

# Policy Brief for Water Resilient Green Cities in Africa

## Introduction

To provide urban dwellers with clean water, proper sanitation and protection against floods is a growing global challenge. Both in Global South, where basic infrastructure systems has never reached an adequate, citywide service level, and probably never will due to continued urbanization in poverty, but also in Global North, where conventional systems increasingly prove insufficient due to climate change.

Using Addis Ababa in Ethiopia and Dar es Salaam in Tanzania as cases, our objective was to test the promising ideas of nature based alternatives that are currently being tested and increasingly implemented in Europe, Canada, USA, Australia and China in a Global South context, where the potential may be even higher.

We found that nature-based solutions for stormwater management hold significant potential for improving the water supply situation, mitigate erosion problems, and improve the livelihood by using the stormwater elements for urban farming, among other things. Furthermore a mind-set change among individual champions and institutional regimes can be obtained through documentation of coherent and feasible catchment plans, complemented by demonstration of key solutions, and through trainings and involvement. We conclude that a green infrastructure approach with nature-based solutions adapted to the local situation holds a stronger potential to reach sustainable and resilient urban development than continued propagation of grey infrastructure.

For improved water supply, flood control, erosion control and livelihood we recommend not to support grey infrastructure projects, but rather to enable local regimes and individuals to develop a green infrastructure for urban water management.

## Background

The project has explored the use, functions and livelihood activities in urban green spaces, identified opportunities and barriers for integrating stormwater management in the landscape and designed and tested specific nature-based solutions. It has also identified opportunities and barriers, from an institutional point of view, for the adoption of landscape-based stormwater management and how to facilitate inclusive stormwater management.

As stated by the IPCC several climate change risks are concentrated in urban areas, and amplified for those communities lacking essential infrastructure or living in poor-quality housing and exposed areas. With one of the world's highest annual urban growth rates at around 3.5 % and much of the growth as informal settlements, cities in Africa are under double pressure. Thus, successful mitigation must address climate-related hazards jointly with the socio-economic processes driving exposure and vulnerability. In East African cities, including Addis Ababa and Dar es Salaam, the primary climate change hazards, and thus primary adaptation targets, are flooding, drought and water scarcity, while the primary socio-economic processes are related to weak city governance and inequality in income, leaving the urban poor particularly vulnerable, and pointing to the necessity of strengthening governance and livelihoods of urban communities to enhance adaptive capacity. Continued rural-urban migration and climate change emphasize the need for a shift in urban development towards a trajectory embracing climate resilience and livelihood for the most vulnerable.

Nature-based solutions emerging in cities of Global North for climate resilience are likely to work as well in African cities, if adapted to the physical conditions, social-economic situation and governance structure.

Global North solutions aim to minimize flood risks by detaining and retaining storm water runoff in the green infrastructure of the city. This approach is known under a number of names, including Green Storm Water Infrastructure, Water Sensitive Urban Design, Sustainable Urban Drainage, Low Impact Development, and Sponge City Concept, among others, which all may be referred to as nature based solutions. Compared to conventional pipe-based solutions the nature-based solutions offer greater flexibility in implementation, and may contribute co-benefits, e.g. groundwater recharging, erosion control, urban heat island mitigation, biodiversity enhancement, urban farming support, and aesthetical and social uplifting of the city.

Addis Ababa and Dar es Salaam cities that lack basic water supply and sewer systems the urban landscape can be seen as a soft infrastructure that can provide some of the same services and at the same time strengthen the urban green infrastructure, reduce the risk of flooding, improve the urban water supply, and support local livelihood activities, if appropriately planned and implemented. By adopting such green infrastructure-centered practices and nature-based solutions, cities of the Global South may leapfrog the conventional, hard-to-adapt conventional (or 'grey') infrastructures of the Global North, and thereby start contributing to future climate solutions of relevance to all urban societies.

The project emphasized PhD studies, stakeholder and community involvement, and building a close link between research and practice, combined with the development of a university courses in landscape-based stormwater management and nature-based solutions. A key methodological component of the research project was the use of three specific pilot sites in a catchment in each of the two cities and a focus on fostering champions of LSM. An action research approach has been applied where researchers/PhD students have interacted with professional and institutional stakeholders as well as local communities on the development of integrated plans for the pilot sites as well as for the catchment. Design Charrettes have introduced as a research method for achieving 1:1 pilot project design solutions as it is the experience that 1:1 pilot projects with stakeholder involvement can provide stronger impact and extend further beyond the borders of the project.

## Results

Calculations showed that stormwater harvesting within the city boundary may potentially cover around 80% of the future water demand in Addis Ababa and up to 95% of the water demand in Dar es Salaam (Figure 1). In addition to harvesting systems, to reach this fraction of coverage large storages are required. Recharging of groundwater aquifers may represent a more feasible approach.

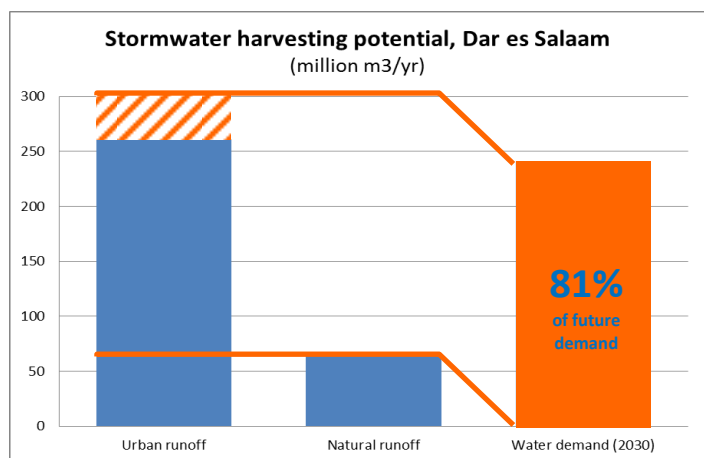
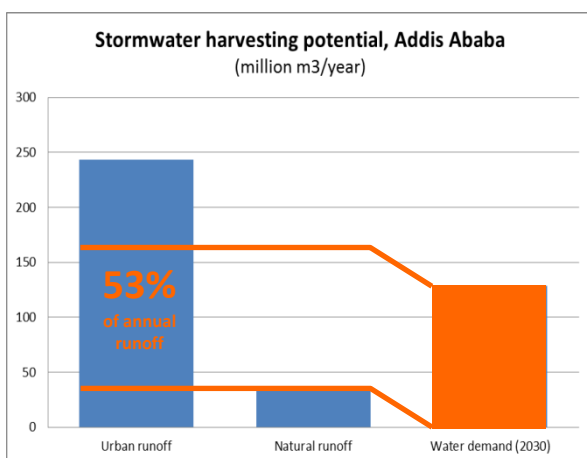


Figure 1: Estimation of water supply potential of stormwater runoff, respecting the natural runoff volume, which should be reserved for feeding rivers, lakes and wetlands as in the pre-urbanized situation. In case of Addis Ababa harvesting 53 % of the annual runoff is enough to cover the estimated water demand in 2030. In Dar es Salaam the available runoff is enough to some 81% of the expected 2030 water demand.

Problems with erosion can be controlled if nature-based solutions for infiltration of roof and road-runoff are adopted. Erosion gullies were observed especially in the case catchment of Dar es Salaam, where un-managed roof runoff initiated small gullies that gradually became larger as gullies from different sealed surfaces merged as the runoff was finding its way to the river. We demonstrated how gravel-filled infiltration trenches constitute a simple measure to reduce flood risk, prevent erosion and recharge groundwater (Figure 2).



Figure 2: Establishment of gravel filled infiltration trenches is a simple way to help stormwater runoff find its way into the ground. Left: Stormwater management at single family parcel, Kibululu, Mbezi River Catchment, Dar es Salaam. Runoff from neighboring road that use to cause flooding and erosion on the parcel is now diverted into the ground. The family may afterwards use the systems for cropping of vegetables. Right: In Addis Ababa many soil roads are converted into cobblestone roads, but the conventional drainage systems add to problems with downstream flooding. Instead, we developed a drainage principle based on gravel filled infiltration trenches positioned across the hill to trap the runoff as it flows downhill.

By means of trainings, workshops and development of a coherent catchment plan we attempted to make a mind-set change among stakeholders (Figure 3). According to questionnaires an effect was immediately obtained, but the long term impact is unknown.

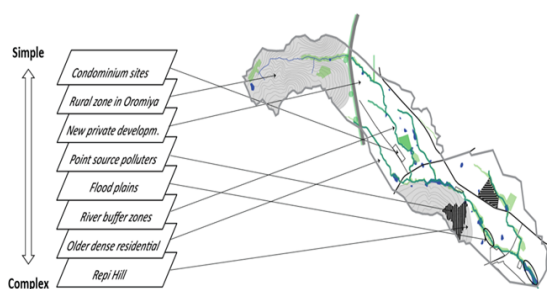


Figure 3: To change mindsets from conventional urban water management to nature-based management was tested by means of catchment plan development (left) and trainings of professionals (right) and workshops with local champions.

Through this project the theoretical and practical understanding of urban water management in developing cities has been heightened. The focus on action research and interaction with stakeholders in the research process has been a new and eye-opening approach to some of the team members. PhD students and other

project team members have started to write scientific papers in the project and several papers have been submitted. The PhD students are in the midst of submitting and defending their work and have all secured employment in their respective universities. The project team in Addis Ababa have secured funding from their university to apply establish a LSM demonstration site at the university where they can apply new ideas in 1:1.

## Conclusions

The potential of nature-based solutions for urban water management is high, and can be based on simple approaches. The approach may ensure control of flood risk, improved water supply, control of erosion and improved livelihood. Transition towards sustainable urban water management by means of nature-based solutions may need to be approached in different ways, depending on institutional profiles. Addis Ababa is hierarchically governed and the champions identified were city managers, particularly in housing and land administration. In Dar es Salaam the governance system is more fragmented and the main champions are land holders and communities in the informal areas.

## Implications and recommendations

Our results document that stormwater management may be key to improved urban water management through linking to water supply, erosion control and livelihood improvement. The results are documented in submitted and future papers, and embedded in the knowledge base of the involved researchers and PhD-fellows, and the updated university curriculums. To take these findings further consolidation is needed. National programs for nature-based stormwater management may be a way to go in Ethiopia, while easy access for the public to manuals, tutorials, and trainings may be the way to go in Tanzania. Link to business development would strengthen the transition in both cities. A strong driver is the link to enhanced livelihood that should be highlighted in all activities concerning stormwater management.

- Avoid blocking the green transition pathway
- Be aware that focus on conventional grey infrastructures may be to step away from resilience and sustainability
- Support development of catchment strategies for stormwater management that include water supply and erosion control and livelihood
- Identify the right stakeholders depending on the governance profiles and power relations
- Support action research and triple-helix partnerships for innovation and business development