolating into the ground. Crucially, this has been causing the borewells to dry up.

This further drives construction of borewells in new locations in peri-urban areas and leads people to resettle there. Lack of regulation of borewell construction encourages the city to sprawl, while built environmental structure impedes replenishment of the water table.

3. Approaches for improving urban water governance

We present three approaches to incorporate gridless water configurations into various forms of urban water governance: recognition of their various forms, inclusivity for planning and policy development, and raising awareness of urban water infrastructure, governance and hydrology.

3.1 Recognition of water configurations and their variability

Bangalore and Nakuru water authorities should recognize and incorporate the various gridless water configurations used throughout the city by local communities into their policies and implementation instruments. In Bangalore and Nakuru, various water configurations are used in multiple ways and by multiple income household levels: rainwater harvesting, borewell construction, water package delivery, boiling water and reusing non-potable water for general household purposes (for details, see Figure 1).

We found such practices enable communities to address issues of water supply, access and quality. For example, in a peri-urban area in Bangalore, for households that are not connected to a water-delivery pipe, household members regularly refill their water tanks at a local water kiosk station (Figure 2).

Figure 2. Left: a peri-urban dweller in Bangalore can ride to a water kiosk (right) to refill household water containers from a reverse-osmosis purification system.

Source: author's own

Similar situations occur in Nakuru (Figure 3). Households have multiple water tanks to store water and refill them at a water kiosk station or from rainfall.

Figure 3. Left: water containers that an informal settlement dweller in Nakuru uses to refill water every two to three days. Right: water filling station in Nakuru.

Source: author's own

However, the lack of recognition from authorities reduces communities' chances to take part in participatory planning and risk management related to urban water stress. Without coupling community water resilience with a participatory planning process, cities cannot create a just development outcome. As such, recognizing gridless water configurations that are informal and typically decentralized – both in the physical (water pipe network) and institutional (not owned by water authorities, utilities or companies) sense – needs to be part of equitable urban water planning.

In Nakuru, despite national legislation mandating the city and water authorities to implement rainwater harvesting practices (The Nakuru County Water and Sanitation Services Act, 2021), the city's water policy – especially the low-income area water action plan (NAWASSCO, 2017) – does not recognize borewell construction and registry, nor rainwater harvesting by local residents. This contrasts with the realities of the 12 settlements that we visited, where settlement dwellers reported collecting rainwater, mainly in the rainy season, from rooftop runoff or in containers standing outdoors when it rains.

Bangalore and Nakuru water authorities can increase the level of recognition of gridless water configurations in their policy and regulation "toolkit" by engaging with local communities and their civil society organization partners, to identify the various forms of water configurations. Via communities' engagement activities, the water authorities can identify and document the pros and cons of each water configuration and draw out themes of community water solutions. For example, the water and city authorities can develop socio-technical models for rainwater harvesting in low-income and informal settlements or for collecting and reusing grey water (e.g. laundry water) for flushing toilets. They should also pay particular attention to social inequities that arise under any system, such as unfair pricing set by landlords that own water supplies.

Water authorities can then consider integrating these water configurations into policies that address urban and community development, water and sanitation planning, and water pricing models. Ultimately, water authorities should actively promote and institutionalize this process, to integrate local communities and civil society organizations as agents in water planning and decision-making processes.

3.2 Inclusion in planning and decision-making

Recognition establishes the basis for creating and strengthening participatory planning. Increasing the recognition of gridless water configurations by local and national water authorities in water planning will help these locally led services or need-driven activities to be seen as legitimate and long-term solutions – which in practice, many of them are.

Incorporating gridless water configurations into planning processes also would allow water authorities to be more effective in designing water policies and revenue models. For instance, we found that the Bangalore water authorities' current pricing model subsidizes residential water use and aims to recover this cost by raising the prices for commercial organizations. However, commercial organizations in the city have turned to cheaper water configurations, such as constructing their own borewells to meet their water needs. In addition to compounding water scarcity issues (through unregulated consumption of groundwater), this jeopardizes revenue generation for the Bangalore water authority. The authority has also incurred debt to the electricity utility company, as it pumps water upstream from the nearby river, which requires large amounts of electricity. The lower-than-expected revenue should signal to the water authority that it has an ineffective pricing model.

Similar to Bangalore, a public hospital in Nakuru has come to rely on privately owned boreholes for water (Figure 4). The hospital official stated that they are otherwise unable to secure a water supply for essential use in the hospital.

Figure 4. Water tanks in a public hospital in Nakuru being filled by pumping water from their own borewells, similar to the case in a private hospital in Bangalore. Water authorities do not charge for water drawn from private borewells.

Source: author's own

3.3 Awareness of urban water landscapes

Fundamentally, gridless water configurations are responses developed by water users in the areas to effective address water supply, distribution and quality issues. By incorporating gridless water configurations into Bangalore's and Nakuru's water planning processes will enable the water authorities and urban dwellers to rethink and transform how water services are perceived and implemented. Integrating gridless water configurations into urban water policies implies reconsidering responsibilities, budgetary outlays and investments in local communities.

In doing so, water authorities and urban dwellers would be co-designing, implementing and operating decentralized water services that rely on groundwater (borewells with protected replenishment of groundwater), precipitation (rainwater harvesting and reservoir planning), and urban water services (standardizing water prices, maintaining quality and regulating services). For instance, water authorities can regulate or subsidize water package prices to fit users' capacities, or they can direct water refilling services to areas that face persisting water supply deficits. As an outcome, Bangalore and Nakuru's urban planning and decision-making processes will inherently become more sensitive to the hydro-social landscape.

Enabling local communities to co-develop gridless water configurations can increase Bangalore's water catchment capacity. In two settlement areas, the communities constructed borewell and reservoirs to capture rainwater, and they implemented sewage treatment plants to recycle the water. This created a circular water system that enabled the two communities to become independent of the central water pipe system. Locals also reported a strong sense of fulfilment and satisfaction in being more water conscious.

Moreover, borewells and reservoirs can be used for other urban needs, such as parks and biodiversity enrichment sites. Two settlements in Bangalore that depend on a community reservoir have developed a community park with running and cycling tracks and sitting benches in the area. This allows the local communities to enjoy other functions, such as recreation and exercise.

One private borewell owner in a peri-urban area of Bangalore explained that their borewell also helps to replenish groundwater. It also helps their household to meet both domestic and agricultural needs (Figure 5).

Figure 5. This local borewell is perpetually replenished by rainwater. Its owner can depend on it entirely for water consumption and agriculture.

Source: author's own

Water authorities should continuously strengthen their capacities to engage with local users, to both accommodate and regulate the variety of gridless water configurations in their cities. Involving locals more in city water planning and decision-making processes would lead to urban water governance in Bangalore and Nakuru that accommodates the local perspective, while delivering water equitably and safely.

In conclusion, this policy brief shows that local water users have developed a range of gridless water configurations to meet their water needs in emerging cities such as Bangalore and Nakuru. By incorporating these configurations into the urban planning process, water authorities can better recognize and enable local to participate in urban water planning more meaningfully and in ways that more effective meet their needs.

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