

Green Roads for Water

Green Roads for Water, are not only means of transport from A to B but also instruments for boosting livelihoods, for water management and climate resilience

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



Impact of Roads on landscape, surface hydrology and livelihoods



(crop loss and health problems)

(Health problems and crop loss)



This can be



And roads and water can become friends

Green Roads can be used to harvest road-runoff that previously would cause flood damage and guide it to recharge areas, surface storage places or distributing it over farmland

What Are the Green Roads for Water?



- Roads that increase the climate resilience of rural communities
 - Roads that are instruments for beneficial water management
 - Roads that reduce land degradation and promote good land management
 - Roads that improve the water supply of rural communities
 - Road that are used for flood protection and flood relief
 - Roads that provide employment opportunities to rural communities
- Roads that have secure transport functions
 - Roads that connect rural communities to foods, services and markets

Green roads can turn problems into opportunities...



Why Green Roads: Big Scale and Big Impact

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



Many tested Green Roads measures exist, suited to different geographies



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



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

> Rate of return high (>4 in a year)

GUIDELINES:

GREEN ROADS FOR WATER

INTERGRATING WATER MANAGEMENT AND CLIMATE-CHANGE ADAPTATION IN THE DESIGN AND CONSTRUCTION OF ROADS



- Approach
- Geographies
- Techniques
- Governance
- Economics

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- Technical
 - Annexes

The GL are targeted at road planners and infrastructure investors but also at people working on flood protection, landscape restoration, agricultural development, climate resilience and environment in general





Main opportunities of managing water with roads

In arid areas, roads can be used to harvest water.

Roads can also be used to manage water catchments by controlling the speed of runoff, compartmentalizing and mitigating flood runoff, and influencing the sedimentation process in the catchments..

In floodplains and lake sides, roads play a role in flood protection. Roads often double as embankments and provide evacuation routes and flood shelters. In low-lying wetland areas and floodplains, roads and bridges affect the shallow groundwater tables and have enormous consequences for land productivity.

Roads can improve pastoralist areas for instance by combining the concentrated run-off from roads with planting native grass species.

Roads can also be used to control sand dune movement.

Roads may serve to protect wildlife areas

Three levels of road resilience in different geographies

Level of Road Resilience	0	1	2
	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 for Water in different geographies

Semi-Arid Areas

Challenges:

Road run-off causes extensive erosion, flooding and sedimentation but also damage to road bodies.

Opportunities:

Use of road for water harvesting at large scale (use of harvested water for irrigation, livestock drinking water and groundwater recharge).

Techniques:

Use of flood water spreaders, flow dividers at culverts, road drifts or road embarkments to divert the road run-off to water storage. Use infiltration trenches, converted borrow pits or farm ponds as water storage structures.



www.metameta.nl ~ totor on cortag

Road drift acting as sand dam

Green roads for Water in different geographies

Lowlands areas

Challenges:

Roads have a major impact on water management which is often manifest in water logging.

Opportunities:

As roads are the main infrastructure in these areas, they can be used to control water levels for productive uses. Such measures contribute also to the longevity of road network. Roads can be also used as flood shelters and evacuation routes.

Techniques:

Use of road alignment to compartmentalize high and lowlands, adequate cross drainage to retain and release water, using gated culverts for water level control, making use of borrow pits for drainage and water storage using roads for land accreditation.



Recommended best practices in coastal lowland areas



Recommended good practices for roads combined with flood embankments

In-polder water management (IPWM)

Improving and making the best use of water management infrastructure inside the polder to maximise returns from agriculture



Green roads for Water in different geographies

Mountain areas

Challenges:

The development of roads in these areas can have a heavy negative impact on the surrounding environment and undermine climate resilience and dry up springs for instannce. Road development can change runoff patterns and cause areas to further dry out.

Opportunities:

Safeguard the road environment with measures that reduce the risk of disturbance whilst also improving the productive value of these areas.

Techniques:

For the development of new mountain roads, the mass balance method should be considered. Main techniques to manage the water road environment are **spring capture**, reinforced road water crossings and bio-engineering.



Landscape management measures for mountain areas (Ecosystemic approach)





Green Roads for Rural Water supply



Even if road surface can affect the water quality, the very large portion of water harvested with roads, originates from the entire cathment. The harvested water can improve the rural water supply by augmenting the resource though recharge and feeding surface storage.





RWH for groundwater recharge Use of groundwater for domestic purposes and irrigation

RWH for water storage Use of harvested water for irrigation and livestock drinking water

Roadside spring management Use of harvested water for domestic purposes







Green Roads and Governance





Green Roads co-benefits









Water from spring opened by road construction



Safeguarding wetland functions with low embankment road







Roads controlling water tables between high and low land



Roads leading to flood shelters, roads serving as (post) flood shelters as well





Employment opportunities for rural communities on road construction and regreening



Green Wall - Roadside Regreening -











Monitoring the impact of Green Roads in Ethiopia

Kifle, W., Berhane, G., Taye, A., Kebede, M., & Marta, A. P. (2019). Practices and Hydrological Effects of Road Water Harvesting in Northern Ethiopia: Towards Design of Multi-Functional Infrastructures. *Momona Ethiopian Journal of Science*, 11(2), 159-186



(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). 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)

-2014

2018

2016

2017

Returns tend to be high and additional costs low

• Ethiopia water harvesting from roads

- Investment (incl capacity building): USD 3600/10 kilometre
- Returns/year USD 16879/10 kilometer
 - Reduced maintenance and down time; reduced land damage; benefits of water retained
- Independently verified
- Households earn on average USD 80-100 USD/more, and crop yields per plot increase with 60-100kg

Bangladesh

- Reduced water logging and better water level control (benefitting area 1680 ha)
- Polder 26 investment USD 200,000
- Returns/year USD 3.1 M

 No / modest additional investment costs – at times even cost savings (low embankment roads, non vented drifts)

Costs and benefits of Green Roads for Water

	Mechanized method	Hybrid method (Mechanized and HIMO)	HIMO method (high intensity manual labor)
Unit Costs (averages) for unpaved feeder road construction without GR4W	39,000 USD/km (baseline)	35,100 USD/km	31,200 ¹ USD/km
Incremental unit cost with GR4W (one off)			+ 1,800 ¹ USD/km
Incremental benefit with GR4W (Cumulative Annual Dividend of GR4W)			~+ 17,000 ¹ UDS/km
Benefits	~ 41 % (baseline)	~ +20% over baseline; or 46 %	~ +25% over baseline; or 51 %

¹ World Bank Guidelines on Green Roads for Water

Green Roads for Water program





- Supported by: The World Bank, ADB, WFP, GRP,
- Development of GR4W Guidelines and Guided Learning packages
- Active in more than 10 countries
- Outreach > 6 M people



- World Bank Global Guidelines (QER successful)
- Asia activities started in Bangladesh, Nepal, India, Tajikistan – interest from other countries
- Africa:: Ethiopia, Kenya, Mozambique, Uganda, Sudan Yemen, Zambia
- Latin America: Bolivia, Haiti

What went before









• Road for Water Programme

- www.roadsforwater.org
- Global Road Achievement Award 2015
- Runner Up Resilience Award 2018
- Since 2015
- Outreach > 6 M people

What went before









Road Water harvesting campaigns > 5 Million people benefitted since 2015

The Green Roads for Water Alliance: DOLI too?





What are the ambitions?

- To promote Green Roads: to have roads for systematically used for water management, regreening and climate resilience throughout World Bank Operations and introduce as standard in at least 50% of countries in Asia/Africa 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



What will be done?

Mobilizing Green Finance

- Connect climate finance with road infrastructure in Bank
- Develop underlying numericals for additional costs and multiple benefits co-benefits
- Prepare packages with Green Climate Fund
- Explore Green Bonds for verified Green Road programs
- Participation in co-benefits methodology

2. Community of Practice – Learning Alliance

- Expand Learning Alliance (building on <u>www.roadsforwater.org</u>)
- Transport resilience COP (DRR/Transport) broaden it
- Promotional training (TED Talks, webinars, blogs, presentation at events) within Bank
- Introduce technical training with (country) training institutes
- E-learning
- Monitoring and learning: promote and update Guidelines as live document
- Outreach to programs of different organizations contribute to regional conference SSATP/ Climate Change

3. On the Ground Support

- Special support to road and water investment projects (training, assessment, design)
- Support to national guidelines and capacity building
- Feed into Community of Practice



Thank you!