



Towards Resilient Cities in Africa: The options of landscape based storm water management

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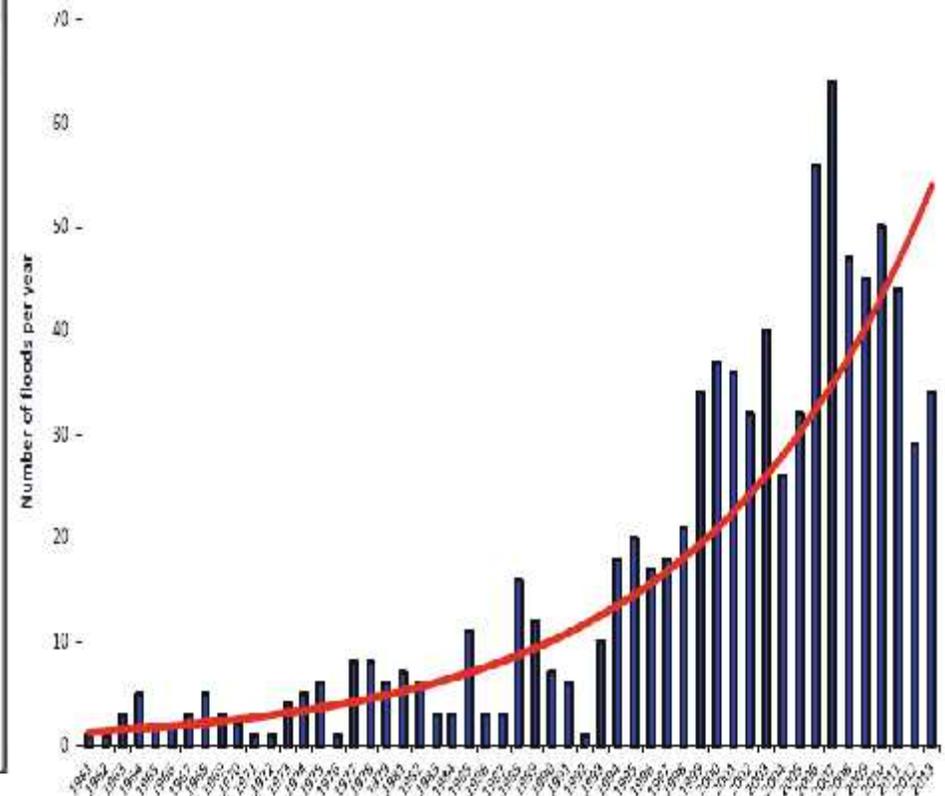
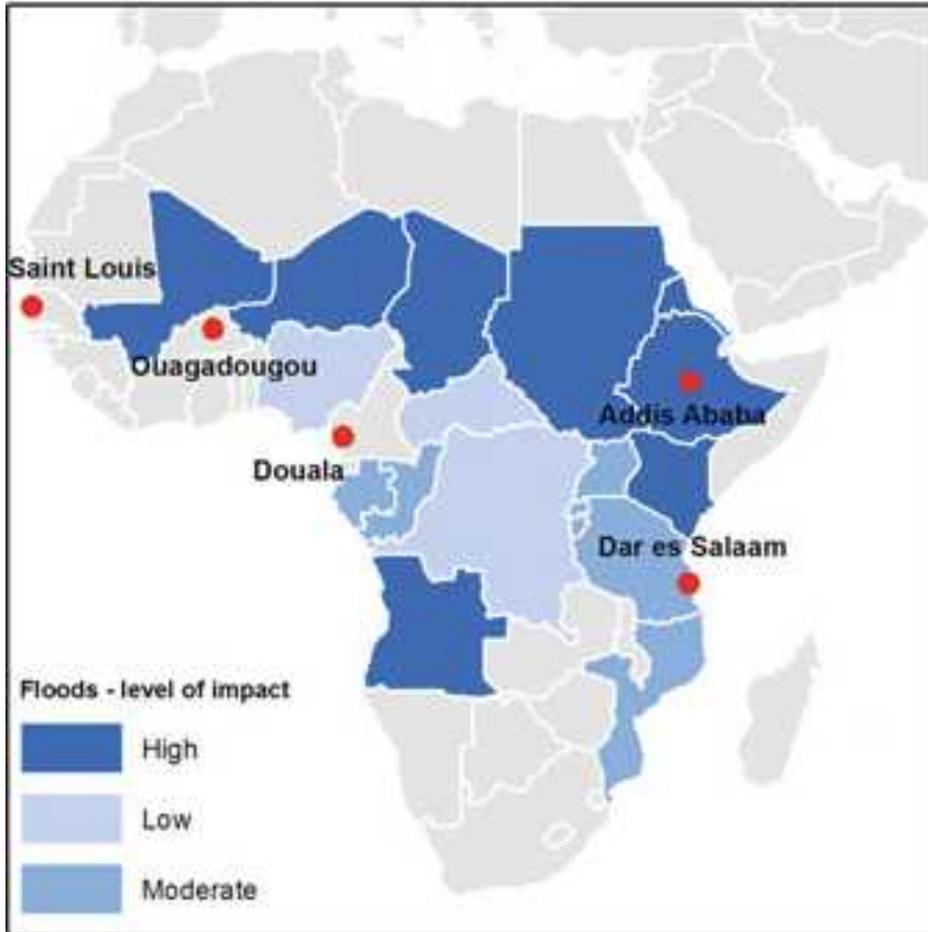
Climate change and Urban Vulnerability in Africa

Assessing vulnerability of urban systems, population and goods in relation to climate induced disasters in Africa

2010-2013



Flood



Pauleit et al 2015

Future City 4

S. Pauleit · A. Coly · S. Fohlmeister
P. Gasparini · G. Jørgensen · S. Kabisch
W. J. Kombe · S. Lindley
I. Simonis · K. Yeshitela *Editors*

Urban Vulnerability and Climate Change in Africa

A Multidisciplinary Approach

 Springer



CLUVA recommendations for the development of climate resilient African cities

Making
Climate
information
relevant to
decision
makers

Adapting
built
environment
and lifeline

Promoting
urban green
infrastructure

Preventive
action for
reducing
social
vulnerability

Fostering
climate
change
governance

Strengtheni
ng strategic
urban
planning



Water Resilient Green Cities in Africa

September 2013 – December 2017



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Building Construction and City Development
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Addis Ababa University
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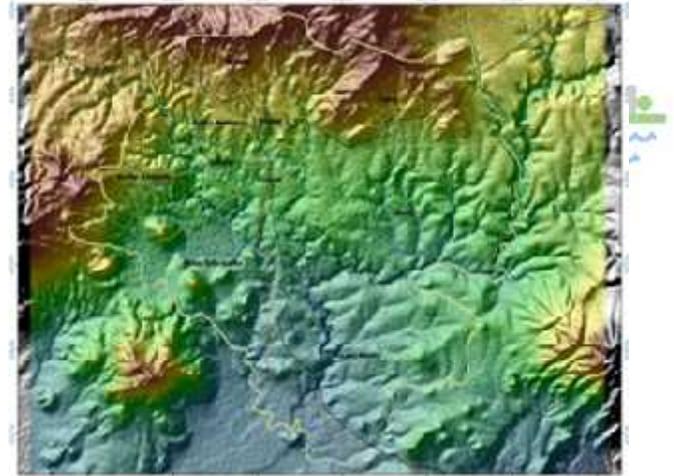


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Case cities

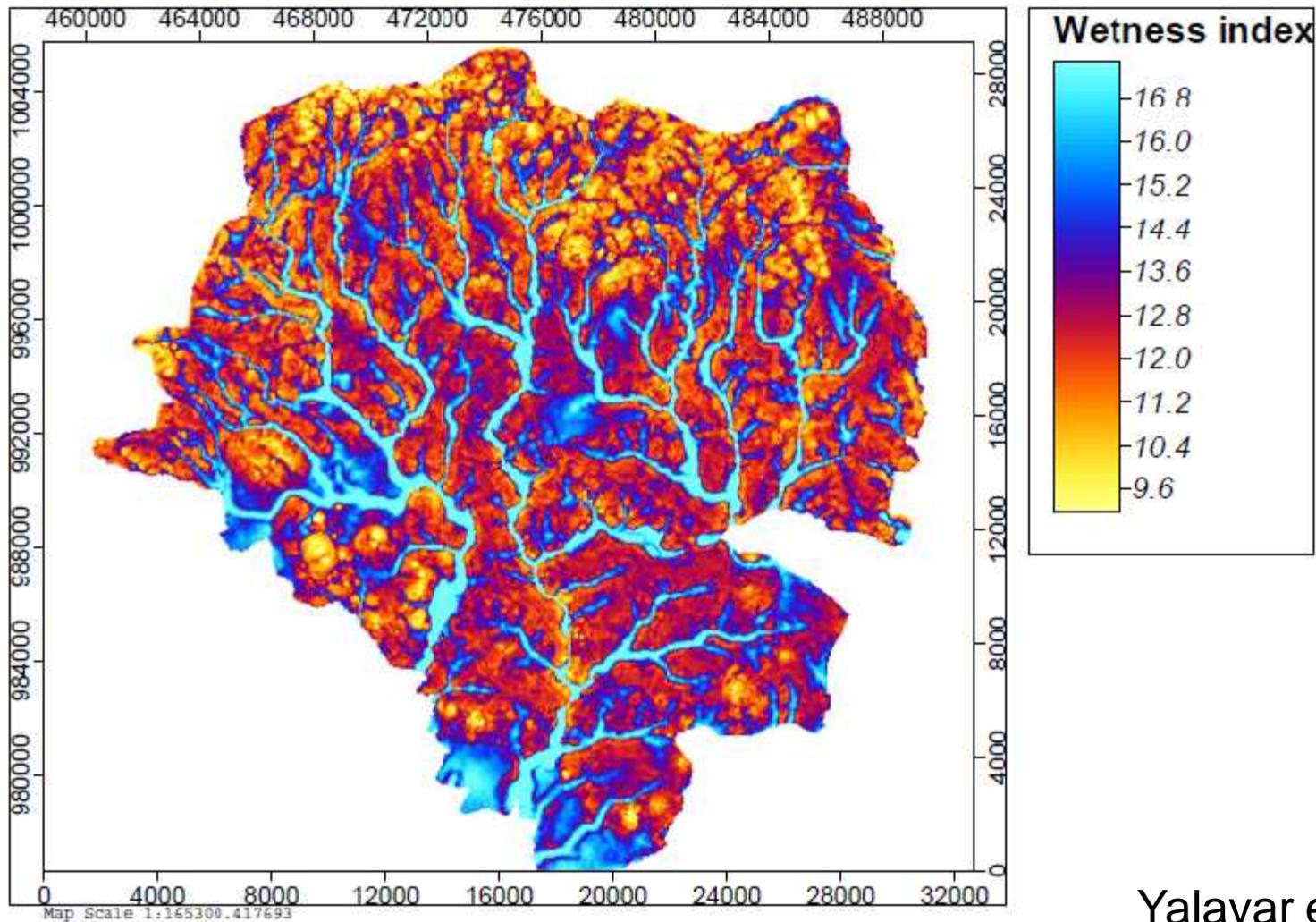


	Addis Ababa	Dar es Salaam
Climate induced hazard	Flood and drought	Flood, drought & sea level rise
Climate projection	Frequency of Extreme Rainfall Events expected to increase (CLUVA 2013)	Frequency of Extreme Rainfall Events expected to increase (CLUVA 2013)
Stormwater	Rainwater runoff expected to increase	Rainwater runoff expected to increase

Flooding problem in Addis Ababa



Flood prone area of Addis



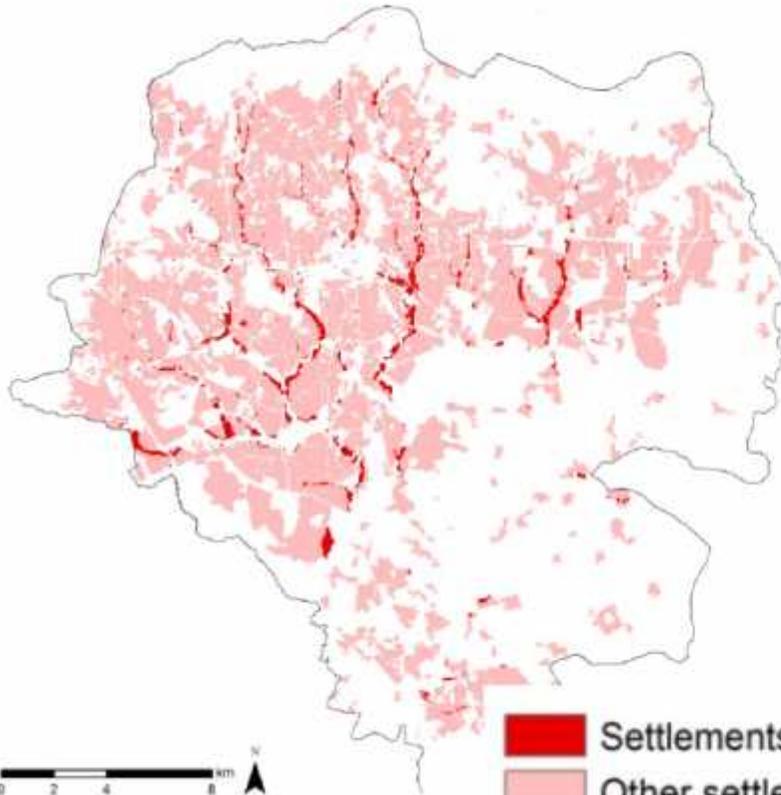
Yalayar et al. 2013



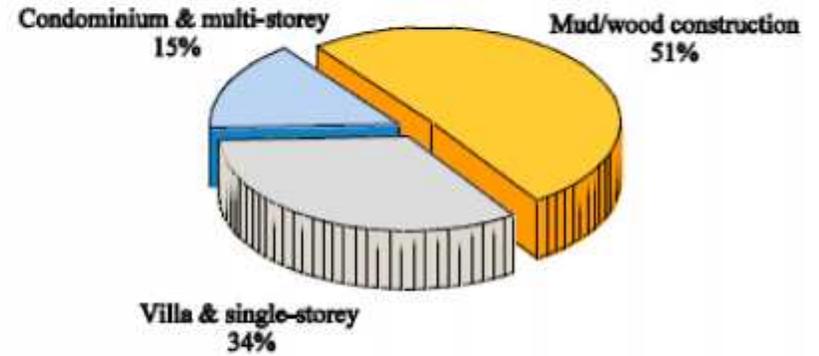
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and its design solutions

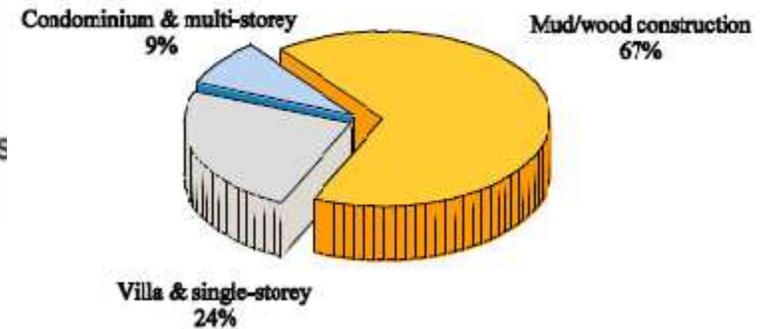
Vulnerability of settlement and people to flood



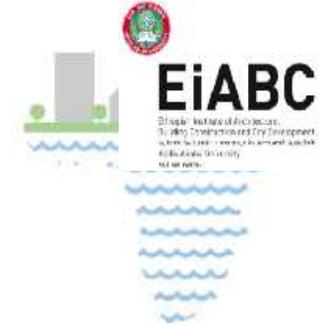
Flood prone residential area



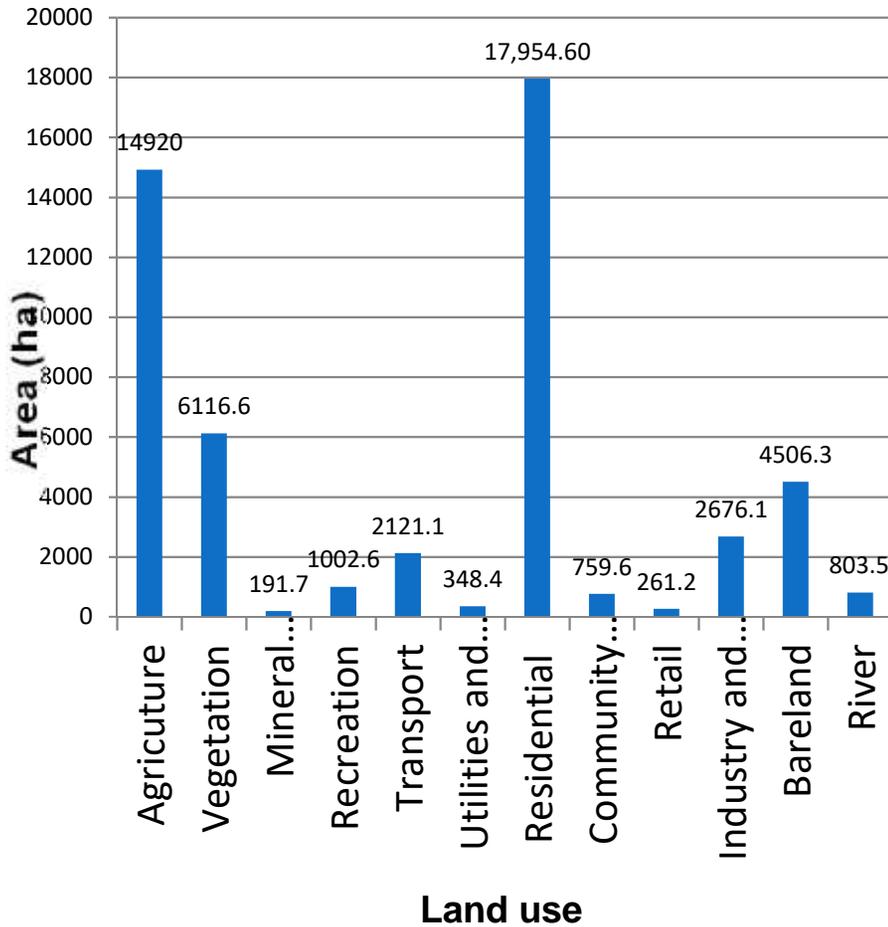
People affected by flooding in the residential area



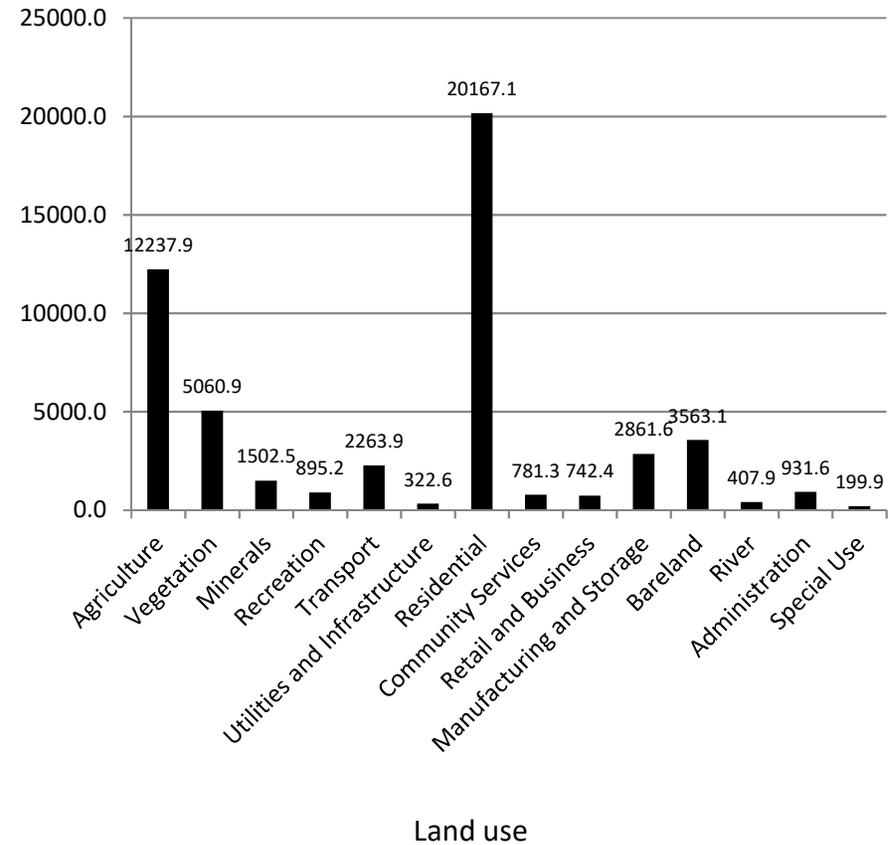
Land use/land cover change



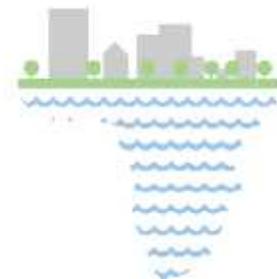
2006

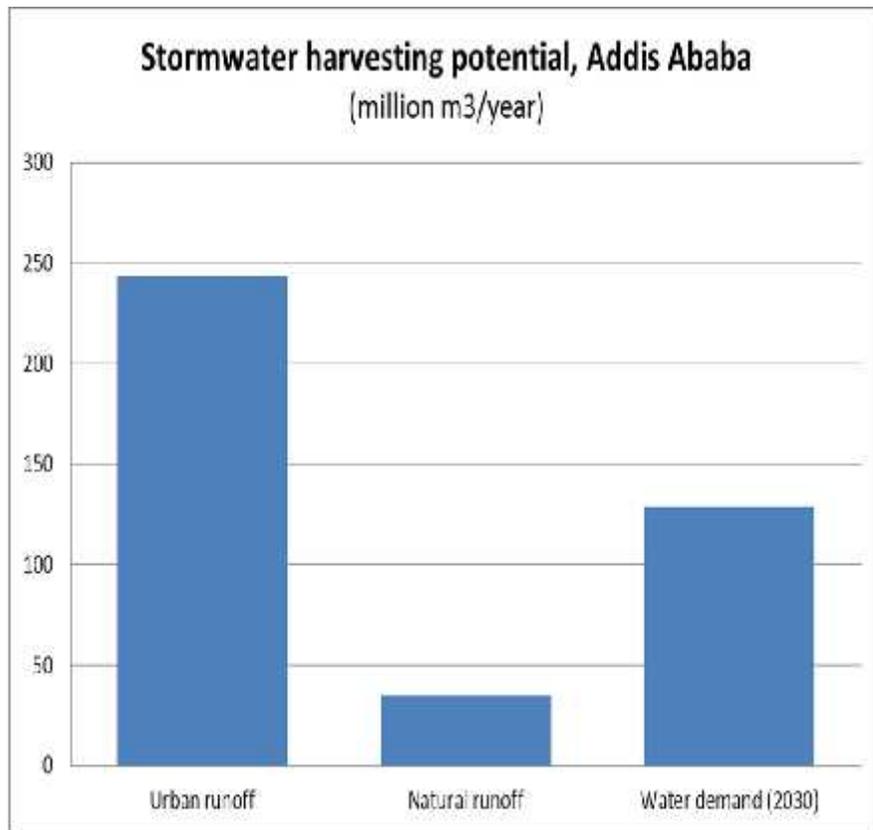


2016

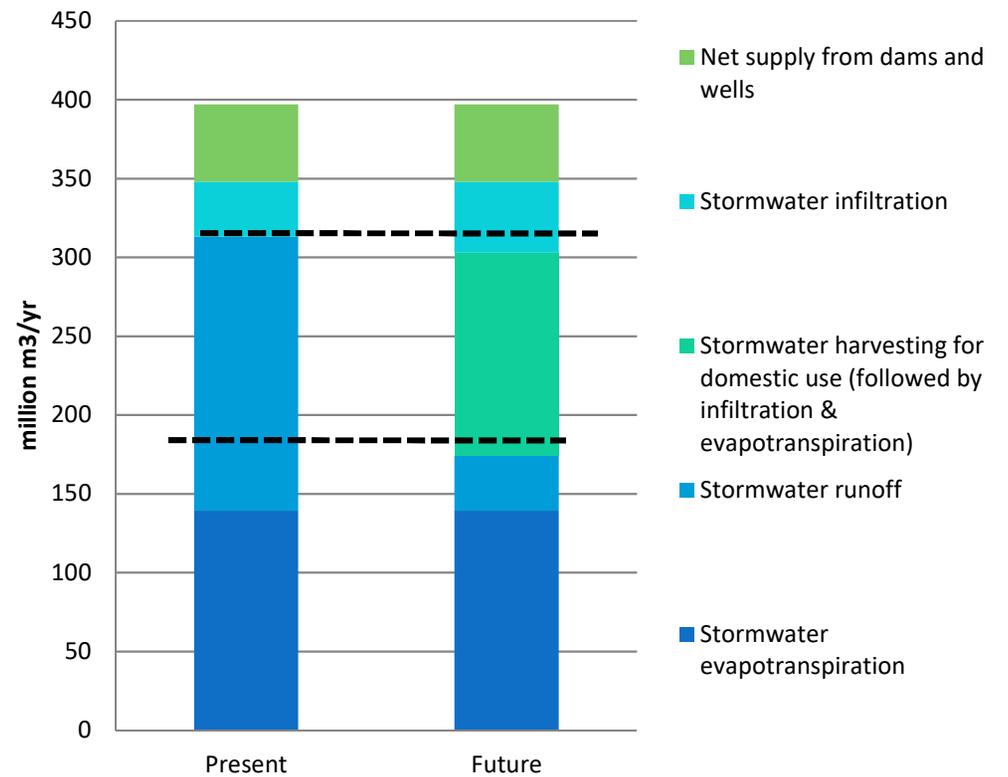


Water scarcity





Possible future water balance for Addis Ababa



Conventional stormwater management

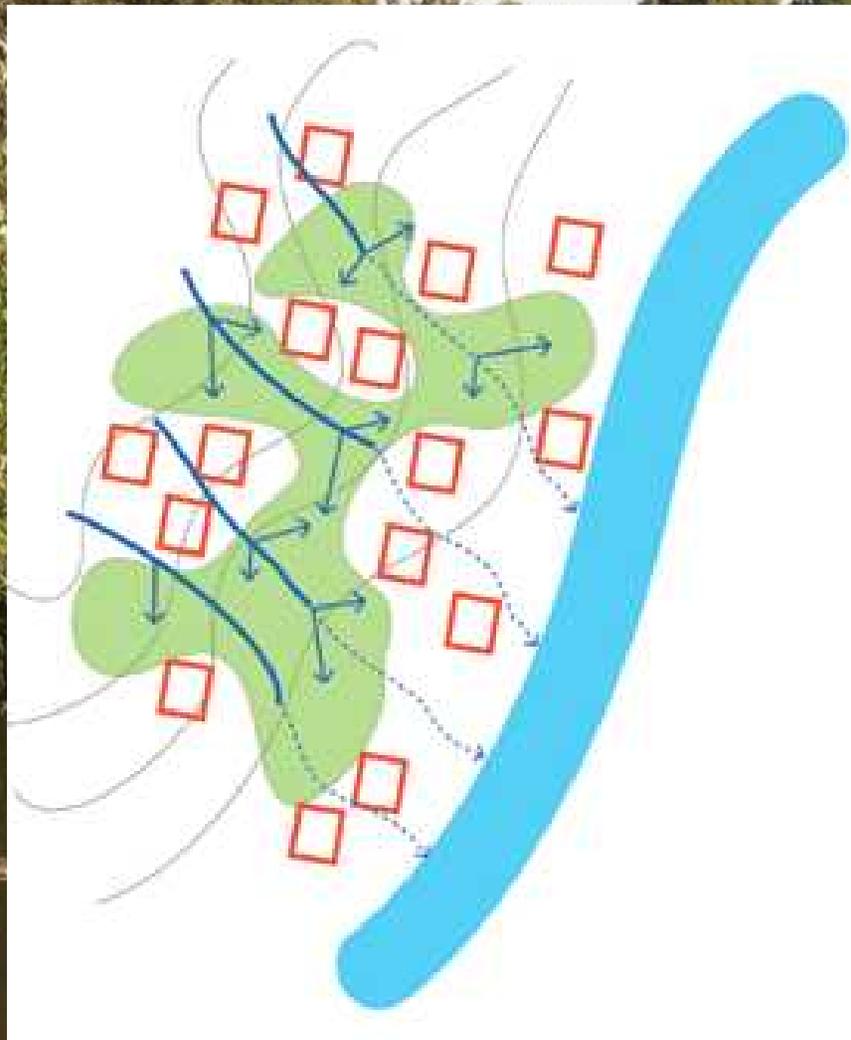
PROBLEMS OF THE CONVENTIONAL APPROACH

- Increase in
 - run-off
 - erosion
 - siltation and
 - Flooding
- Causes pollution due to waste water and solid waste disposed in environment
- It is expensive
- Water a threat not a potential

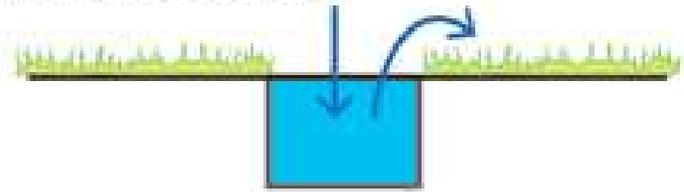


Landscape based stormwater management

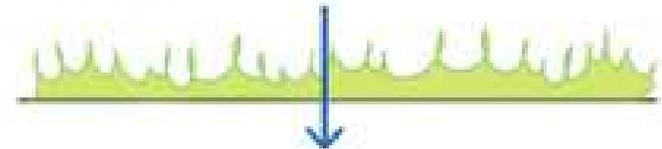
Stormwater is a resource



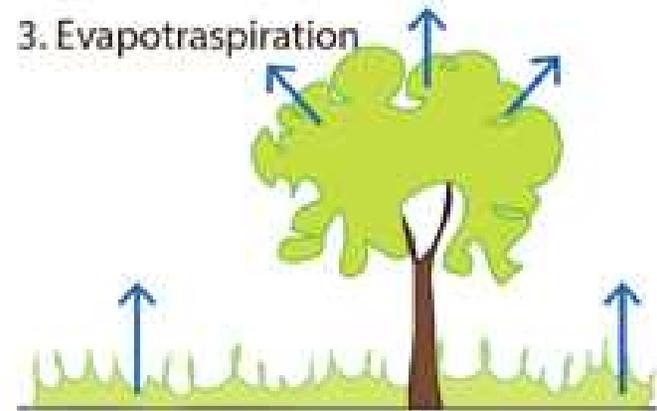
1. Reuse & retention



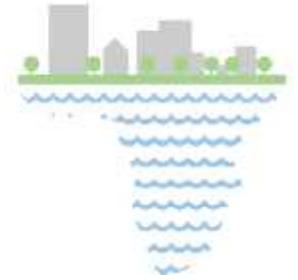
2. Infiltration



3. Evapotranspiration



Project Hypothesis



• African cities can leapfrog

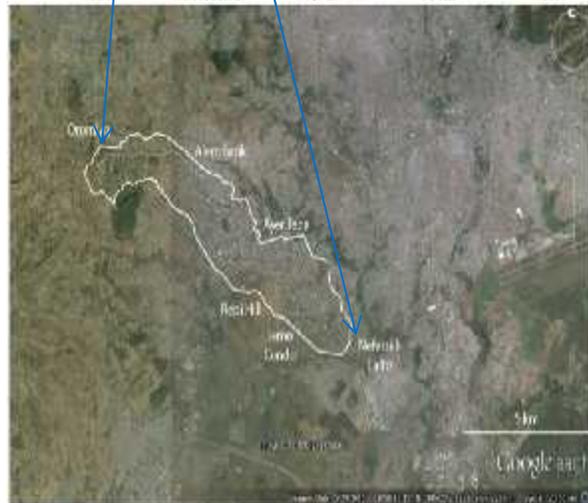
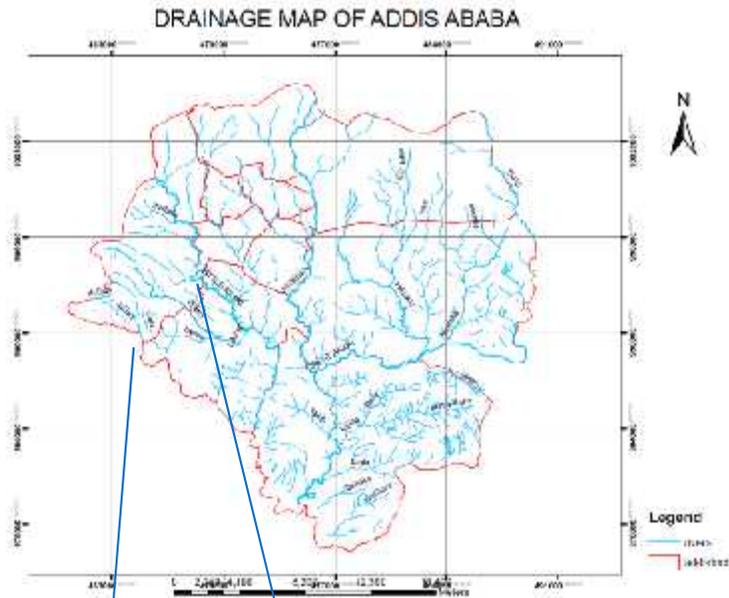
Urban water resilience can be improved by establishing a strong **green infrastructure** that can

- reduce the impact of floods *and*
- provide day-to-day services to the citizens (such as water supply, food, open space)

Case study sites



Jemo river catchment, Addis

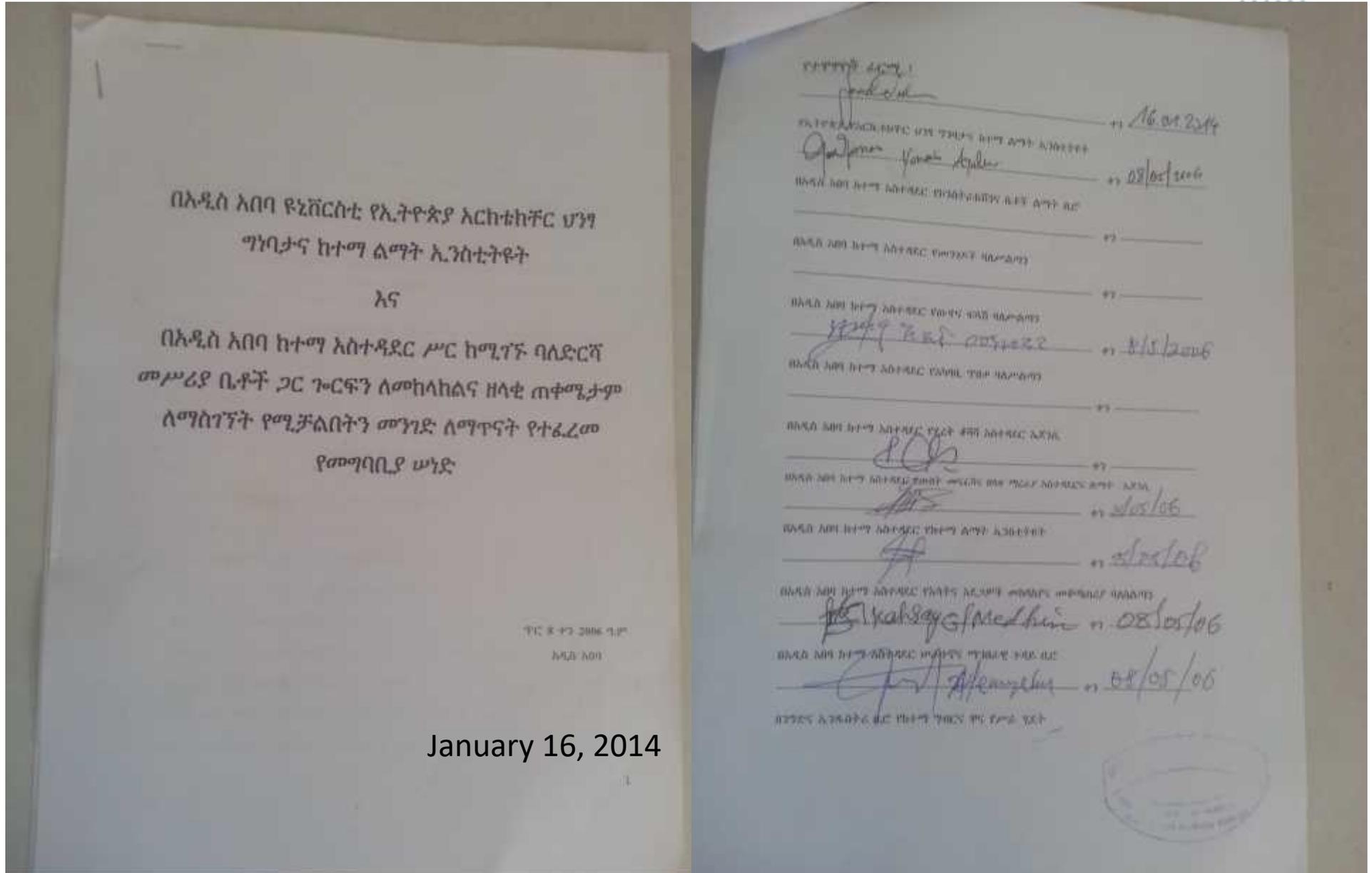


Mbezi river catchment, Dar





MoU signed with Addis Ababa city administration



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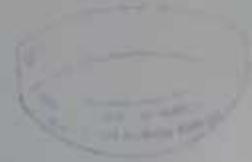
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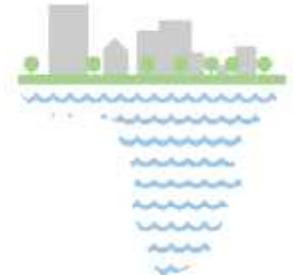
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January 16, 2014

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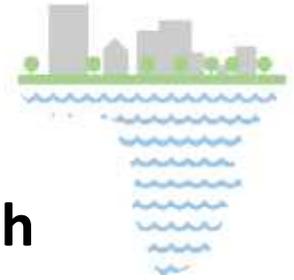
Stakeholder interaction



- Three City level stakeholder workshops
- Two Local level stakeholder workshops
- Training to city experts on landscape based stormwater management and green infrastructure development
- FGD and Household survey



Testing of 1:1 stormwater management pilot projects



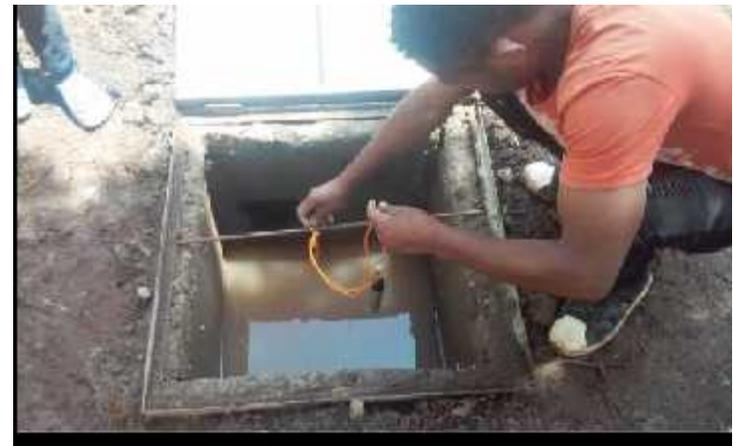
1. Bio-retention system



2. Infiltration trench with tree pit



3. low-cost storm water filtration technology





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www.eiabc.gov.et

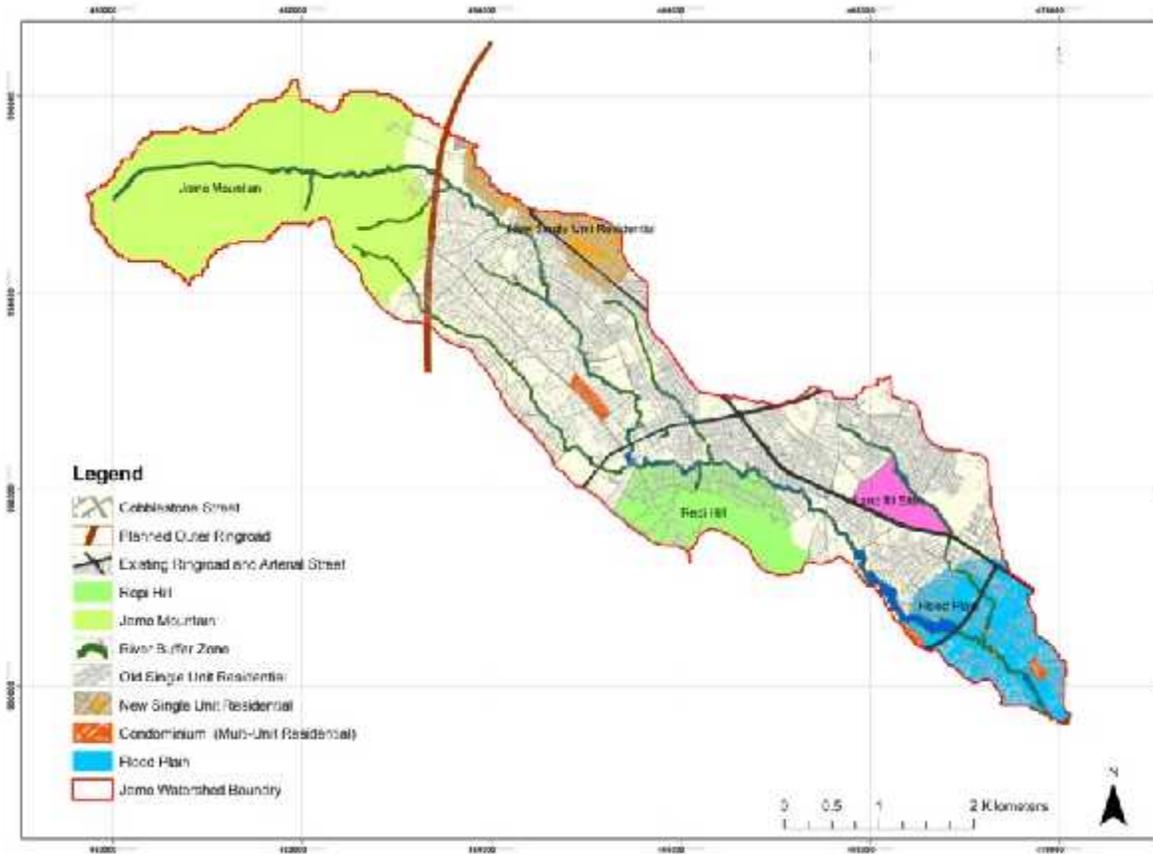
LANDSCAPE BASED STORM WATER MANAGEMENT STRATEGY FOR JEMO RIVER CATCHMENT IN ADDIS ABABA



**Ethiopian Institute of Architecture, Building
Construction and City Development (EiABC), Addis
Ababa University**

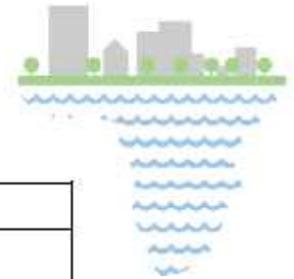
April 2017

Layered Retrofit Approach to improve water resilience at Jemo River catchment



1. Jemo Mountain
2. River buffer zone
3. Floodplain
4. Condominium residential
5. Single family residential (planned and unplanned)
6. Primary Arterial street
7. Cobble stone street
8. Repi Hill

Proposed responsibility of actors for LSM



	Institution	Expected activities related to LSM
1	Addis Ababa Environmental Protection Authority	<ul style="list-style-type: none"> • Provides regulatory framework, regulation and standard for catchment management plan • Awareness raising on catchment management
2	Oromia Regional State and Addis Ababa City Government	<ul style="list-style-type: none"> • Collaborate in Jemo mountain management and implementation of LSM measures on the mountain
3	Addis Ababa City Roads Authority (AACRA)	<ul style="list-style-type: none"> • Be involved in catchment management plan preparation • Implement different LSM measures on roads
4	Addis Ababa River, River side and Climate change Project	<ul style="list-style-type: none"> • Be involved in catchment management plan preparation • Delineate and maintain river buffers for stormwater management, pollution reduction and other benefits
5	Beautification, Parks and Cemetery Development and Administration Agency	<ul style="list-style-type: none"> • Be involved in catchment management plan preparation • Implement LSM measures on public parks, plaza and cemetery
6	Addis Ababa Construction Bureau	<ul style="list-style-type: none"> • Collaborate with communities in the implementation of LSM measures on local streets and communal green spaces
7	Addis Ababa Water and Sewerage Authority	<ul style="list-style-type: none"> • Implement reservoir watershed management
8	Addis Ababa Urban Plan Institute	<ul style="list-style-type: none"> • Integrate landscape based storm water management in the planning process

Activities and actors for implementing LSM measures at Jemo river catchment



N ^o	Land use/layer	LSM measure	Activities	Project strategies	Actors	
1	Jemo mountain	Afforestation	<ul style="list-style-type: none"> • Development and preparation of nursery site 	<ul style="list-style-type: none"> • Identification of land holders and users • Awareness of community • Creating financing source • Support farmers financially • Social awareness, social cohesion 	<ul style="list-style-type: none"> • Addis Ababa Environmental Protection Authority • Oromia Forest and Wildlife Authority 	
			<ul style="list-style-type: none"> • Mountain terracing and planting holes preparation • Transfer from the nursery to the mountain site 		<ul style="list-style-type: none"> • Community, farmers, local administration • 	
		Storm water interceptor swale and dyke system			<ul style="list-style-type: none"> • Training 	<ul style="list-style-type: none"> • Addis Ababa Environmental Protection Authority • Addis Ababa Bureau of Construction • Addis Ababa Roads Authority
2	River bufferzones	Setting buffer zones & flood plains	<ul style="list-style-type: none"> • Piloting on specific river segment • Identification of properties & land users of adjacent areas • Reconciliation of stakeholders' interests on river buffer zone setting • Setting rules laws and social arrangements • Participatory resettlement of residents living in the designated buffer zones 	<ul style="list-style-type: none"> • Differentiated strategy for open field areas and settled areas • Select open areas for buffering pilot project • Seek community consent • Institutional leadership • Green& health sensitization • Negotiation, cooperation & formulation • Creating employment opportunities 	<ul style="list-style-type: none"> • Addis Ababa Environmental Protection Authority 	
		Vegetating river buffer with perennial and annual plants	<ul style="list-style-type: none"> • Identification of vegetative types to be planted • Selecting specific locations for plantation • Identifying properties 			
		Storm water interceptor swales and dykes	<ul style="list-style-type: none"> • Same as above 			



THANK YOU FOR YOUR ATTENTION

Acknowledgement



- The Danish Development Agency (DANIDA) is acknowledged for financing the WGA project