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VERTICAL INTEGRATION AND LEARNING FOR LOW-EMISSION DEVELOPMENT IN AFRICA AND SOUTHEAST ASIA

Water and the city: Where adaptation and mitigation converges

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One of the most essential elements of human life, water, is also one of the resources most impacted by climate change. The management of our water resources brings to light the limitations of the dominant, short-termist approach to resource extraction and utilisation. Managing water with a higher degree of respect for natural systems and human rights, would demonstrate the transformative shift that is needed to address the increasing development pressures of population, urbanisation, inequality and climate change. A shift in resource management practices would also ensure that water is able to enhance adaptation and mitigation outcomes, thus indicative of a shift in values and world views needed to face the climate crisis.

This brief was written by Johara Bellali, Meaghan Parker and Yann Robiou du Pont, based on a V-LED commissioned research on "*participative bio-regional planning and water sensitive design for South African local governments*" by M.Maynard and C.Bester carried out in 2016 and interviews with Belynda Petrie, One World solutions, Cape Town, South Africa. This brief uses the South African example to illustrate a global issue. It will provide an overview of the links between water, adaptation and mitigation; and present an alternative approach to water planning at multiple levels.

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Executive Summary

Access to water is a human right (UDHR, 2010). But in the world's growing cities, local governments struggle to provide sustainable water services for all of their residents. As population growth and urbanisation increase demands on scarce water supplies, this goal is made increasingly more difficult to achieve. For example, water and sanitation infrastructure is almost universally inadequate in Lagos, for its burgeoning population, currently ~ 21,5 million.

In many cities, growing demand for water supplies combines with other trends to challenge municipal governments' efforts to provide water and sanitation. In many parts of the developing world, climate change impacts are predicted to strain water supplies, exacerbating water scarcity at the local level. At the same time, providing water services is becoming increasingly energy-intensive. Many cities, for example, are turning to the use of expensive and energy-intensive desalination plants to generate new sources of water supply, hindering efforts to meet greenhouse gas emissions reduction targets, until these are powered by renewable energy. Furthermore, as rural-to-urban migration and population growth push cities to expand, so do unplanned, informal settlements, further straining services, particularly for the poorest and most vulnerable. Finally, resource-intensive centralised water infrastructure systems threaten to lock-in greater vulnerability to rapid environmental and social changes. This is true both with regards to infrastructure that is vulnerable to the effects of climate change arising from increasing and more intense natural disasters, but also in terms of the financial risks associated with so-called "stranded assets". For example, multi-purpose dam installations that are unable to produce the planned levels of electricity due to droughts that reduce water levels to below hydropower generation requirements.

Traditional responses to increasing demand and drought risks, based on the development of mega-scale infrastructure and linear water management solutions have reached their limit in many cities around the globe. This can be attributed both to a lack of available water resources, as well as the financial resources required to develop such projects; the risks posed by climate change (along with water governance risks) influencing the ability to attract investment into such projects. This illustrates the limits of a short-termist extractive approach to resource management. Water services now need to operate within a 'new normal' water-scarce physical environment and hence rethink management beyond the individual and city level. We need to tackle water supply in the face of climate change with a multi-level climate governance lens, that includes a strong focus on citizens.

To meet all of their residents' needs, cities must develop water service systems that are socially inclusive, ecologically sustainable, and climate-sensitive. Building a **resilient, socio-ecological water service delivery system** can help cities adapt to climate change by decreasing their vulnerability to its impacts—and at the same time, helping them to meet mitigation goals by reducing certain emissions. In addition, a sustainable model has several important co-benefits: it can empower citizens, create job opportunities, improve human wellbeing, and protect livelihoods, thus creating more equitable, liveable cities.

To achieve this goal, municipal governments should:

- Realise the convergence of water management, climate adaptation, and mitigation;
- Update, and in some instances, transform regulations, targets, and guidelines;
- Develop a decentralised, circular model of management; and,
- Use a watershed approach that integrates governance across multiple levels.

Differentiating adaptation and mitigation at local levels is counterproductive, the pathway to low emission development needs both perspectives and water is the best illustration of its convergence.

Four Challenges Facing Cities

The world was shocked to learn that taps in the city of Cape Town, South Africa were about to run dry in 2017 following three years of below average rainfall. The City was preparing to distribute bottled water, through identified city points, meaning people would queue and compete for the resource, for essential uses to alleviate potential disastrous impacts on public health, hygiene, hospitals, fire services and the full spectrum of economic activities.

The City's aggressive communication strategy with a count-down towards a "Day-Zero", and increasing restrictions effectively catalysed action from all levels of civil society as well as the private sector (particularly the hotel industry). The population engaged in exceptional measures, limiting water consumption to 50 litres per person per day, whilst industry and farmers were also required to severely limit their water usage, contributing to an almost 50% overall reduction in water use in the city[i]. Although these actions pushed the date of day zero back, the risk of running out of water remains very real. The drastic measures implemented by the City reached the limits of their powers and Day-Zero was ultimately avoided due to the voluntary release of water by farmers from dams outside the City's jurisdiction, and subsequently by unusual levels of unseasonal rainfall. Early analyses highhlights that City authorities prepared and responded adequately to the unforeseen intensity and duration of the drought. Though ultimately, the issue of opposing mandates between the different levels of government had the greatest impact on the ability of the City to respond appropriately. In South Africa, whilst local government is responsible for basic service delivery, including the delivery of water, national government holds the exclusive mandate to invest in new water storage and supply infrastructure.

Cape Town is not alone: A growing number of cities are confronted by the same or similar problems that undermine their ability to provide water services for all of their citizens. Water is already scarce in cities all around the world, both in developing and developed countries, such as Sao Paulo, Cairo, Beijing, Moscow, London and Tokyo[ii], to name a few. A close look at South Africa sheds light on the challenges facing local governments in other water-stressed regions.

Growing demand of water and electricity

South Africa's freshwater ecosystems are generally declining faster than they are being regenerated, while the demand for water is increasing. In many South African municipalities, demand already exceeds the available supply, and this trend is projected to intensify between now and 2030. Importantly, this overshoot will take place even if the national government's proposed new water infrastructure projects are built on time by 2035, and even if conservation and water demand management measures are implemented. Thus, to achieve sustainable local water service delivery, local governments in South Africa must step in to fill the gap.

Of course, water is not only needed for drinking; water is also key for electricity production, industry and manufacturing, agriculture and food production. Therefore, water demand must be managed across multiple scales and governance levels to balance individual and commercial uses. In particular, fossil fuel-dependent electricity generation is water-intensive, requiring water for mining source fuels and for cooling power plants. Similarly, water provision itself can be energy-intensive, requiring heavy use of fossil fuels for transportation or some technologies, like desalination. Water is at the nexus of climate adaptation and mitigation.

Rapid urbanisation and informality outpaces water service delivery

South Africa is fast becoming a predominantly urban nation, with the United Nations projecting it will be 71 percent urban by 2030, and 80 percent by 2050. The scope of water services needed to support this urbanisation is significant. At the same time, the rapid pace of urbanisation will increase the size of unplanned settlements. The growth in informal slum settlements will greatly affect the type of infrastructure and service delivery required to serve residents in these settings, which are typically unconnected from traditional water delivery systems.

Globally, “by 2050, it is estimated three billion people will be living in slums and informal settlements: neighbourhoods without formal governance, on un-zoned land developments and in places that are exposed to climate related hazards (IPCC 2018[iii])”. The vulnerability to climate risks is growing as the informality grows – spinning into a societal risk of conflict.

The construction of formalised water services infrastructure is not able to keep up with South Africa’s rapidly expanding informal areas, producing a self-reinforcing informality effect: growing slum settlements reduce the rate base and thus also reduce the available capital for new formal infrastructure investment which, in turn, increases the informal and un-serviced areas. While urban areas in South Africa are currently predominantly formal, this self-reinforcing informality effect is already underway and will likely accelerate as urbanisation increases.

Cumulative drought-flood cycles erodes development and economic gains

While each city has specific exposure to environmental risks, global warming increases water risk in cities across the world by changing both trends and patterns of extreme temperature and precipitation events. The rise of sea level resulting from global warming is a gradual ramping threat to freshwater availability in coastal areas when 90% of the world’s urban areas are on coastlines[iv]. The infiltration of salt-water in deltas and water-tables affects ecosystems, agriculture and cities’ access to drinking water. However, most current impacts of climate change on societies are not rampant and result from more likely and less predictable extreme events such as floods and droughts[v]. The current observed trend of recurrent, chronic droughts followed by floods in a cycle of micro-disasters. It is indeed the cumulative effect of small but more frequent disasters that erode development gains, coping capacity and resilience. The resulting uncertainty affects the ability of planners and decision makers to design resilient water services, and most cities are not very resilient to water risks[vi]. Currently, the municipal water management infrastructure is not built in a way that flood water can be managed in prevision to the next drought; our concrete jungles encourage wasteful surface run-off, and are grid-locked during rains (e.g. Nairobi, Manila, etc.).

Infrastructure lock-in

The negative effects of rapid urbanisation and climate change are exacerbated by cities’ dependency on “hard” infrastructure solutions. South African cities—like most cities—have prioritised concrete, centralized systems. In addition to being expensive, this infrastructure is relatively inflexible and unable to adapt to rapid environmental and climatic change.

By building concrete jungles, cities have rendered the land impermeable to rainfall, thus reducing groundwater recharge and exacerbating other problems affecting groundwater, such as salt water infiltration, subsidence, and pollution. In addition, these urbanised infrastructures contribute to the “urban heat island” effect, creating in turn increased demand for air conditioning and other cooling technologies, boosting GHG and other emissions up.

Mega-scale water infrastructure predominantly serves industries like mining and large-scale agriculture, which are also water and energy intensive and themselves depend on centralised infrastructure, thus escalating the cycle of dependence. These resource-intensive forms of economic growth impede sustainable—and equitable—water service delivery, particularly to marginalised communities who may not benefit from industrial economic development.

By investing in these large, costly, centralised infrastructure solutions, municipalities risk “locking in” investments and their vulnerabilities to climate change and thus eliminating the flexibility needed to adapt to future risks and opportunities. Applying purely technological solutions that do not account for the complexity of reality creates path dependencies and sets development trajectories that reinforce a detrimental relationship between ecosystems and society.

Municipal water management decision making across levels and sectors

There is a scale mismatch "between the local manifestation of climate impacts and the diverse scales at which the problem is driven" (Shi et al., 2016 in IPCC 2018)

Researchers at the University of Cape Town recently identified that the conventional models long used to forecast supply and demand are based on incomplete statistical analysis[vii], which led to overconfidence from the City authorities to avoid an exceptional drought[viii]. As water managers continue to wait for climate change models to become more certain or more specific, they defer action, paralysing decision-makers[ix] when innovative climate adaptation programmes are needed. However, hydrological models forecasted the risk of droughts that hit many cities and disagreements across levels of governance[x]exacerbated political inaction.

Water management considerations are not only vertical across levels of governance but also horizontal across sectors, and so is its governance. Globally the agriculture and energy sectors are both heavily relying on water provision while being great contributors to global warming, with 12% and 70% of global emissions respectively[xi]. Interestingly, renewable energy has important co-benefits for water provision: Replacing thermal power plants (based on coal, nuclear and other fossil fuels) can significantly increase water availability. Although global estimates are lacking in the absence of transparent reporting[xii], the International Energy Agency's World Energy Outlook 2016 found that energy production currently accounts for 10 percent of the world's total water withdrawals. India could reduce its water consumption intensity by more than 25 percent just by achieving its renewable energy targets[xiii].

Cities currently planning their water services have a great opportunity to design and create a *climate risk-proofed, low emission, socio-ecological sustainable model*. To do so, the scale of water management plan needs not only to adapt to water demand, but also to the geography of hydrological cycles[xiv].

The concept of 'bioregionalism' planning was introduced in the 1970s to maintain the integrity of ecosystems while promoting sustainable development. A bioregional plan looks **at a circular model of management instead of a linear one**.

Building a circular water system

In contemporary formal water infrastructure systems, water is sourced from predominantly surface water sources, such as mountain catchments and dams, transported to a treatment plant, distributed via pipes and pumps to be used across urban areas. Wastewater is then disposed of into a treatment plant, before it is released into river systems or coastlines. Thus, global legislature and investments have been oriented towards protecting, developing, and utilising surface water, with infrastructure such as large reservoirs for water collection and distribution. Rainwater is regarded as a waste product, and unpotable stormwater is drained out of the urban system into streams and rivers. Sewerage is waterborne, requiring thousands of litres of additional treated surface water per person each year.

This linear, artificial, and unsustainable approach to urban water systems is not only unsuccessful in water-scarce cities, it is unsustainable in the face of climate impacts. Today, it is time for a new water paradigm, one that recognises that water is part of a cyclical system where everything is connected. The new water paradigm views the small water cycle as part of integrated regional cycles, which supply vapor to the atmosphere, where the sun condenses it to form rain. In this sun-driven hydrological cycle, natural ecosystem infrastructures are no longer separated from the more dominant man-made infrastructures.

Regulations and engineering guidelines for infrastructures and urban development are sometimes based on outdated standards that do not account for current realities and current necessities. Infrastructure was sometimes designed to serve political development plans, sometimes purposefully detrimental to populations under the apartheid in South Africa[xv], rather than hydrological or social logic. The design of long-term plans remains often driven by short-term populist considerations, rather than based on science and risk assessment towards, and their implementations depend on multiple-levels of governance often not involved in the design itself[xvi].

Building a resilient, socio-ecological water service delivery system that leverages the power of natural solutions can not only help cities meet growing water demand, it can help cities adapt to climate change by decreasing vulnerability to its effects and reduce emissions. This sustainable model has co-benefits: it can increase citizen ownership, job opportunities, human wellbeing, and livelihoods, thus creating more equitable, livable cities.

There are three core approaches that cities need to adopt in order to build resilient, socio-ecological water service delivery systems:

1. Bioregional ecological management and planning; and,
2. Water-sensitive settlements
3. Multi-level multi-stakeholder management

Bioregional ecological management and planning

In most cities, local municipal boundaries have been established along fiscal and political demarcations, but watersheds may span multiple municipal boundaries, forcing different municipalities to share the same water sources. In South Africa, the apartheid system used spatial planning and hard infrastructure to reinforce systems of exclusion. A new approach called 'bioregional planning' may enable municipalities to effectively manage shared watersheds and increase social inclusivity at the same time (Maynard, M and Bester, C.D.2016).

Bioregional planning promotes the sustainable relationship between environmental integrity, human well-being, and economic efficiency within a defined geographical space determined in accordance with environmental and social criteria. A bioregion is a geographical place that contains one or several nested ecosystems characterised by landforms, vegetation cover, human culture and history as identified by local citizens, governments and scientists. Thus, natural forms and living communities, including human, become the descriptive features of each bioregion instead of the politically drawn lines used to define municipalities, districts, provinces and the country.

To address current and future water needs, we need to begin to regenerate the ecological foundation to support sustainable local water services and increase the availability of water. Using bioregional planning to regenerate local freshwater ecosystems could also unlock significant opportunities to create new jobs and skills, and thus create more livelihoods and more livable settlements.

Water-sensitive settlements

The water-sensitive settlements approach, which was developed by the South African Water Research Commission and the University of Cape Town Urban Water Management Research Unit, integrates the design, planning, and infrastructure aspects of water supply, demand, and disposal. This approach focuses on the sensitive integration of "natural" ecosystem infrastructures with manmade (formal and informal) infrastructure systems. This sensitive integration aims to retain, regenerate, and maximise the wise utilisation of natural water systems (including catchments, rivers, wetlands, water retention areas and floodplains) thereby reversing the trend of ecological degradation from human livelihoods and development. This re-connection with ecological systems also introduces greater information flows and feedback loops across the socio-ecological system.

In addition, it re-establishes human relationships with natural systems, which could help open public spaces to re-connect diverse groups of citizens. Particularly in post-apartheid South Africa, such a reconnection can help counter infrastructure-facilitated spatial segregation.

This approach also provides significant livelihood opportunities: hybridized, decentralized water infrastructure systems can integrate relatively no-skill and low-skill jobs, such as clearing swales and managing wetland systems, with high-skill technological tasks, such as control room operators, town engineers, and centralised water systems managers. The transition to will require more heterogeneous, adaptive forms of design, planning, and governance that incorporate informal settlements and integrate local communities into decision-making, ownership, and monitoring.

Involving communities of practice and learning alliances, including academics, local residents, and the business sector, is vital for ensuring joint ownership in project selection, monitoring, and evaluation. Municipal managers are key champions in integrating and promulgating this new approach at local municipal level.

Multi-level governance lens on water management

1. Changing the scale of management

Water needs to be managed throughout its supply and usage in a coordinated manner. It almost never is. In South Africa, water resource management (or basin management, catchment area management) is done at the national level, whereas water distribution to households is the mandate of the municipality. This discrepancy is at the root of the problem in many areas of the world and the situation can aggravate when the different levels are in opposite political side, which was the case for Cape Town in South Africa.

A water catchment area can be outside of the boundaries of the receiving municipality and governance is generally inadequate at a transboundary levle to manage both the water resource and its distribution. In cases where a water basin agency exists, it rarely has the authority over agencies *within* a municipal boundary. A decentralised and participatory approach to water resource management can be more adaptive and flexible to the changes needed to ensure adequate recharge of the water supply - be it a dam or groundwater - whilst distributing the water to its citizens[xvii]. Customised demand side management regulations can then be enforced to reactively align practices to climatic variations and extreme events. The decentralisation process can include reforms "to further improve accountability, strengthen capacity for regulation, improve the investment planning process, reinforce participatory approaches, and further reduce the fiscal burden" (FAO, 2015)[xviii]. These reforms need to address inequities more effectively and strengthen the social compact between institutions and communities[xix].But a decentralised system needs strong governance structures, in particular with regards to cross-subsidisation of water services and with transboundary negotiations. A centralised agency is needed to coordinate subnational action. This overview from a national perspective is especially needed as government agencies of the same rank cannot issue binding order to each other[xx]. Overall, the national and local governments must have clear mandates and be accountable to allow for customised improvements over time, while citizens are accountable for consumption and water quality management.

Sustainable management implies a comprehensive inclusion of both temporal and spatial scales. Long-term requires bi/multi-partisan planning. Watershed-level management that may cross regional and national boundaries do effectively improve resilience, in particular in poor upstream communities[xxi], thus we need both horizontal and vertical cooperation[xxii].

2. Building the new climate sensitive qualified force across the levels

The management and monitoring of water systems also requires qualified human-resources that are sometimes lacking[xxiii]. The skills needed for tomorrows cities are diverse: university, vocational, formal and informal trainings need to be updated to energy and water efficient, green, healthy designs, and low emission plans.

Regulations and technical (architecture, engineering, urban planning) guidelines and curricula are being updated in various parts of the world. It is crucial to assess in which ways regulations can hinder innovative solutions, such as rainwater harvesting or renewable energy for water pumping, and also adapt them to more operational and financial flexibility especially in terms of crises.

3. Communicating skilfully at different levels

Water is not waste. Water is a limited public good that should be re-used, recycled and recharged. Communication about water was crucial in "day zero" and can have massive impacts, create fear, destabilise, public outcries and therefore needs to be particularly consciously crafted. "Effective risk communication can influence local support of climate action plans and implementation of strategies that address climate justice and achieve social sustainability in local communities".[xxiv]

Reuse of waste-water exemplifies this circular approach to water consumption. While many populations refuse to drink recycled water[xxv], many cities and countries started reusing such Orange County, California[xxvi], Singapore[xxvii] and Malta[xxviii]. Communication is key to make water reuse more widely accepted. For example, Beijing increased water reuse by 66% and has renamed all wastewater treatment plants "water purification plans".

In crisis time, Communication is essential to preserve the cohesion of the population and its responsiveness to exceptional measures. The use of the term 'day zero' sent a clear signal to Capetonians that urgent and collective action should be taken. The city of Cape Town also communicated maps of water consumptions. Comparing its own water consumption to that of your neighbours or other neighbourhoods is an efficient incentive[xxix]. However, blame and shame can be dangerous in periods of stress and nominal or personal information should not be disclosed[xxx].

Taking the Next Steps: Four Concrete Recommendations for Cities

To achieve socially inclusive, ecologically friendly, and climate-sensitive water service delivery, municipalities should focus on four concrete next steps:

- Realise the synergies between water management, climate adaptation, and mitigation;
- Update regulations, targets, and guidelines;
- Develop a decentralised, circular model of management; and,
- Use a watershed approach that integrates governance across multiple levels.

1. Realise the synergies between water management, climate adaptation, and mitigation:

a. Forward-looking management can avoid severe socio-ecological crises. If water is not managed properly it can impact other locations and future situations.

b. Employ diverse solutions and flexible models, including formal, informal, and hybrid systems of service delivery and maintenance.

c. Regular monitoring maintains socio-ecological sustainability and resilience.

2. Update regulations, targets, and guidelines:

a. To avoid the risk of "lock-in," change outdated technical standards, regulations, and guidelines that do not account for today's realities. Improved regulations can facilitate innovative solutions like rainwater harvesting and renewable energy for water pumping.

b. Update curricula, skills and training at all levels—university, vocational, formal and informal—to support more energy- and water-efficient systems.

c. Target setting can bring different stakeholders together to jointly negotiate and cooperatively achieve the targets. This process can also help guide regulations and guidelines, and clarify mandates, roles, and responsibilities.

3. Use a decentralised, circular model of management:

a. Change the scale of management to a more reactive, flexible decentralised water system, that is overseen by a centralised agency.

b. Move from a linear model to a circular one.

c. Balance the water-energy nexus to mitigate climate change.

d. Change the perception of water from waste to reuse, recycle and recharge.

4. Utilise a watershed (bioregional) approach that brings together different levels of governance around the same table.

a. Stakeholder negotiation and cooperation improves water management

b. Balance horizontal cooperation and vertical governance.

c. Deploy innovative financial instruments and incentives.

Endnotes

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From 2015 through 2018 V-LED aimed to stimulate local climate action by rallying ambition and facilitating dialogue between national institutions, municipal authorities and communities and enabling knowledge sharing and learning among local governments.

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