Green Roads for Water: Kenya experience, impact and lessons

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

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# Resilience dividends – responding to climate stressors

1. Restore natural resources and optimize landscape functionality
2. Unlock economic potential
3. Direct use and benefits of road water management to agricultural sector

| Paved roads | Temperature | Increased temperature leads to accelerated aging of binder  
|            |             | Increased temperature leads to rutting (of asphalt), and bleeding and flushing (of seals) |
|            | Precipitation | Increased precipitation leads to increased average moisture content in subgrade layers and reduced load-carrying capacity  
|            | Flooding (in excess of design flood) | Washaways and overtopping of road |
| Unpaved roads | Temperature | No effect  
| Unpaved roads | Precipitation | Increased precipitation leads to increased roughness of the road surface, increased average moisture content in subgrade layers, and reduced load-carrying capacity |
Kenya experience

1. Techniques: What is being done?
2. Approach: How is it done?
3. What is the impact?
1. What is being done?

A dryland geography

Dryland adaptations with fodder production
Road river crossings as sand dams
Rainfall distribution pattern typical for Arid to Semi-Arid Lands (ASALs)

Rainfall distribution pattern - short rains
(October-December, 2017)

Rainfall distribution pattern - long rains
(March-May, 2018)
Causes of land degradation in the drylands

Examples after reseeding and rainwater harvesting

BEFORE

reseeding + rainwater harvesting

AFTER
Typical examples of lead out trenches from unpaved roads in Kenya

Cutoff from side drain
Excess water redirected
Stored in a trench to increase soil moisture for agricultural production
Impact of grass reseeding combined with road water harvesting

1. **Perennial and indigenous** grass species withstand climate vagaries
2. Soil loss is prevented – **roads are safeguarded**
3. Soil moisture is increased significantly and **moisture availability prolonged** (1 month)
4. Kitui County has **changed their policy** to include road water harvesting for pasture production – **inter-sectoral collaboration**
5. Increased farmer **income** through seed, hay, meat and milk production
6. **Change in attitude** among communities and government that road water can be useful and that pasture is worth cultivating
Technique: Non-vented drifts

Road river crossings functioning as sand dams
Recurring issues with vented drifts:

- Requires regular maintenance to remove sediments and flotsam
- Capacity of culverts is greatly reduced resulting in wash away and cutting in the road
- It does not retain water
- Increased flooding size and occurrence pose higher risk to the structure
The opportunity: non-vented drift

- Road drifts in dry river bed builds up water storage in sand
- Used to stabilize ephemeral riverbeds
- It can be constructed in a cascade to optimize functionality
- Drifts create all weather road crossing – enhancing connectivity and reducing travel time
Non-vented drift acting as sand dam
| Drift type 1: Large drift, foundations excavated at maximum depth of 1.5 m and elevated 0.3 m above the existing sandy riverbed. | 1240 US$ per meter |
| Drift type 2: Large drift, constructed on bedrock, elevated 0.5 m to 1.2 m above the existing riverbed. | 760 US$ per meter |
| Drift type 3: Small drift, constructed on normal, ordinary river channels. Little or no elevation above the existing riverbed level. Depth 0.5 m to 1.0 m. | 475 US$ per meter |
| Type 4: Small drift (road slabs), constructed on bedrock or swampy plains. Little or no elevation above the existing riverbed level, maximum depth 0.5 m. | 330 US$ per meter |
Practical note specifies design and construction standards for non-vented drift
2. How is it done?

Decentralized government

Inter-sectoral teams within local/regional government
Beyond techniques, it’s about Governance

Integrate in County Programs on Roads and Water

Community engagement

Change procedures in roads development
- Manuals
- Investment budgets
- Maintenance budgets
- Cooperation

Capacity building
- Technical training – county staff and road engineers
- Short courses
- Tools (run-off models)
- Guided learning
Kenya: working as partners with County Governments

• Technical team in Kitui, Makueni & Machakos
• Cross-sectoral coordination
  • For all activities within the County
  • Departments of Water, Agriculture, Roads & Coordination
  • Representatives of Road authorities such as KeRRA/KeNHA

➢ Ongoing integration within county programmes and policy
Scope of Work - Technical Teams

• Capacity building
  • County, Sub-County & Ward levels
  • Road engineers specifically trained on road design of non-vented drifts
  • To farmers in their communities/groups
  • WRUAs
• Support to implementation – extension officers on the ground giving technical advice to farmers
• Monitoring the impact of Road Water Harvesting
• Documenting good practices
• Information sharing and outscaling to other counties
Machakos County

- 50 county staff – County representation + selected sub-counties
- 4 sub-counties: >600 farmers trained

Kitui County

- 202 county staff - all sub-counties
- >400 farmers

Makueni County

- 50 county staff – County representation
- >120 farmers
3. What is the impact? 
*Roads’* benefit
Cost Benefit Analysis of farmers

Kitui representative of 8 sub-counties (30 farms)

Costs: 62833 KSH, 60%

Benefits: 42274 KSH, 40%

The costs of construction compared with the return on investment after 1 growing season

Mbitini (ward in Kitui County) (60 farms)

Costs: 2440 KSH

Benefits: 7273 KSH
What has changed in Kitui, Makueni and Machakos?

- Myriad of road water harvesting techniques adapted and combined for ASAL conditions
- >50,000 people benefit from improved road safety and connectivity
- >10,000 people benefit from prolonged water availability for essential dryland agriculture
- Policy change through intensive inter-sectoral collaboration
Green Roads Kenya 2019-2024

- Accessibility to basic facilities and market
- Agricultural outputs
- Value creation from local value chains
- Food security and stability

- Risk of environmental hazards
- Conflicts over natural resources
Lessons and take-aways

- Dryland and ASALs present huge opportunity for roads to benefit agriculture/landscape and vice versa
- Change in attitude through champions both in farming communities as well as in road engineering communities
- Impact is multi-fold and keeps building up
- Direct benefits triggers involvement of sceptics
Steps ahead

• Standardise Green Roads approach with road bodies and governments
• MM + IRF + partners to spread the message through multiple engineering bodies
• Connect road improvement directly towards climate resilience for landscapes and agriculture \(\rightarrow\) change the narrative
• Others, please share!
Thank you!

Let’s travel together 😊