The Beneficial Use of Road Water for Climate Resilience and Asset Management

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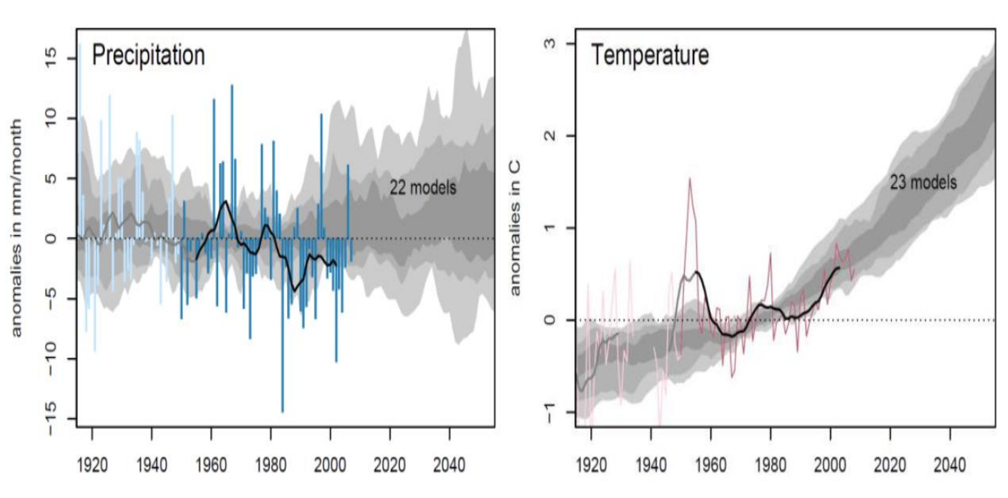
2nd IRF Africa Regional Congress
Windhoek. Namibia
July 11 – 13, 2017

Outline of the Presentation

1. Background and objectives
2. Techniques of water harvesting with roads
3. Effects of water harvesting with roads
4. Potential for up-scaling
5. The way forward
6. Acknowledgements

1. Background

- Water scarcity is one of the critical challenges to ensure food security in arid to sem-arid regions.
- Predicted extreme events to come (IPCC, 2007)
- Road construction is one of the biggest investments globally – 1-2 Trillion USD
- Roads put an imprint on the hydrology of an area: roads act as dikes or drains
- This now often causes negatives – erosion, waterlogging, flow disruption and adds to the cost of road maintenance.



Objectives

Can we turn this negatives into positives and make roads instruments for water management?

Can at the same time also reduce the costs of maintenance and the risks of road disruption?

Findings from assessment in Tigray, Ethiopia

Erosion in 62% of culverts

Sedimentation: 11% of culverts

Waterlogging: 5 location/10 kilometer

Local flooding: 5 location/ 10 kilometer

To minimize the damages to roads

- If not well handled water is No. 1 enemy of roads the most appropriate way to do this is making the enemy a friend

- In Ethiopia water typically is the cause of 35% of the damage on paved roads and close to 80% on unpaved roads. Problematic drainage is the most common factor in construction delays

To minimize …

- Reduced maintenance burden among others by uphill watershed protection,
- Reduced damage from uncontrolled run-off on unpaved roads (a major issue) and reduced risk of gully damage

To minimize …

- ❖Reduced risk of road induced flooding and water logging
- ❖Reduce erosion and sedimentation

For better consideration of the hydro-ecosystems

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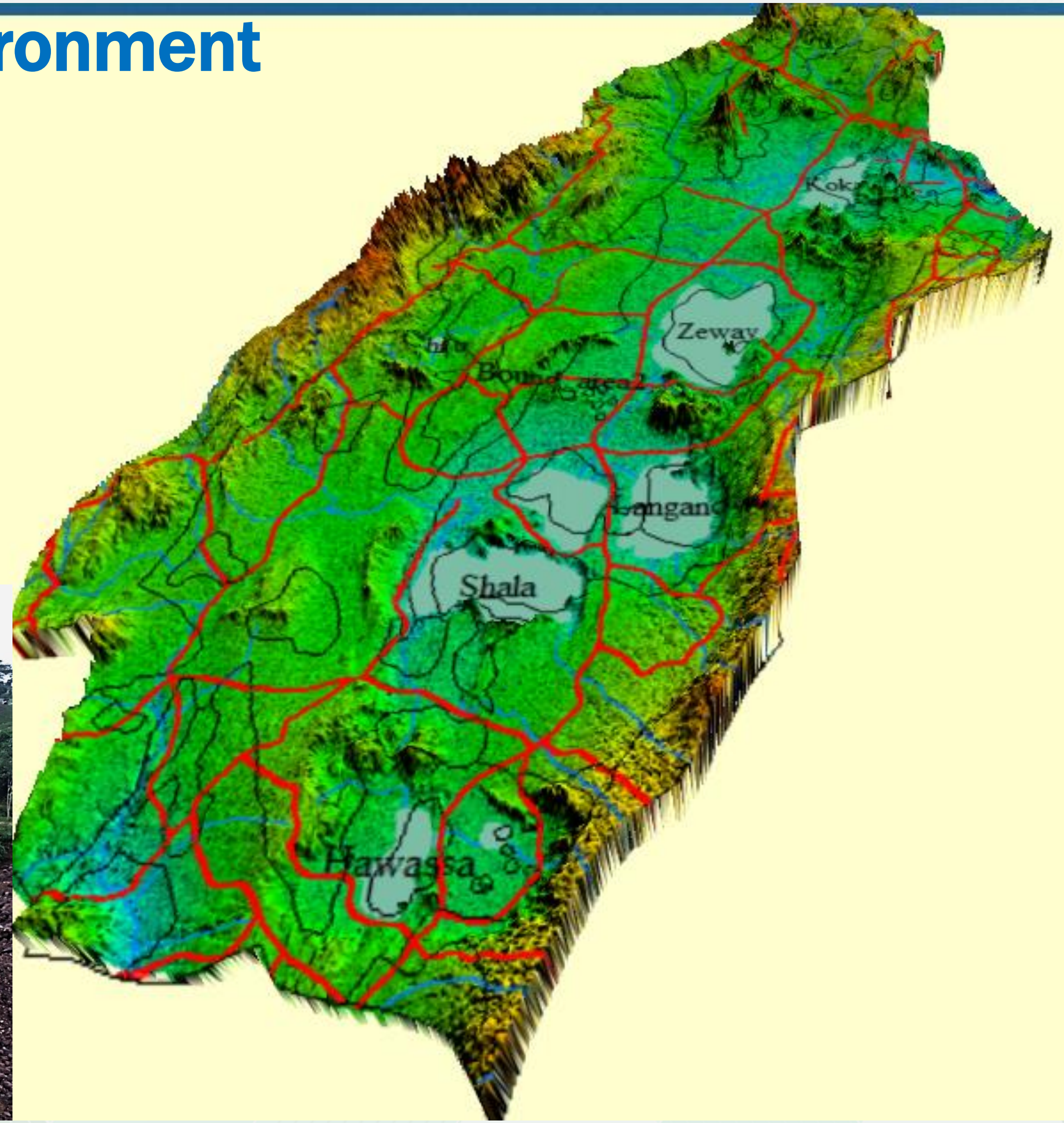
ROADS AUTHORITY
SAFE ROADS TO PROSPERITY

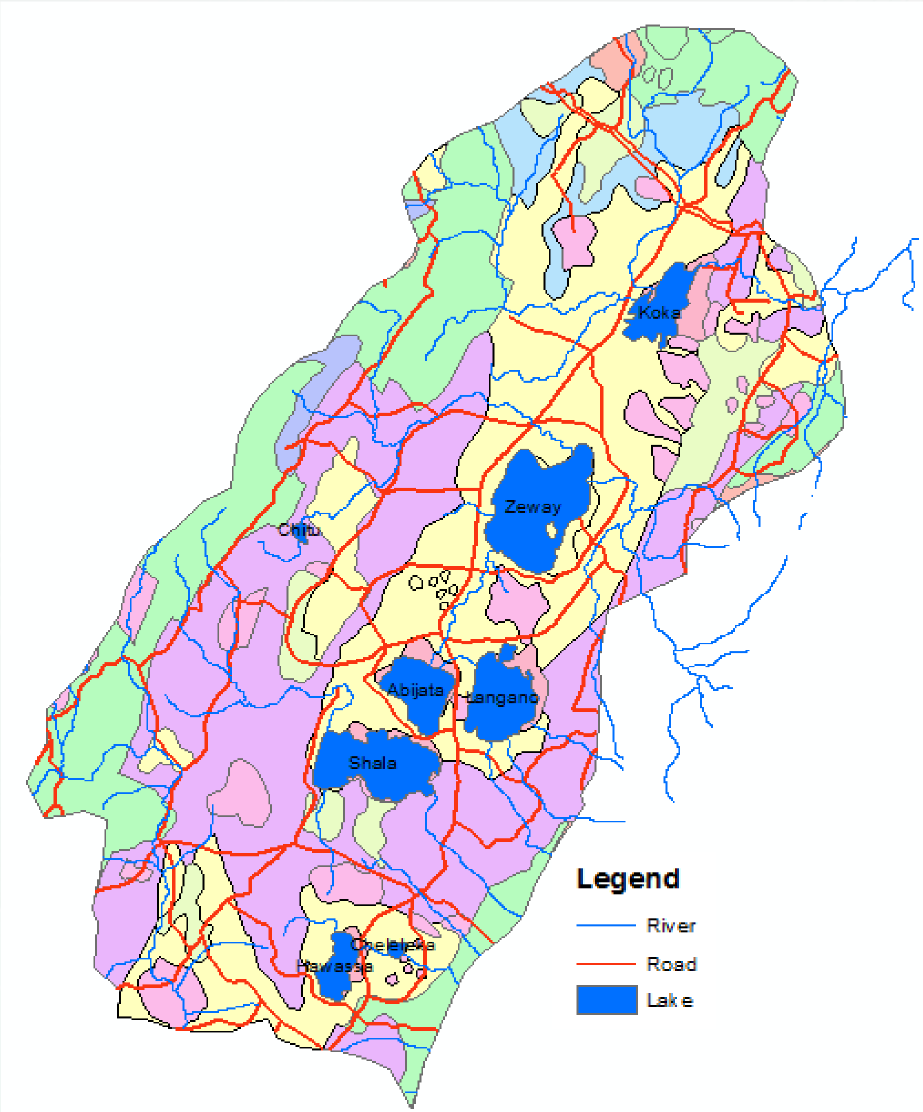
the rift valley lakes environment

- Reduced flow to the reservoirs
- Damage to the roads, particularly in such high rainfall years



the rift valley lakes environment…

- Vulnerable geological formation and rift structures are the main controlling factors



To tackle roads impacts on wetlands & excess rainfall situation

- Impacts also depend on hydrological responses – impoundments may or may not create wetlands

2. Techniques for collecting water with roads – applied in semi-arid area of Tigray

- Construction of Deep trenches at downstream side of roads to recharge the groundwater and improve moisture conditions of soils.
- Road side ponds to recharge groundwater and enhance in-situ moisture in soils

- Road side run-off diverted into ponds for surface water storage and groundwater recharge

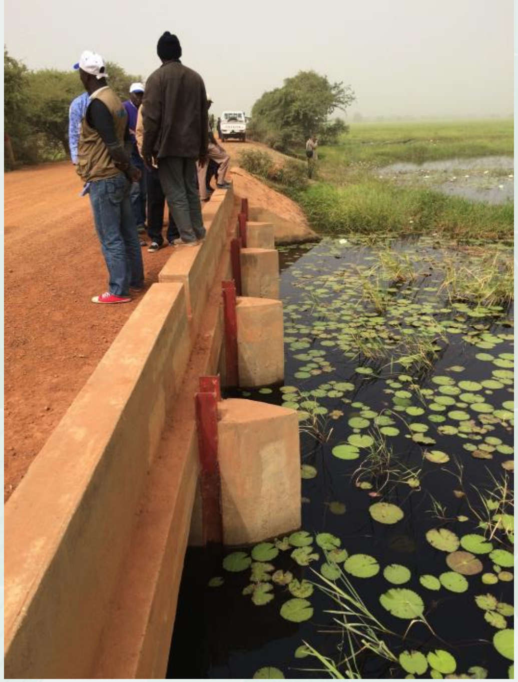
- Water from a culvert is channeled into farmlands (used for groundwater recharge and improving soil moisture).

- Road side runoff is channeled into farmlands (used to improve soil moisture and reduce runoff to downstream areas).

- Water from a culvert and road side drainage channeled to remodelled borrow pit.

Related techniques:

- Drifts (non-vented) acting as sand dam, bed stabilizer or flood water spreaders
- Spring capture
- Road as dam embankment



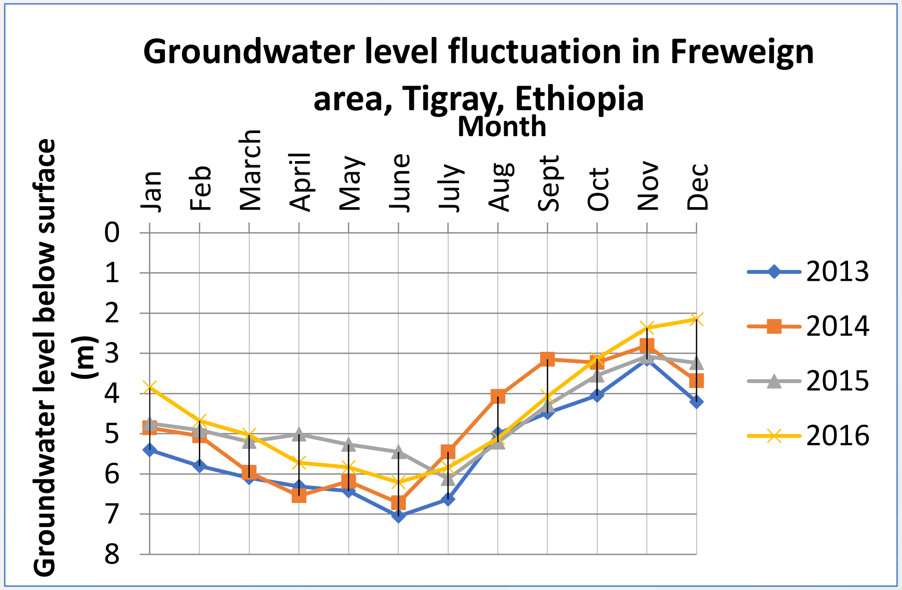
3. Effects of water harvesting with roads

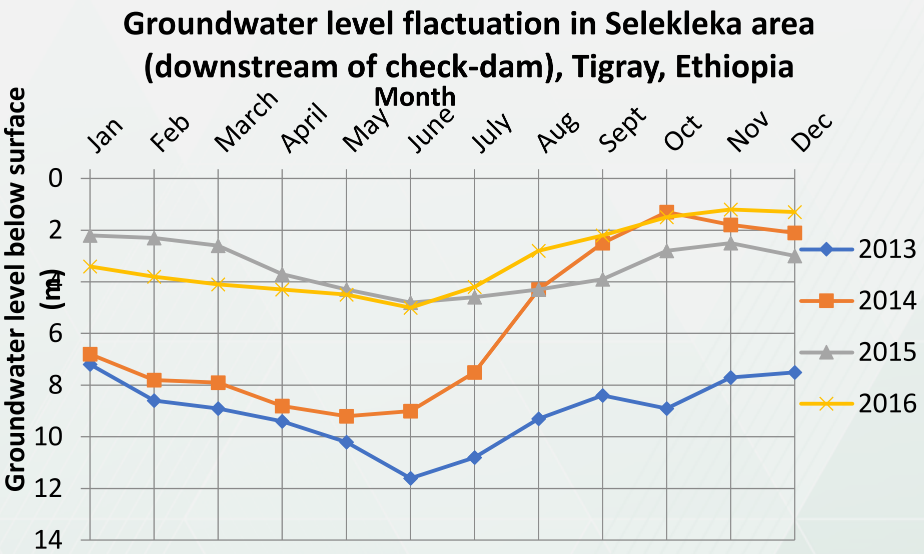
- The implementation of water harvesting with roads in Ethiopia has gone beyond piloting programs.

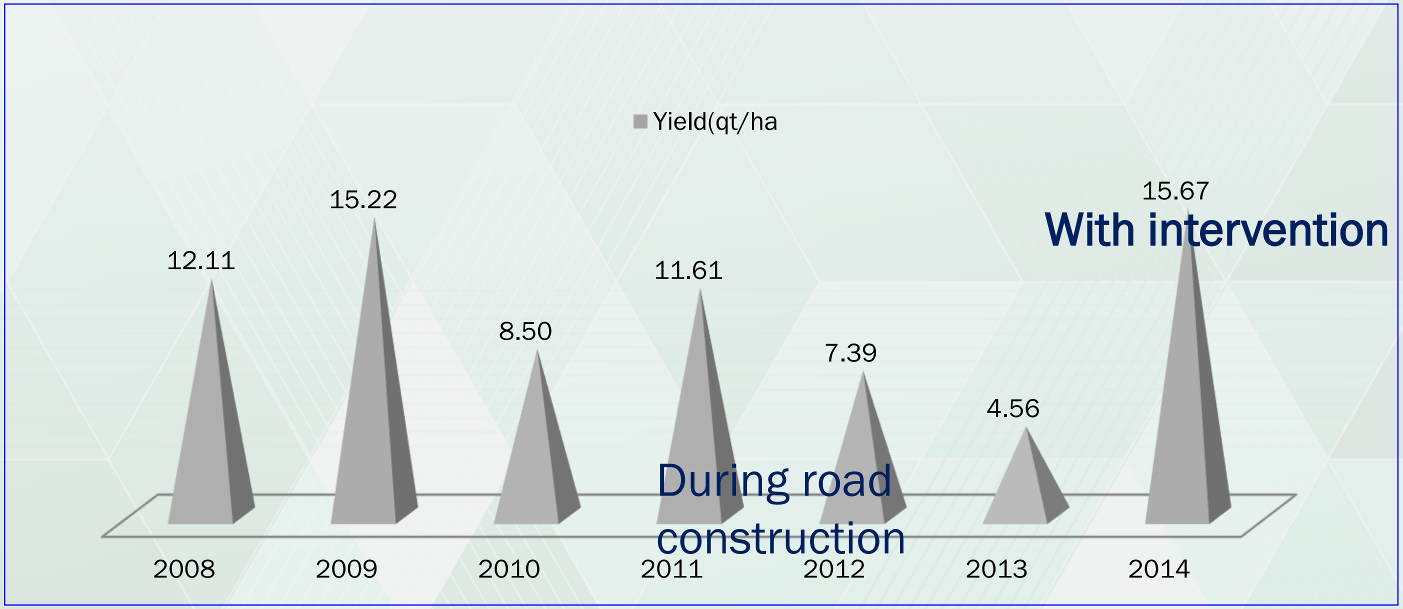
- The technologies applied are variable, depending on site condition.
- The technologies were implemented in all districts since 2014 and more than 4 million people involved.

Evaluation from 10 monitoring sites in Tigray

	Implemented Technique	Effects
1	Deep trenches at downstream side of roads (culverts, bridges, etc)	**Shallow groundwater** level has improved: from dry to productive, reaching to to 3m below ground surface. The moisture content of the soil has improved up to 50% more than the previous year of the same critical period (August-September)
2	Road side ponds	**Moisture of soils** along road has improved by upto 100% as compared to the moisture condition of previous year of the same season. Shallow groundwater level has improved by up to 1m.
3	Road side runoff diverted into ponds	**New surface water** for supplementary irrigation and animal watering created.
4	Water from a culvert is channeled into farmlands	**Moisture** content of the soil has improved by up to 50%, and groundwater level has improved with 1-2 meter at recharge sites. As a result, new groundwater wells are being developed.
5	Road side runoff is channeled into farmlands	Road side erosion has been **halted** and moisture condition of the soil has improved by up to 30%.


Groundwater level fluctuation in Freweign area, Tigray, Ethiopia
Month
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Groundwater level below surface (m)
0
1
2
3
4
5
6
7
8
2013
2014
2015
2016


Groundwater level fluctuation in Selekleka area (downstream of check-dam), Tigray, Ethiopia
Month
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Groundwater level below surface (m)
0
2
4
6
8
10
12
14
2013
2014
2015
2016


Yield(qt/ha
12.11
15.22
8.50
11.61
7.39
4.56
15.67
With intervention
During road construction
2008
2009
2010
2011
2012
2013
2014

Triple resilience dividends of the ‘Roads for Water approach” in Ethiopia

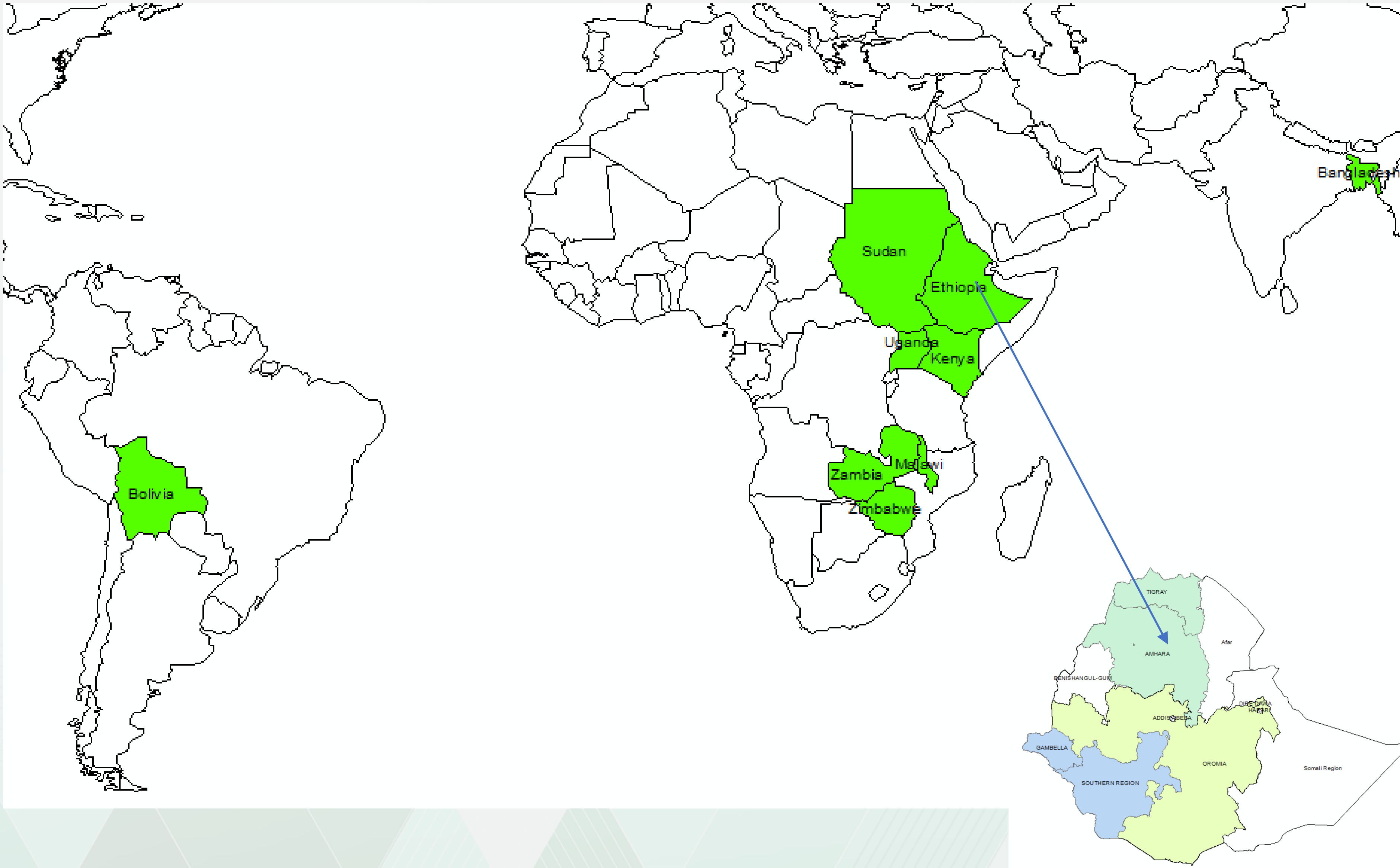
	Resilience	Impact
1	Reduced damage in the wake of disaster and unusual events	Reduced cost of road maintenance
		Reduced damage due to erosion
		Reduced damage due to flooding
		Reduced damage due to sedimentation
2	Unlocking the economic potential	Less down time of roads
3	Co-benefits	Beneficial use of water harvested from roads

4. Potential for up/out-scaling

The potential for up-scaling of water harvesting with roads is high – it addresses a triple win:

- Negative effects of roads (often major source of landscape degradation) is reduced;
- Large scale contribution to overcome water scarcity and increased water demand;
- Reduces cost of maintenance and risk of disruption;
- Many techniques require low additional investment cost.

Wide acceptance and fast spread…



5. The Way Forward

- Climate resilient roads should not mean making more costly and weather-proof roads, but (at zero net cost)

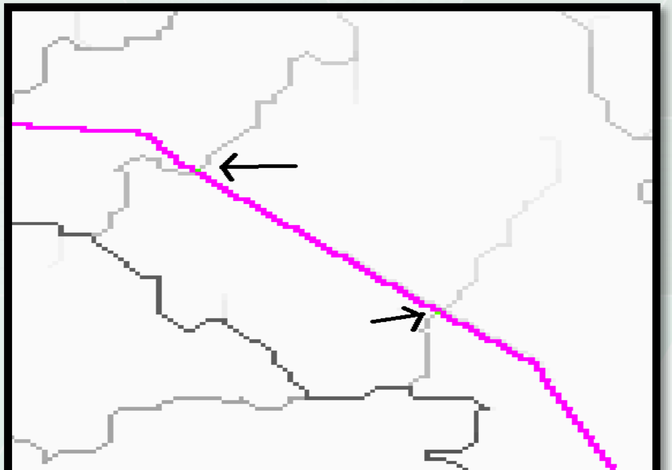
- Institutionally there was no link among water, road and land sectors but this should change and it changing
  - In modified guidelines and designs
  - In budget procedures
  - In capacity building and governance
- Need to create in different condition close linkages

Revisit existing approaches and guidelines

- ❖Each sector (road, water, agriculture) has its own guidelines and manuals to do its mandated task.
- ❖The road sector guidelines never consider the beneficial use of water.
- ❖The agricultural sector consider roads as aggravating land degradation
- ❖The modification to the hydrology by roads is a concern for the water sector

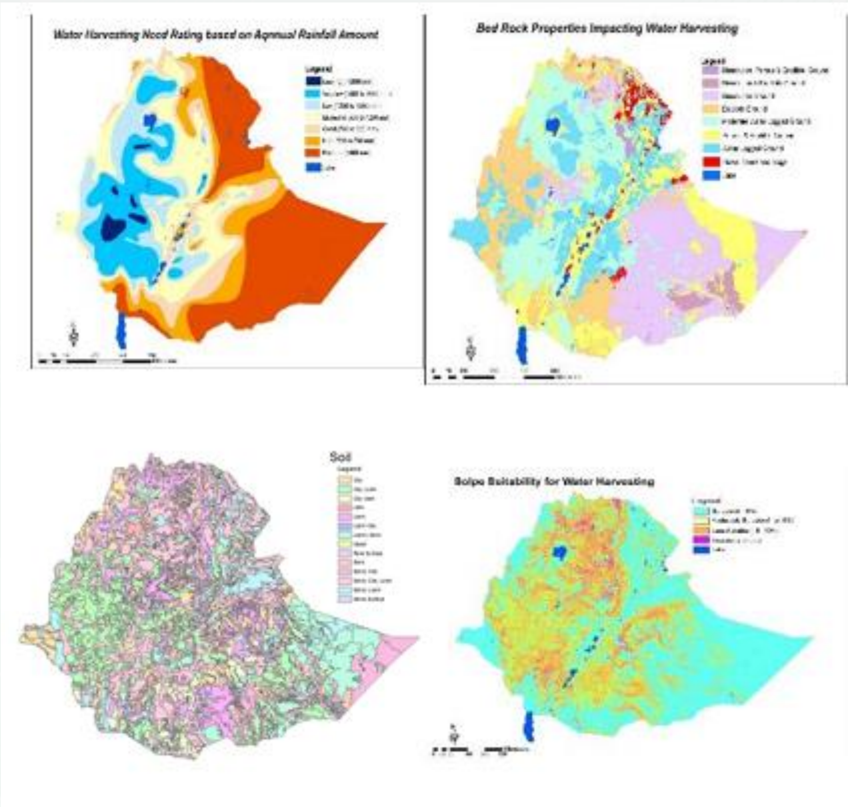
Next level:

- Adjusting location of road and drainage structures to optimize balance between costs, reduced risk of damage, water to be beneficially used and reduced land damage



Lessons learned

- Better understanding of the need for ‘road water management’ in its new form
- Identification of **homogenous ‘road water management’ units** is important to design GLs in accordance to specifics of these units
- Agreement on the ‘dissipate water’ approach supported by the existing functional GLs by the road sector is not preferred option.
- The need to incorporate ‘road water management’ guideline to be one of the road sector GLs
- The widely varying hydrogeomorphic and agro-ecological conditions of Ethiopia make the GL easily replicable in other sub-Saharan African countries
- The leaning alliance is creating more awareness and attracting people and countries to adopt the approach

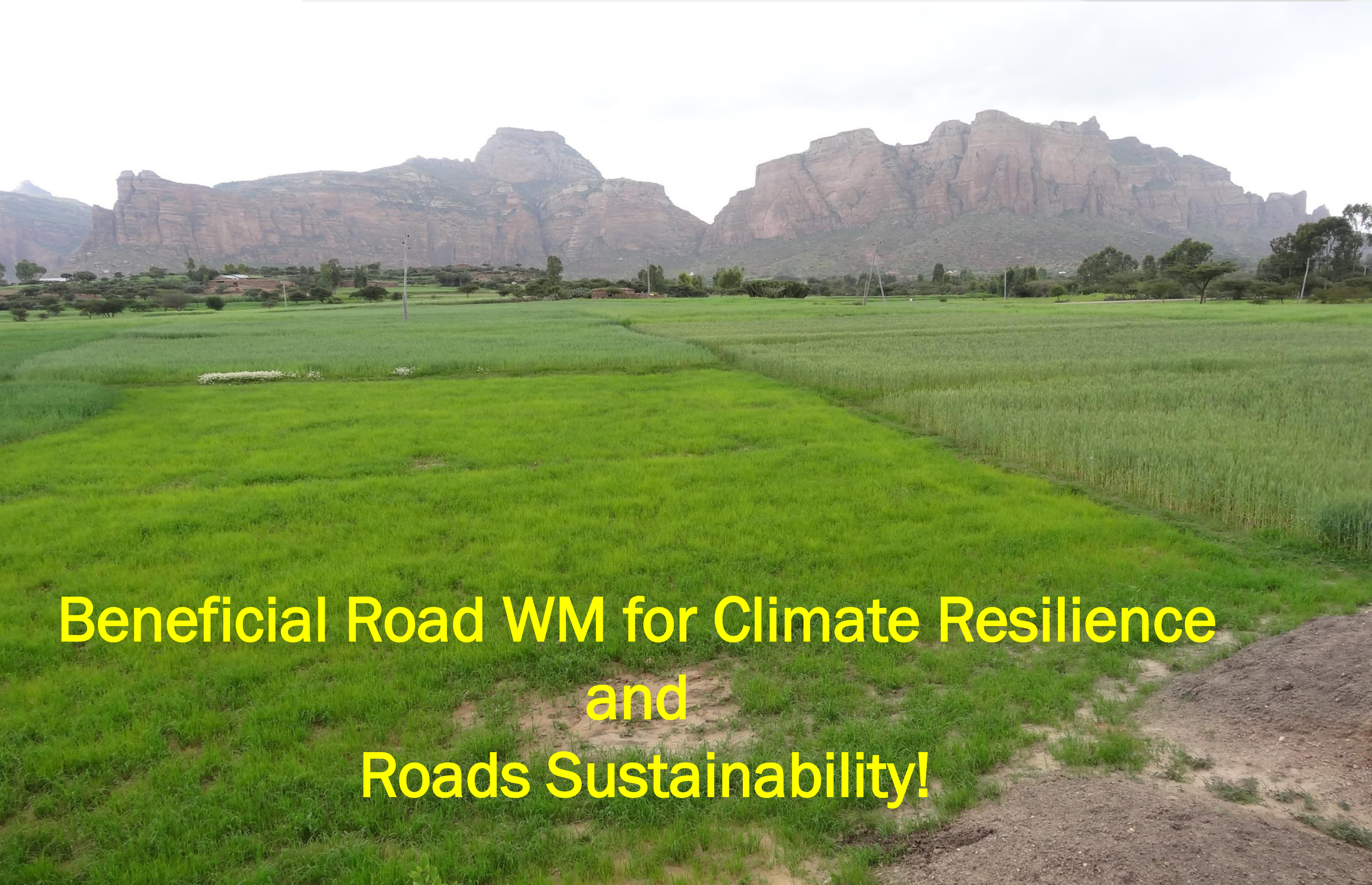


Acknowledgement

- **Support is acknowledged from: UPGRO, NOW, Global Resilience Partnership and WB**
- **Collaborating institutions in each countries**
- **Partners**: MetaMeta (The Netherlands), IDS (UK), and Mekelle University (Ethiopia).

We are keen to develop better water management around road projects – and seek your cooperation and partnership.

www.roadsforwater.org
www.metameta.nl



Beneficial Road WM for Climate Resilience and Roads Sustainability!