Green Roads for Water

IRF Training “Building Climate Resilience into Roads & Transport Infrastructure”

November 9, 2020 4:00pm – 6:00pm CET

Presenter: Anastasia Deligianni – MetaMeta Research, Program Manager of the Green Roads for Water Program
What are the Green Roads for Water?

- Smart way of meeting climate resilience of roads
- Smart way of collecting and using the road run-off
- Smart way of reducing adverse weather impact on road bodies and the surrounding environment
- Smart way of securing transport
INTRODUCTION: Impact of roads

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

- Flooding
- Water logging
- Erosion and sedimentation
- Road damage

(on average there are 13-25 problem spots along a 10km stretch of road)
Green Roads are instruments for climate resilience, better water management and regreening. Management of water with road infrastructure presents a triple win with very little additional investment: (1) reduced road maintenance costs, (2) reduced degradation of the landscape around roads and (3) productive and consumptive use of the water harvested with roads.

This can be turned around: roads can become GREEN ROADS.
## Levels of road resilience in different geographies

<table>
<thead>
<tr>
<th>Level of Road Resilience</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic Resilience: Protective</strong></td>
<td>Protecting road infrastructure</td>
<td>Making best use of and adapting to changed hydrology</td>
<td>Redesigning road infrastructure to optimize the area’s water management/climate resilience</td>
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<tr>
<td><strong>Key words</strong></td>
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<tr>
<td><strong>Geographies</strong></td>
<td></td>
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<tr>
<td><strong>Semiarid areas</strong></td>
<td>Catchment measures to reduce water damage to roads</td>
<td>Use runoff guided from roads for recharge and storage; upper catchment protection</td>
<td>Design roads and cross-drainage facilities to collect runoff and guide to recharge area</td>
</tr>
<tr>
<td><strong>Watersheds and catchments</strong></td>
<td>Catchment protection to protect road infrastructure</td>
<td>Catchment protection to protect road infrastructure</td>
<td>Plan road alignment and drainage structures in support of catchment management</td>
</tr>
<tr>
<td><strong>Coastal areas and floodplains</strong></td>
<td>Increase height of flood embankments to deal with higher floods</td>
<td>Convert village roads for water-level management with gated structures</td>
<td>Consider low embankment roads with controlled floodways develop road levees in flood-prone areas; use roads for land accreditation</td>
</tr>
<tr>
<td><strong>High- and medium-altitude areas</strong></td>
<td>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</td>
<td>Using water-retention and land-management measures suitable to mountain areas to stabilize mountain catchment and retain moisture and snowmelt; systematic spring management</td>
<td>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</td>
</tr>
<tr>
<td><strong>Desert areas</strong></td>
<td>Revegetation and dune stabilization using road runoff</td>
<td>Develop small roadside oases taking road runoff to depression areas</td>
<td>Adjust road directions to deal with wind directions to control sand dune formation</td>
</tr>
</tbody>
</table>

**Regular Roads**

**Green Roads**
Green Roads co-benefits

**Water security**
- Improved soil moisture and subsurface water storage
- Controlled water table
- Springs and wells
- Extended supplementary irrigation

**Agricultural production**
- High-value crops
- Increased production, cattle drenching
- Better value chain

**Risk management**
- Reduced flood risk
- Flood protection
- Post-flood functions
- Non-interrupted logistic chains

**Land protection**
- Reduced erosion
- Land accretion
- Reduced sedimentation
- Regreening borrow pits

**Connectivity**
- Economic integration
- Access to vital services
- Communication
- Reduced maintenance costs

**Food and Nutrition Security**
- Food, fodder and woodlots
- Income generation (transfers)
- Access to food (FFA)
- Empowered organizations
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).
IRF’s mission: to encourage and promote the development and maintenance of better, safer and more sustainable roads at a service of economic growth and regional integration.
Green Roads for Water program

- Initiated by MetaMeta
- 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
- Supported by: The World Bank, GRP, NWO, NERC, RAP3, Blue Gold and more
- Development of GR4W Guidelines and Guided Learning packages
- Active in more than 10 countries
- Outreach > 6 M people
The Green Roads for Water Initiative
Connecting with (in progress):

- National Programs
- Bilateral & Multilateral Organizations
- Green Finance Initiatives
- Private Sector foundations
- Academia
- Contractors
- United Nations
- Main NGOs

Logos of various organizations are displayed in the diagram.
Green Roads Guidelines

Supported by: WORLD BANK GROUP

- Guidelines for integrating water management and climate-change adaptation in the design, construction and maintenance of roads.
- These Guidelines are targeted at road planners, infrastructure investors, private road developers – be it at the World Bank, the partner countries or elsewhere. They are also targeted at other communities of practice: those that work in flood prevention, landscape restoration, agricultural development, climate resilience, disaster risk reduction and environment in general.

- Approach
- Geographies
- Techniques
- Governance
- Economics
- Technical
- Annexes
Please access the draft version of the Green Roads for Water Guidelines through this link. The official version will be published soon by the World Bank.
Green Roads:
Landscape level till spot interventions

A series of infiltration pits, percolation ponds and Swales that collect road run off constructed on a roadside field by local farmers who were trained on the GR4W approach.

Gazgibla Woreda, Ethiopia (2019)
Lilongwe District, Malawi (2019)

The GR4W approach has been adopted as national policy in Ethiopia and road water harvesting has been incorporated into the annual National Watershed Campaigns.
Green Roads 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 embankments to divert the road run-off to water storage. Use infiltration trenches, converted borrow pits or farm ponds as water storage structures.
Green Roads in different geographies

Coastal 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.
Green Roads 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. 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)
Road-side Tree Planting

Advantages of road-side tree planting:

- Removes dust and other pollutants from the air, protecting crops, roadside communities, and livestock.
- Reduces soil erosion: holds soils in place.
- Wind breaks that reduce desiccation and wind erosion.
- Flood control: slows and absorbs road runoff.
- Carbon dioxide sequestration.
- Direct benefits: timber, fodder, fuelwood, fruits, pollinator habitat.
- Provides shade and keeps the road cool for road users.
- Beautification
# Costs and benefits of Green Roads

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

1 World Bank Guidelines on Green Roads for Water
Good news: many things can be done

Converting borrow pits to store water from roadside drains and culverts
Good news: many things can be done

Water from feeder road is collected and diverted into a water storage structure or a farm through a trench/ditch.
Good news: many things can be done

Flood water spreaders from road surface to enhance soil moisture and recharge groundwater
Good news: many things can be done

Employment opportunities for rural communities on road construction
What are the ambitions?

- 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 the countries in Africa and South Asia 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

<table>
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<th>Who does what</th>
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<tr>
<td>World Bank</td>
<td>Promote within operations, expanding learning through contacts, leadership among international organizations, financial support</td>
</tr>
<tr>
<td>MetaMeta</td>
<td>Lead/ coordination, operate CoP learning alliance, on the ground support, documentation, update guidelines</td>
</tr>
<tr>
<td>International Road Federation</td>
<td>Promote within global road community, technical support</td>
</tr>
<tr>
<td>Global Resilience Partnership</td>
<td>Promote in resilience community, M&amp;E, financial support, networking</td>
</tr>
<tr>
<td>Zurich RE</td>
<td>Develop insurance finance modalities</td>
</tr>
</tbody>
</table>
What will be done?

1. **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 [www.roadsforwater.org](http://www.roadsforwater.org))
   - Transport resilience COP (DRR/Transport) — broaden it
   - Promotional training (TED Talks, webinars, blogs, presentation at events)
   - 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!

For more information contact:
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