



# Green Roads for Water Training in Sudan

Wad Madani, 15-20 January 2023

## Introduction to Green Roads for Water

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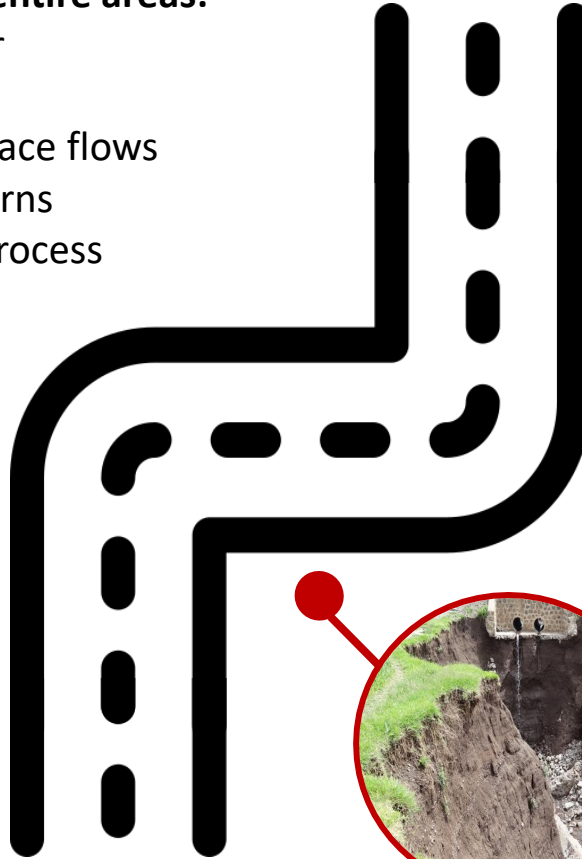
# Introduction to Green Roads for Water

Roads affect the hydrology of entire areas:

- They block and guide water
- They concentrate runoff
- They interfere with subsurface flows
- They change flooding patterns
- They get damaged in this process



**Water-related road damage**



**Flooding**



**Water logging**



**Erosion (gullies and landslides)**



This can be



roads can become  
**GREEN ROADS**

Green Roads present a triple win with very little additional investment:

1. reduced road maintenance costs,
2. reduced degradation of the landscape around roads and
3. Improved water management around roads

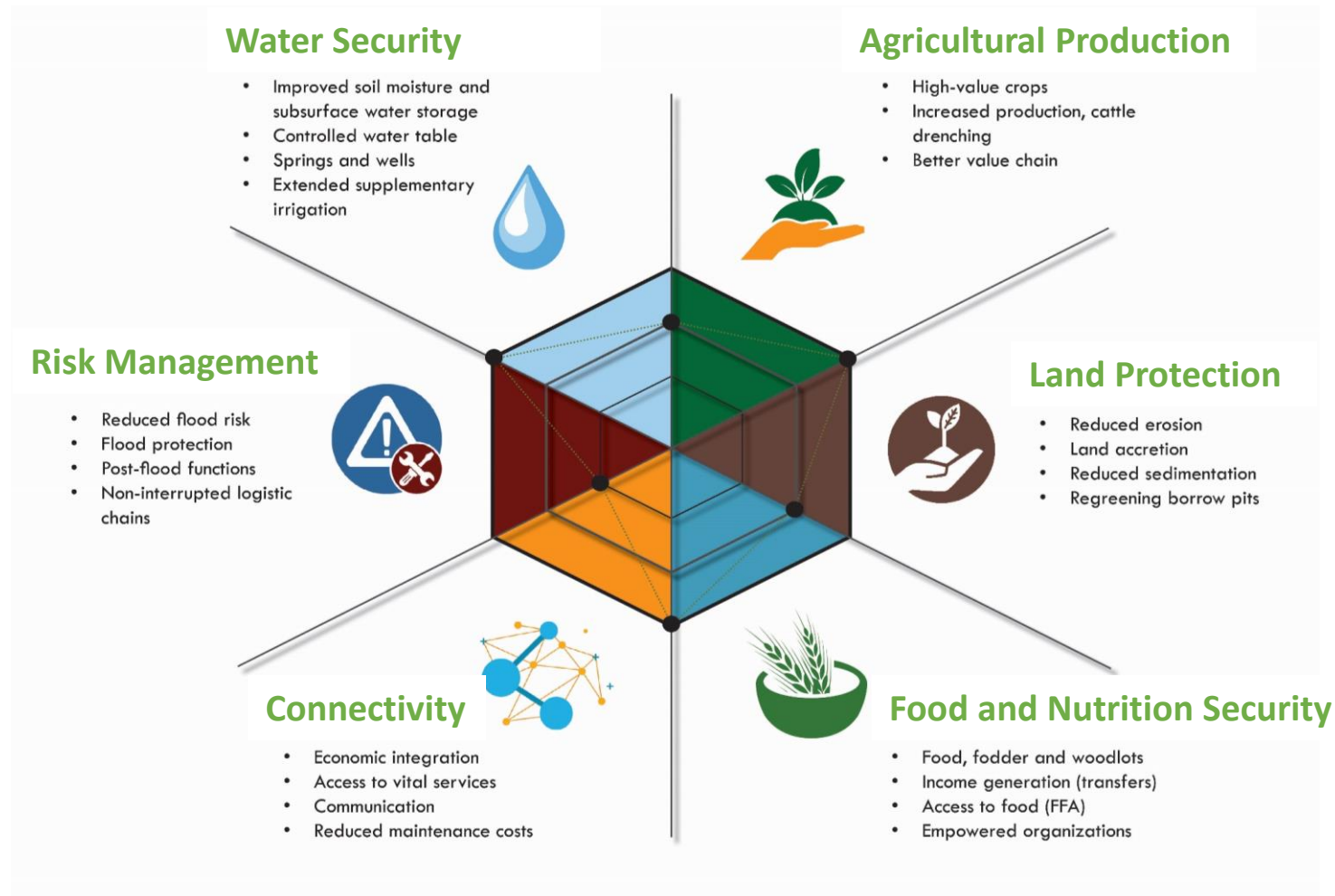


# Levels of road resilience in different geographies

	Regular Roads		Green Roads
Level of Road Resilience	Basic Resilience: Protective	Resilience Plus 1: Adaptive	Resilience Plus 2: Proactive
Key words	Protecting road infrastructure	Making best use of and adapting to changed hydrology	Redesigning road infrastructure to optimize the area's water management/climate resilience
Geographies			
Semiarid areas	Catchment measures to reduce water damage to roads	Use runoff guided from roads for recharge and storage; upper catchment protection	Design roads and cross- drainage facilities to collect runoff and guide to recharge area
Watersheds and catchments	Catchment protection to protect road infrastructure	Catchment protection to protect road infrastructure	Plan road alignment and drainage structures in support of catchment management
Coastal areas and floodplains	Increase height of flood embankments to deal with higher floods	Convert village roads for water-level management with gated structures	Consider low embankment roads with controlled floodways develop road levees in flood-prone areas; use roads for land accreditation
High- and medium-altitude areas	Have safe road water crossing and protection measures; have adequate road drainage; reconsider road alignment to higher areas; train mountain rivers to reduce exposure of roads to mountain floods	Using water-retention and land-management measures suitable to mountain areas to stabilize mountain catchment and retain moisture and snowmelt; systematic spring management	Use cut and fill instead of cut and throw methods; observe maximum slope and gentle alignments; combine roads with additional storage to and drift for torrent stabilization
Desert areas		Revegetation and dune stabilization using road runoff. Develop small roadside oases taking road runoff to depression areas	Adjust road directions to deal with wind directions to control sand dune formation



# Green Roads co-benefits



# Why Green Roads:

## Big Scale and Big Impact: The Trillion USD Gap



**Roads are major investment globally  
(1-2 Tr USD/year)**

For instance: It is estimated that 25 million km of paved road-lanes and 335,000 km of rail-track will be added from 2010 to 2050: a 60 percent increase.



**At the same time, water causes 35- 80% of road damage**

For instance: Transect surveys undertaken along roads in upland Ethiopia and Uganda show that in every 10 km of roads there may be 8 to 25 flash points, such as local erosion, flooding, sedimentation, or waterlogging.



# Why Green Roads:

## Big Scale and Big Impact: Positive perspectives



Many tested Green Roads measures exist, suited to different geographies



Green Roads can be a main instrument for climate resilience, health and increased agricultural production



Measures are low cost in comparison to total road investment (<5%) – and often saving cost of investment and maintenance



Rate of return high (>4 in a year)





# Green Roads for Water program

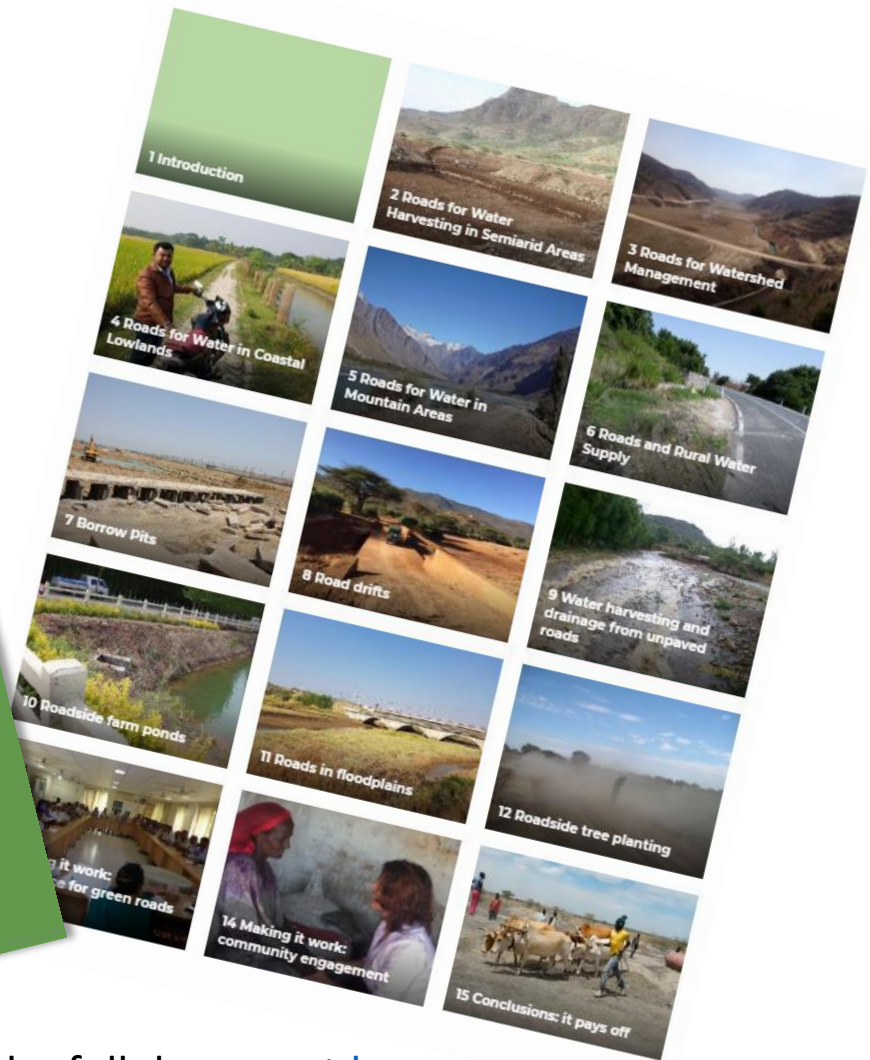
- Initiated by MetaMeta in **2014**
- Aim: To have roads systematically used for water management, regreening and climate resilience and introduce as standard in at **least 50% of countries in the world by 2025**
- Active in more **than 15 countries**
- Various types of projects: **research, capacity building, implementation, policy formulation**
- Supported by: The World Bank, ADB, GRP, NWO, NERC, RAP3, Blue Gold and more
- Development of **GR4W Guidelines**, Guided Learning packages, Training Material
- Outreach > **6 M people**





# Green Roads Guidelines

Supported by:  **WORLD BANK GROUP**



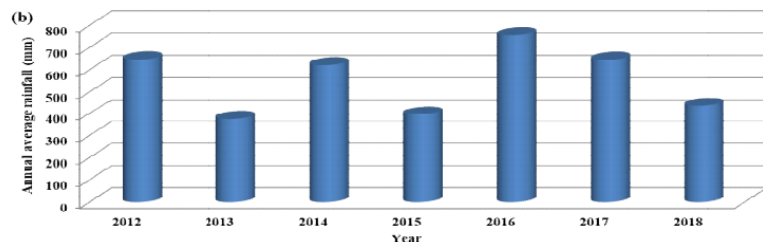
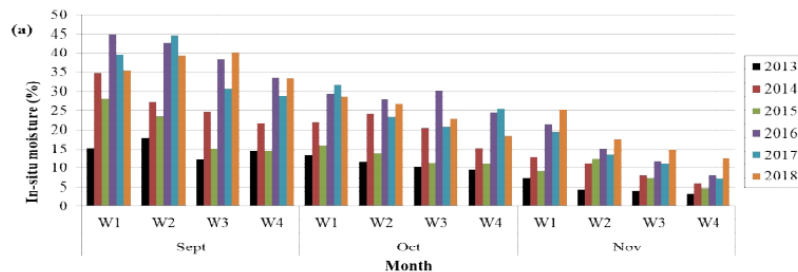
Download the full document [here](#)



# Impacts of Green Roads in Ethiopia

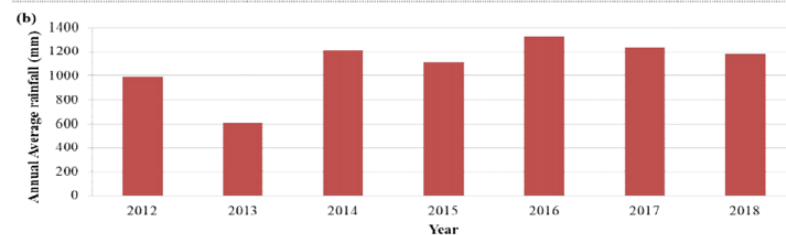
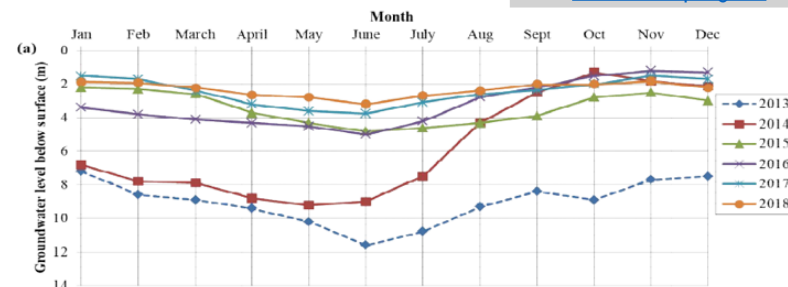
Raised water availability after implementing Green Roads in Ethiopia at a large scale

[Additional information on the benefits of GR4W on rural livelihoods. This blog was published by GRP after a site visit at the road-water-harvesting sites implemented in Northern Ethiopia during the GR4W program](#)



(a) In-situ moisture distribution in soils (before and after the construction of structures that divert runoff from culverts into farmlands along the Mekelle road (Kihen), Tigray, Ethiopia. Construction of the diversion structures was done on May-June 2014. Monitoring was done for the period September years 2013 to 2018. (W1= Week one; W2=Week two; W3=Week three and W4=Week four). (b) Rainfall distribution for (ENMSA, 2018).

Source: [Kifle et al., 2019](#)



a) Groundwater fluctuation in Selekleka area, Tigray, Ethiopia (at downstream of a check-dam which was constructed in the period January is designed to store improved at downstream of the box culvert b) Rainfall distribution for the year 2012 to 2018 (ENMSA, 2018)

Source: [Kifle et al., 2019](#)



# Costs and Benefits of Green Roads in Ethiopia

NO CLIMATE RESILIENCE INTERVENTIONS		GREEN ROADS FOR WATER (ETHIOPIA) <sup>a</sup>	PROTECTIVE RESILIENCE <sup>b</sup>
<b>Costs per kilometer</b>			
Intervention costs:			
Paved roads	US\$0.00	US\$1,800	US\$45,000
Unpaved roads	US\$0.00	US\$1,800	US\$31,200
<b>Benefits per kilometer</b>			
1. Resilience dividend			
Routine maintenance	Costs increase substantially across the network because of climate change impacts that damage the road over the year	Cost savings per year: Paved: US\$1,100 Unpaved: US\$2,200	Cost savings are generally comparable to those from the roads-for-water technique
Periodic maintenance	Costs increase substantially across the network	Cost savings: Paved: US\$3,400 Unpaved: US\$1,870	Cost savings are generally comparable to those from the roads-for-water technique
Reduced damage from erosion	Erosion from peak weather events is not mitigated	US\$2,675	Erosion often worsens downstream from protected roads, sometimes severely
Reduced damage from flooding	Flood impacts typically not mitigated upstream or downstream of roads	US\$1,762	Road is protected; Flood damage often worsens downstream of improved roads
Reduced damage from sedimentation	Higher levels of sedimentation	US\$180	Higher levels of sedimentation, sometimes severe
2. Unlocking economic potential			
Reduced impact from climate change	Climate impacts not mitigated	US\$550	Climate impacts are not mitigated and may be exacerbated
Duration of road closures or downtime	More road closures and downtime	US\$3,800	Generally comparable to those from the roads-for-water technique
3. Co-benefits			
Beneficial use of water harvested by the road	No opportunities to harvest water beneficially	US\$4,500	Opportunities to use water beneficially are forgone

Source: [Green Roads for Water: Guidelines for Roads Infrastructure in support of water management and climate resilience](#)





## Our mission

- **To make Green Roads a standard:** to have roads systematically used for water management, regreening and climate resilience and introduce as standard in at least 50% of countries in the world by 2025
- **To work with other organizations to adopt and support the same practices**
- **To fast-track climate change adaptation** by retooling roads for water and regreening and at the same time have more reliable transport connections







## Our services

- ✓ **Road water assessments** – identifying the best options along selected roads
- ✓ Working with engineers and implementers to **design better practice**
- ✓ **Developing guidelines** appropriate to specific countries and situations
- ✓ **Training and coaching** towards a change in culture and governance for green roads for water
- ✓ **Developing strategies** to optimize the wider socio-economic benefits of road development and road construction



## Connecting with (in progress):

### National Programs



### Green Finance Initiatives



### Academia



### United Nations



### Bilateral & Multilateral Organizations



### Private Sector foundations



### Contractors



### Main NGOs



# Related sources

- [Green Roads for Water website](#)
- [Green Roads for Water brochure](#)
- [Green Roads for Water Guidelines \(supported by the World Bank\)](#)
- **Videos:**
  - [Green Roads for Water: The pitch](#)
  - [Making Roads Work for Water: Local Impressions- Mozambique](#)
  - [Gender, Rural Roads, and Transport](#)
  - [Road Water Harvesting in Tigray, Ethiopia](#)
  - [Kenya- Catching Road Runoff in Ponds](#)
  - [Connecting Roads, Water, and Livelihoods in Uganda](#)
  - [Roads for Water: Experiences from Malawi](#)
  - [Roads for Water: Zambia](#)





# Thank you!

For more information visit [www.roadsforwater.org](http://www.roadsforwater.org)  
or send an email to [adeligianni@metameta.nl](mailto:adeligianni@metameta.nl)