Green Roads for Water: Kenya experience, impact and lessons

Green roads for climate resilience and water management

Tailor Made Training

Dhulikhel, Nepal

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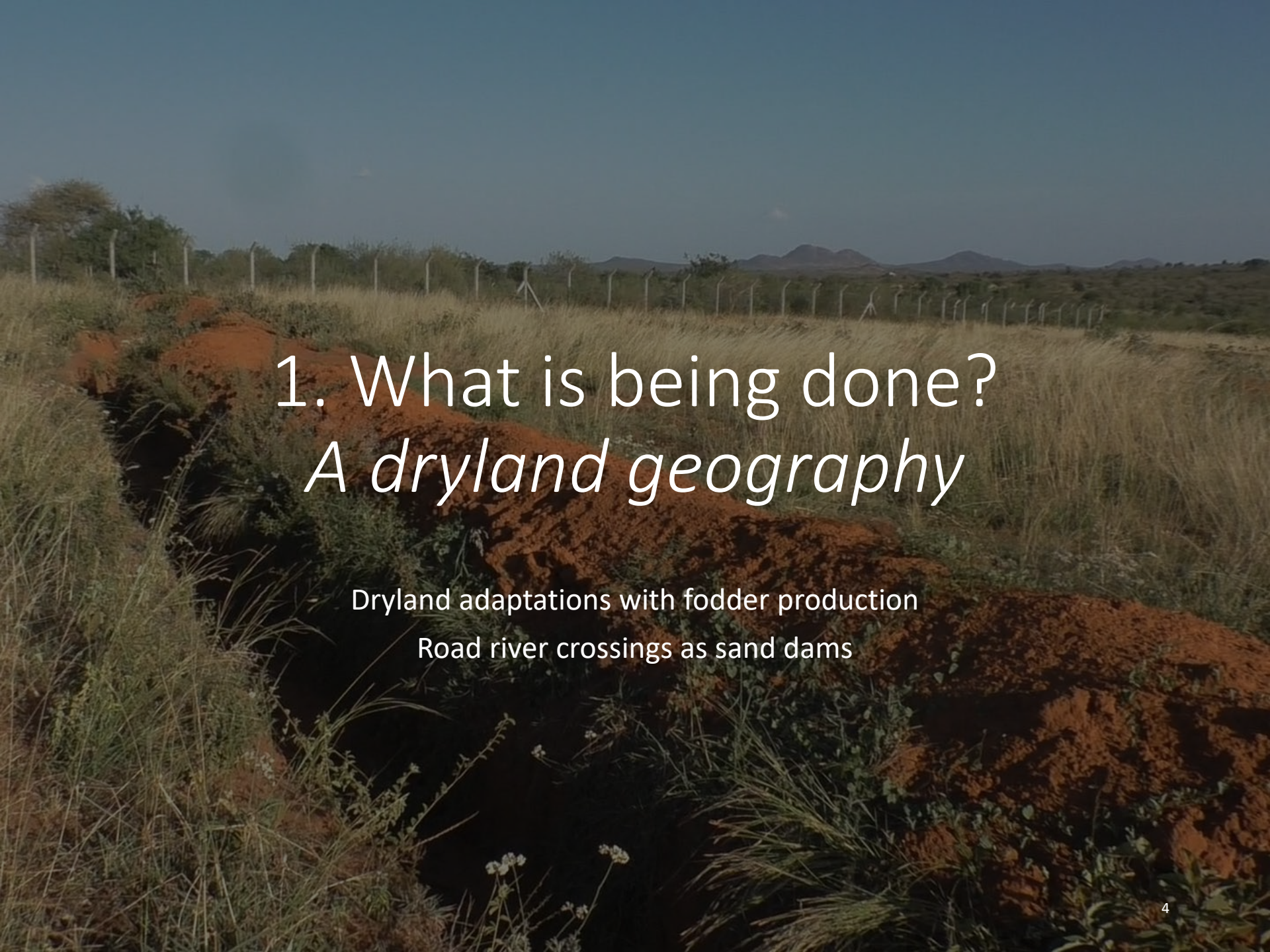
Resilience dividends – responding to climate stressors

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
	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?

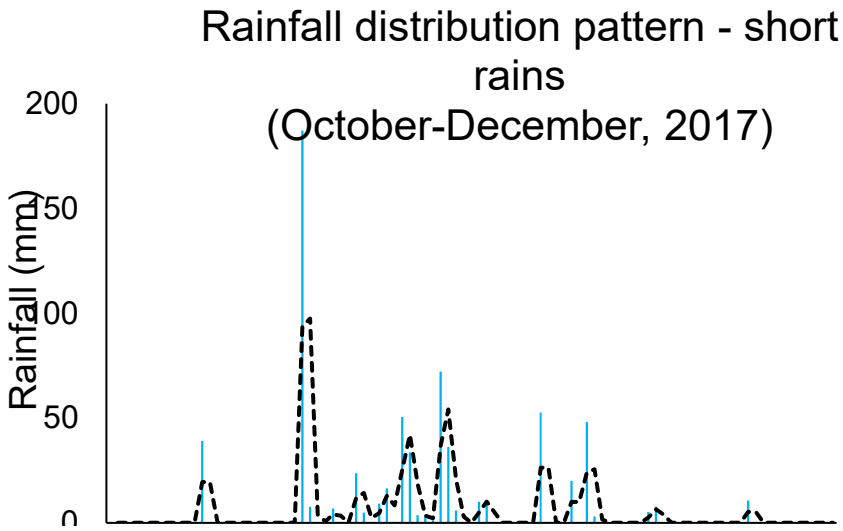


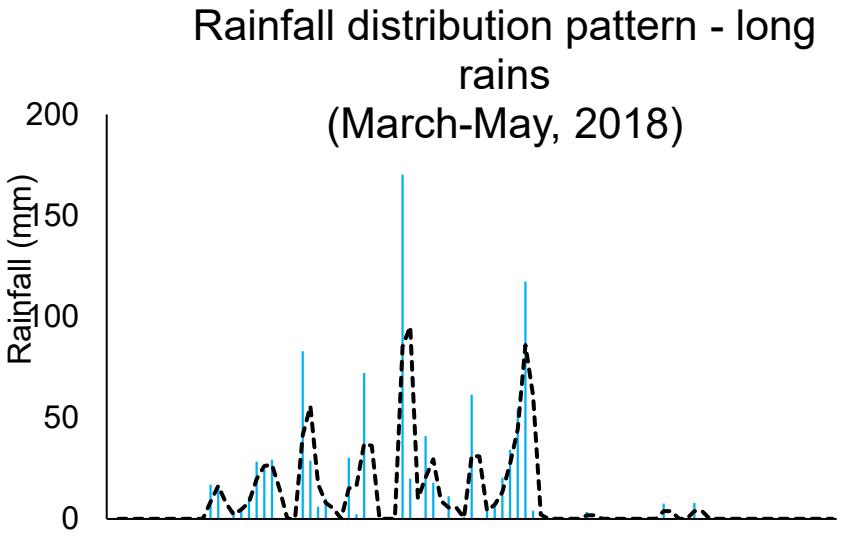
1. What is being done?
A dryland geography

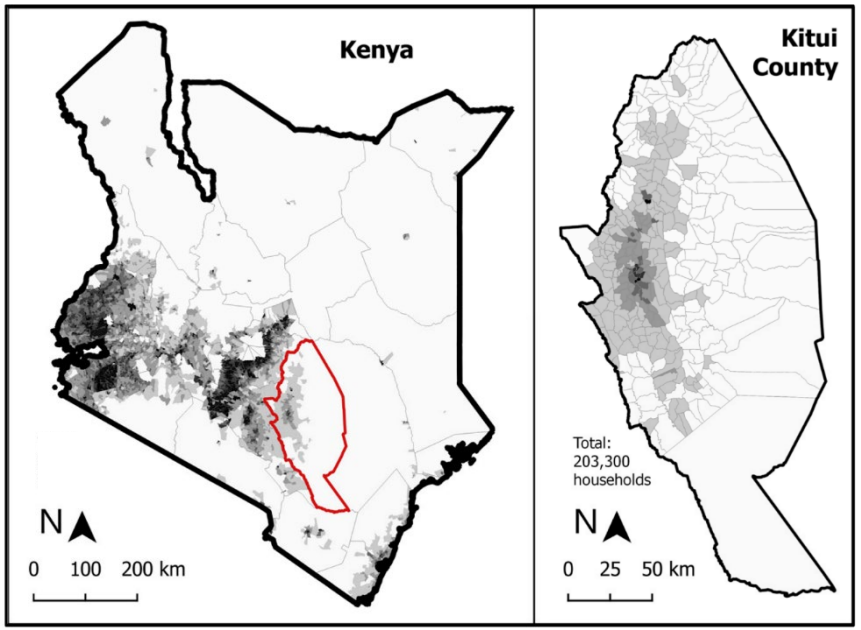
Dryland adaptations with fodder production

Road river crossings as sand dams

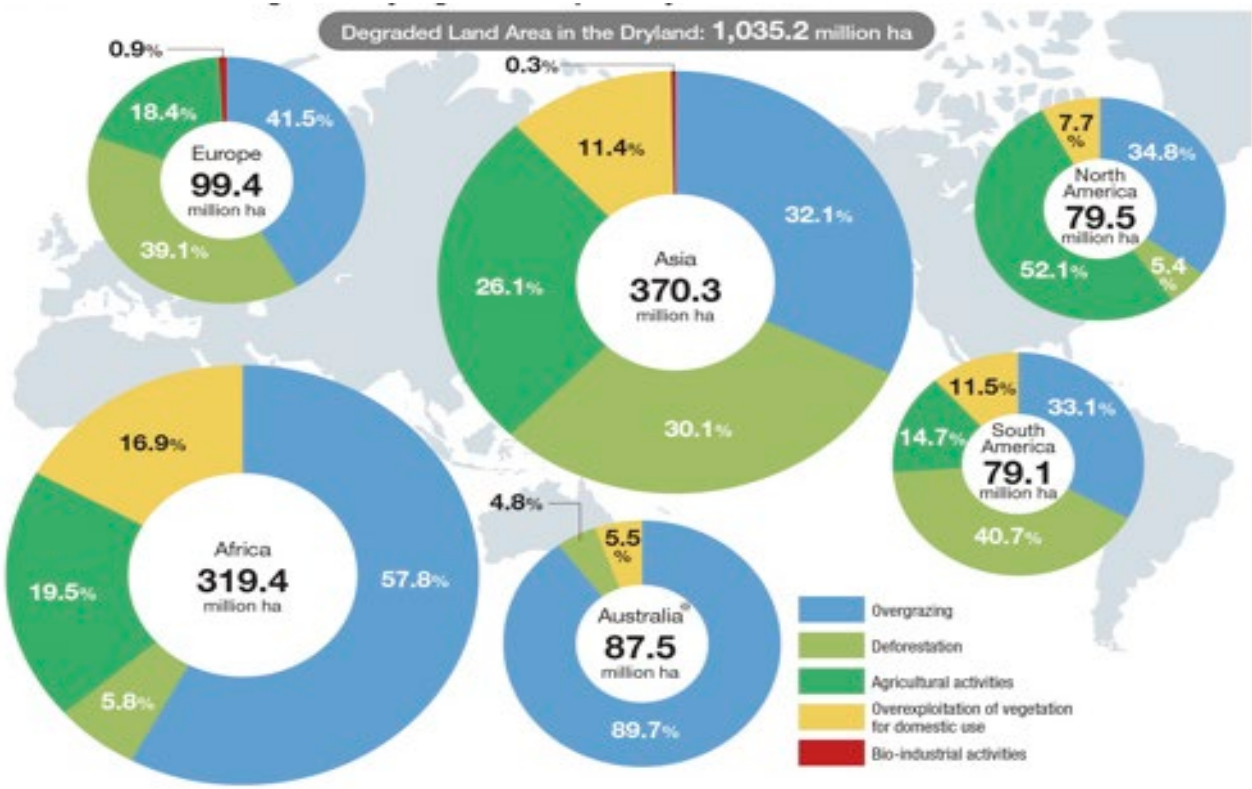
Rainfall distribution pattern typical for Arid to Semi-Arid Lands (ASALs)







Causes of land degradation in the drylands



Source: World atlas of land degradation, 2nd Edition (UNEP)

Examples after reseeding and rainwater harvesting

reseeding
+
rainwater
harvesting

BEFORE

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

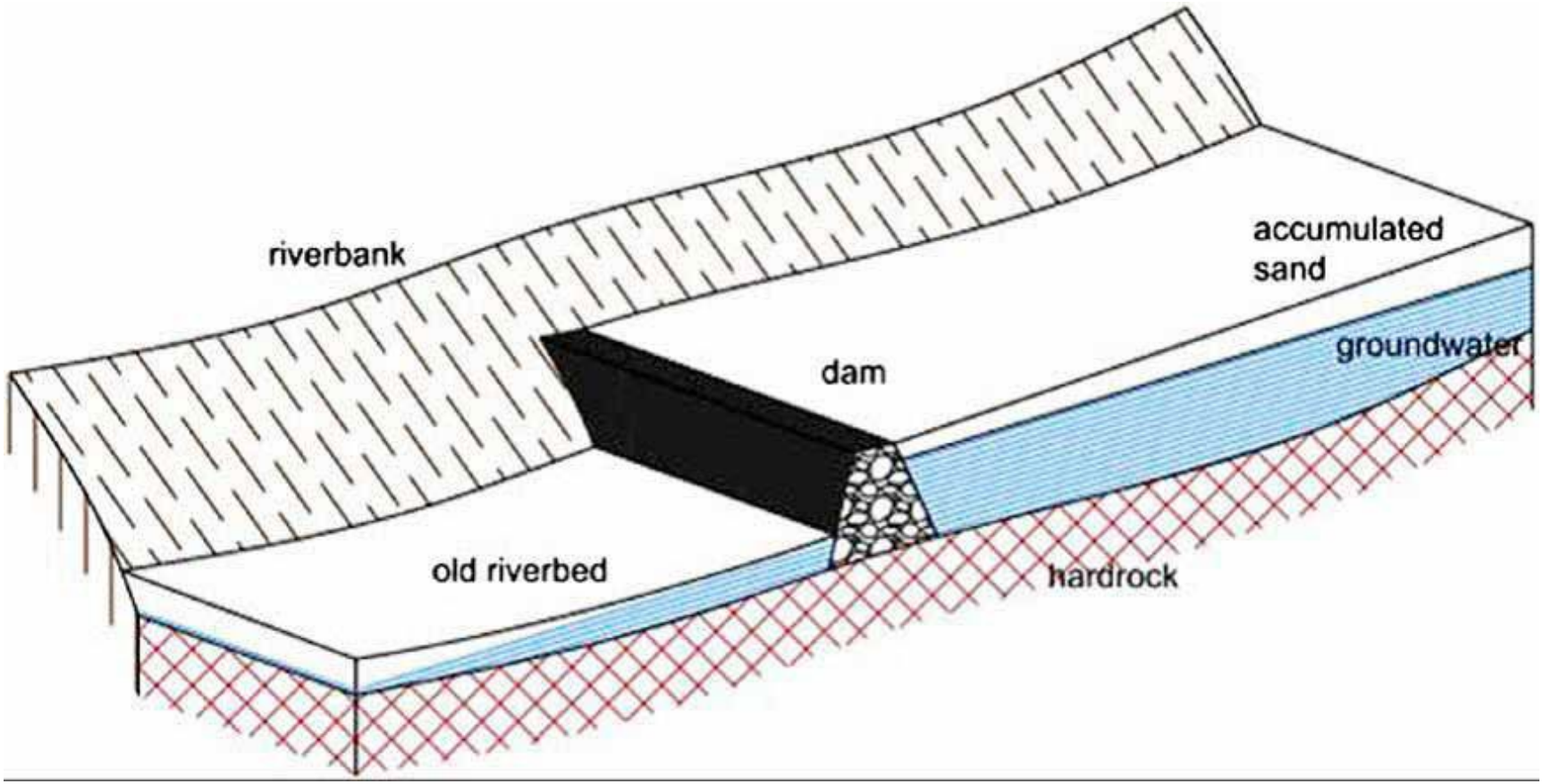
Recurring issues with vented drifts:

- 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 opporunity: non-vented drift

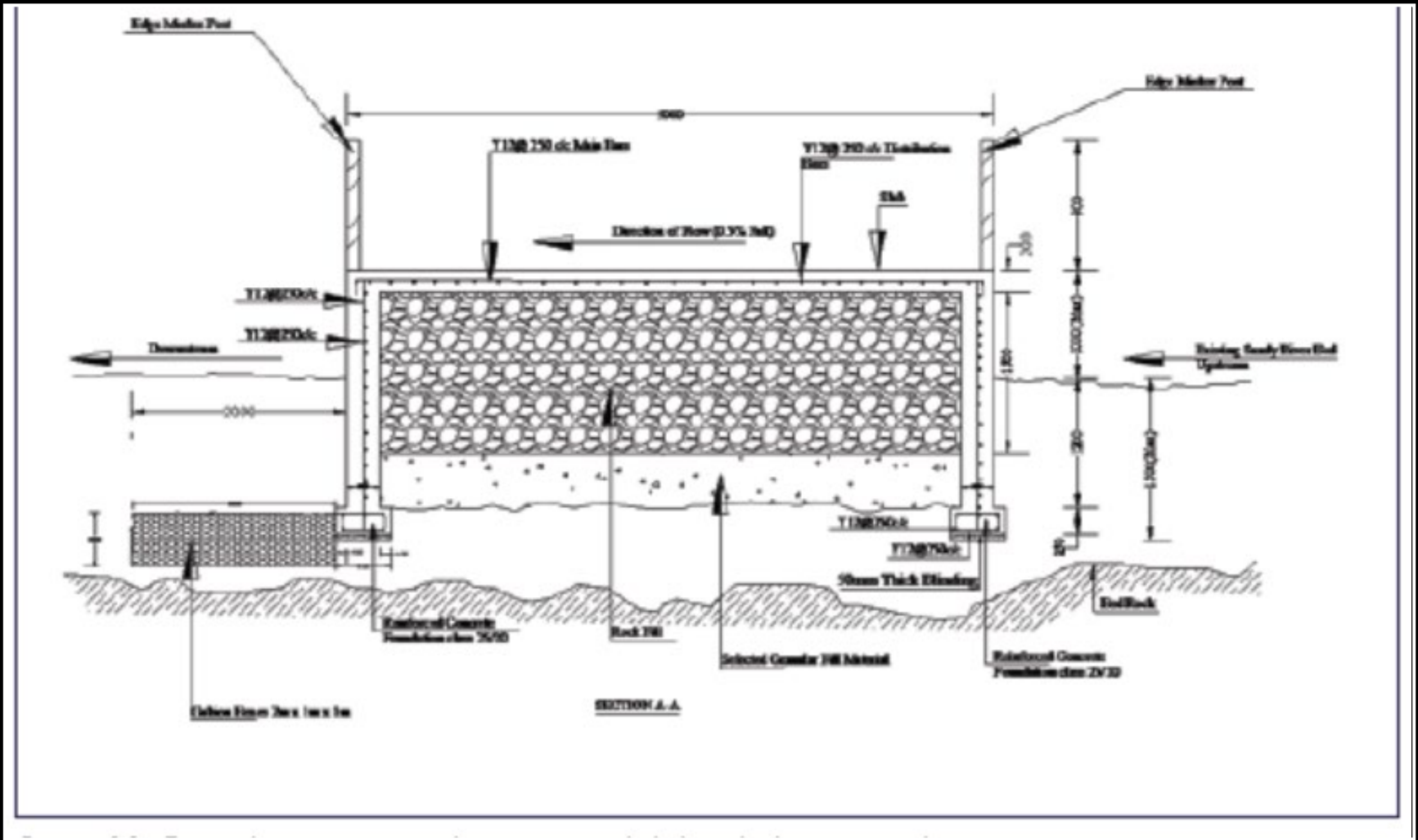
- Road drifts in dry river bed builds up woter storage in sand
- Used to stabilize ephemeral riverbeds
- It can be construcuted in a cascade to optimize functionality
- Drifts create all weather road crossing – enhancing connectivity and reducing travel time

Non-vented drift acting as sand dam



Drift construction costs per meter in Makueni County, Kenya 2015

	US$ per meter
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
Drift type 2: Large drift, constructed on bedrock, elevated 0.5 m to 1.2 m above the existing riverbed.	760
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
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



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

Capacity building

Machakos County

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

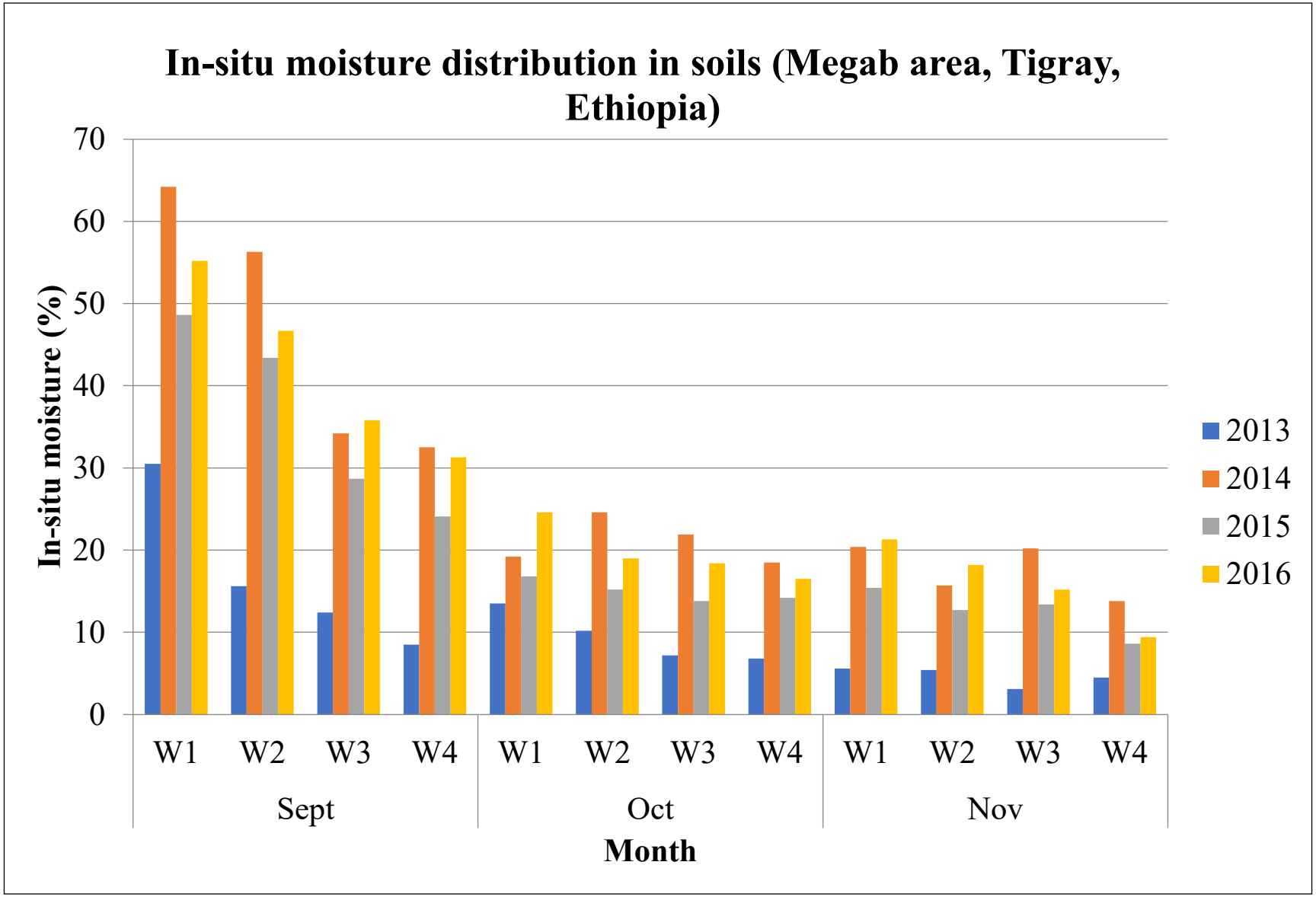
Kitui County-

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

Makueni county

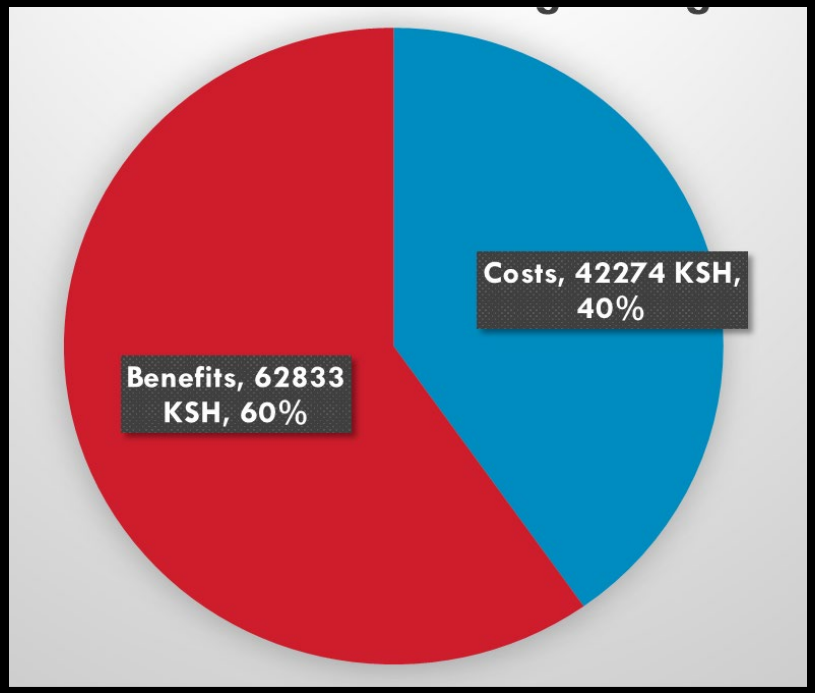
- 50 county staff – County representation
- >120 farmers

3. What is the impact?
Roads(') benefit

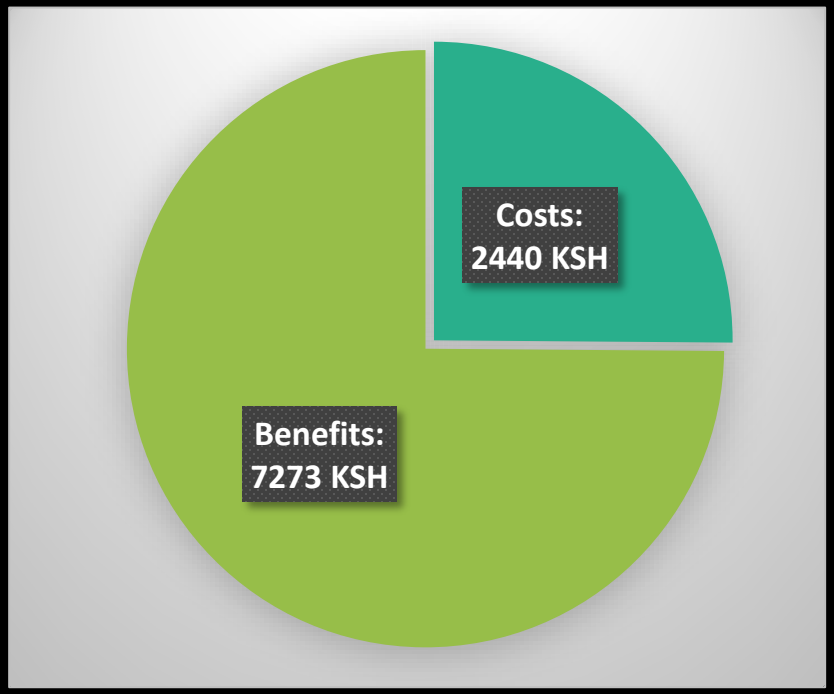

In-situ moisture distribution in soils (Megab area, Tigray, Ethiopia)
In-situ moisture (%)
70
60
50
40
30
20
10
0
W1
W2
W3
W4
W1
W2
W3
W4
W1
W2
W3
W4
Sept
Oct
Nov
Month
2013
2014
2015
2016

Cost Benefit Analysis farmers

Kitui representative of 8 sub-counties (30 farms)



Mbitini (ward in Kitui County) (60 farms)



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

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

Increase

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

Decrease

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 → change the narrative
- Others, please share!

Thank you!