WEATHER PROOFING: MANAGING WATER WITH ROADS

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Program

1. Introduction
2. Discussion on designs and guidelines for road water management
3. Discussion on governance
4. Ways forward

Opportunity

To have roads systematically used for water management, in different economic and environmental settings

Examples: roads as flood protection

Examples: Roads as spillway

Examples: Groundwater recharge

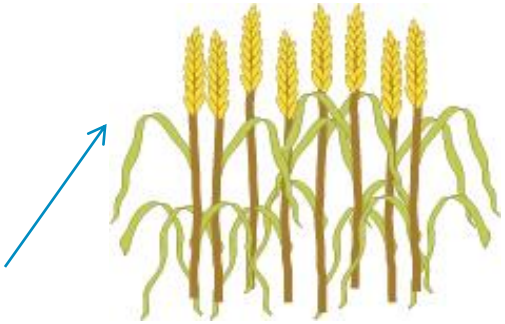
Because

- Annual investment 700 Million USD
- 40% in developing countries
- 1 Billion people totally unconnected
- Increased water stress – most poor in water stressed areas (74%)
- MDB's invest USD 17.5 Billion/Yr up to 2022
- **United Nations Secretary-General's High-Level Advisory Group on Sustainable Transport:**

  '*Transport plays an essential role in countries' economic growth, competitevess, balanced and liveable spatial development, access to water and energy and food saving*'

Continued increasing demands on water

- The demand for food is expected to rise with 60% by 2050
- Caused by rising population (40%) and higher per capita calory intake (11%) and intake of lower calory items (especially fruits and vegetables)
- The supermarket revolution particularly effects groundwater
  - Higher quality standards
  - More uniformity
  - Vegetables
  - Throughout the year
  - Special agronomy



Demand for fibre and bio-energy

- Demand for sawn wood to increase with 45% from 2005-2030, in the same period, demand for roundwood with 47% and for wood panels 120%
- Demand for cotton is to increase with 81% between 2010 and 2050
- Demand for bio-energy = dark horse, depends on 2nd generation bio-fuels among others

Because

Water main source of (potential) damage to roads

Roads change the surface hydrology and have major impacts on run-off

- now often causing local flooding, water logging and erosion
- this can be turned around in large potential for water harvesting and water management

Roads acting as dikes or drains

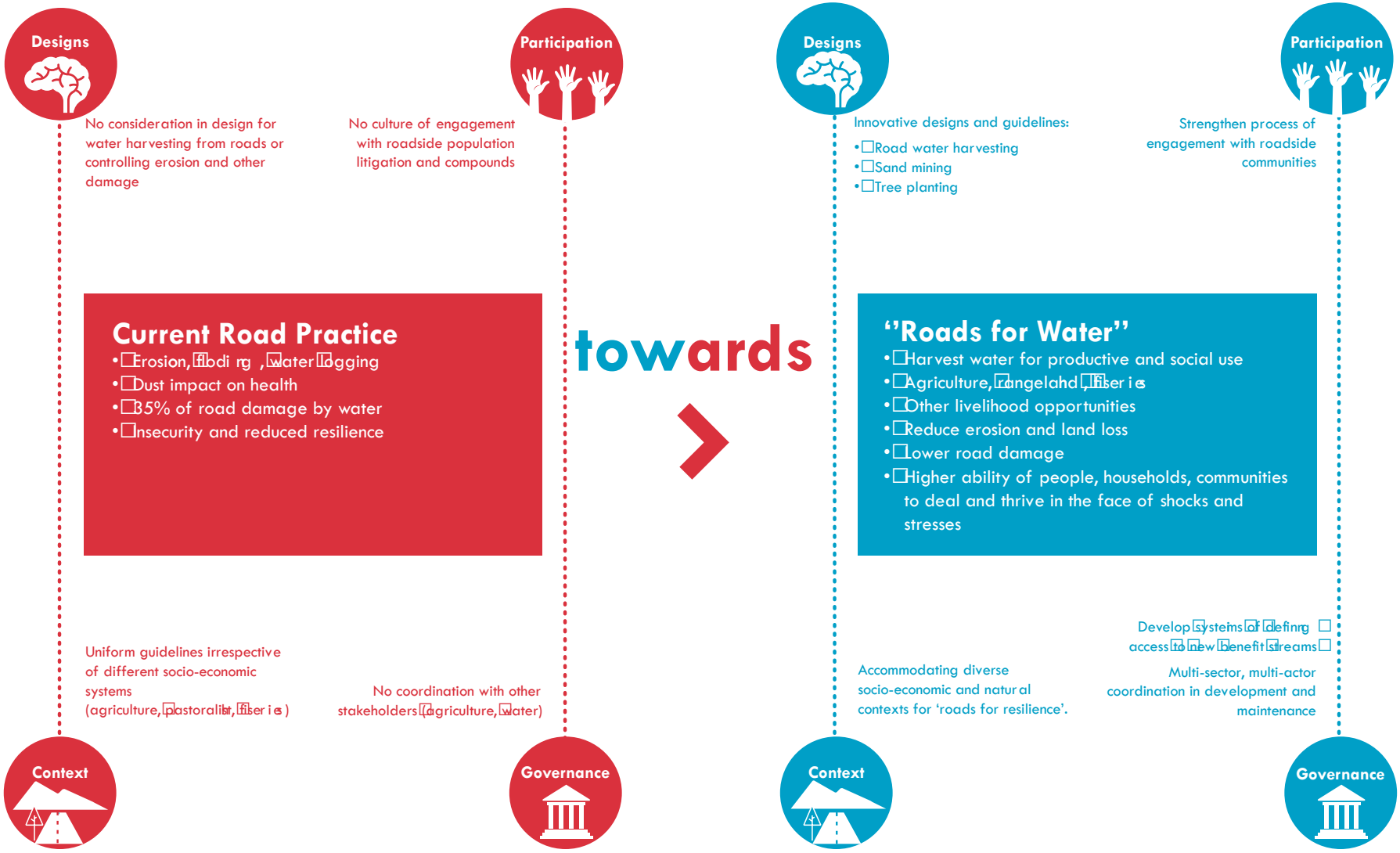
Example current situation 'roads and water as enemies'

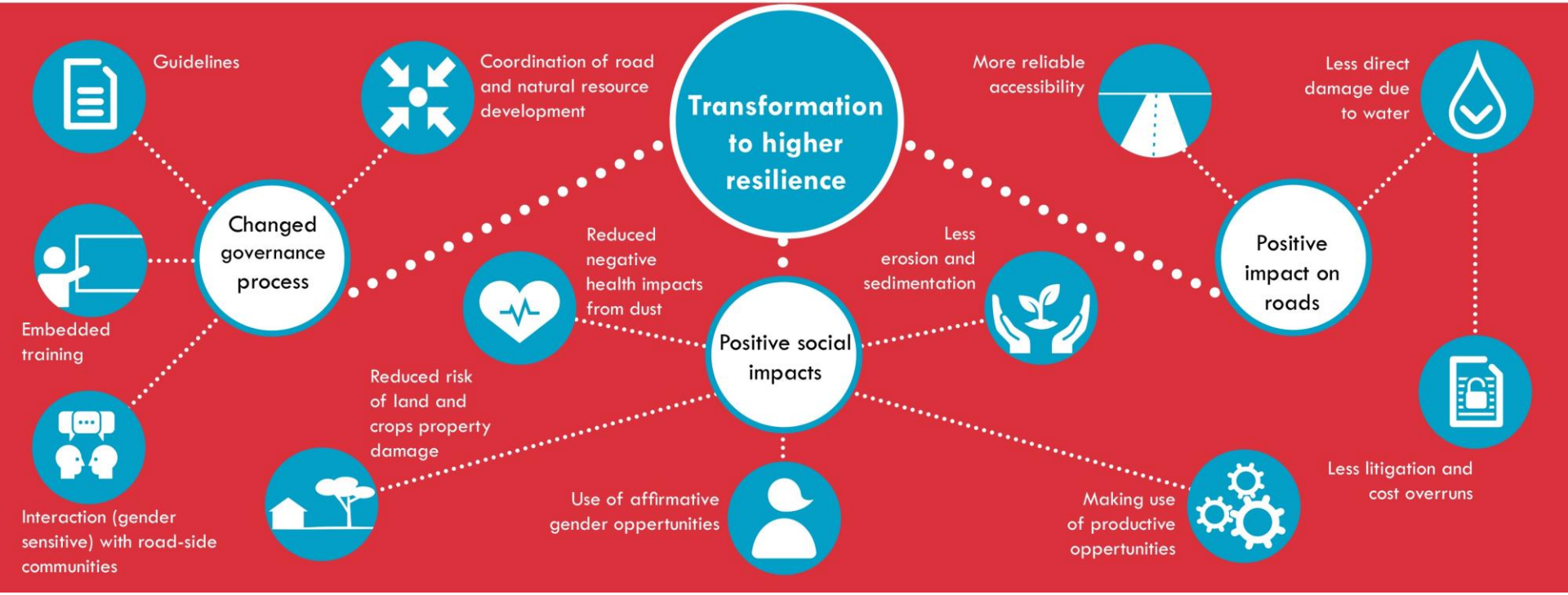
- On average in 10 kilometer (research in Tigray, Ethiopia on highways)
  - Erosion and sedimentation: 7.5 locations
  - Flooding of houses and land: 2 locations
  - Persistent waterlogging: 4 location
  - Lost opportunity to capture water 4 M m3
  - Unpaved roads main source of sedimenation (>10%)
- Deficiencies in governance process
  - Missing from guidelines
  - No coordination
  - No interaction with road-side stakeholders

Current situation 'insensitive roads'

- Social impacts
  - Damage to land and property
  - Dust: health and loss of production
  - Missed opportunity
- Impact on roads
  - Direct damage due to water
  - Added to this: water-related landslides
  - Feeder roads: huge maintenance costs due to inadequate drainage/ water management
  - Common cause of delay are drainage Issues (ERA)

Urgent need to turn things around


Designs
No consideration in design for water harvesting from roads or controlling erosion and other damage
Participation
No culture of engagement with roadside population litigation and compounds
Current Road Practice
•Erosion, flooding, waterlogging
•Dust impact on health
•35% of road damage by water
•Insecurity and reduced resilience
towards
Uniform guidelines irrespective of different socio-economic systems (agriculture, pastoralist, fisheries)
No coordination with other stakeholders (agriculture, water)
Context
Governance
Designs
Innovative designs and guidelines:
•Road water harvesting
•Sand mining
•Tree planting
Participation
Strengthen process of engagement with roadside communities
"Roads for Water"
•Harvest water for productive and social use
•Agriculture, rangeland, fisheries
•Other livelihood opportunities
•Reduce erosion and land loss
•Lower road damage
•Higher ability of people, households, communities to deal and thrive in the face of shocks and stresses
Accommodating diverse socio-economic and natural contexts for 'roads for resilience'.
Develop systems of defining access to new benefit streams
Multi-sector, multi-actor coordination in development and maintenance
Context
Governance


Guidelines
Coordination of road and natural resource development
Transformation to higher resilience
More reliable accessibility
Less direct damage due to water
Changed governance process
Positive impact on roads
Embedded training
Reduced negative health impacts from dust
Less erosion and sedimentation
Positive social impacts
Reduced risk of land and crops property damage
Interaction (gender sensitive) with road-side communities
Use of affirmative gender oppertunities
Making use of productive oppertunities
Less litigation and cost overruns

Triple Win

REDUCED WATER DAMAGE TO ROADS

HIGHER CLIMATE RESILIENCE

REDUCED DAMAGE FROM ROADS THROUGH FLOODING, EROSION AND SEDIMENT DEPOSITION

NEW EU PROCUREMENT RULES

WATER MANAGED FOR PRODUCTIVE USE

RISING GROUNDWATER LEVELS

INCREASED SOIL MOISTURE

WATER RETENTION

FLOOD MANAGEMENT

Examples of what can be done with watershed and water management programs

1. Using run-off and water flows generated by roads

1. Spreading water from road surface
2. Harvesting water from culverts, side drains and depressions
   - Converted borrow pits
   - Infiltration ponds
   - Infiltration trenches/ pits
   - Swallows
   - Dug outs
3. Gully plugging for recharge
4. Spring capture

Examples of what can be done with watershed and water management programs

2. Managing water flows with roads

- Water management in polders with controlled culverts
- Steering fish movement
- Roads doubling up as riveraine/ coastal flood embankment – synchronized use
- Flood compartimentalization

Other opportunities – by changing road designs

3. Improving road design for multiple functions

1. Irish bridges/ fords:
   - for flood water spreading
   - for river bed stabilization
   - acting as sand dams
2. Changing road alignment to recharge areas
3. Change culvert location
4. Permeable road foundations

Many other opportunities to better use of roads for water!

4. Additional

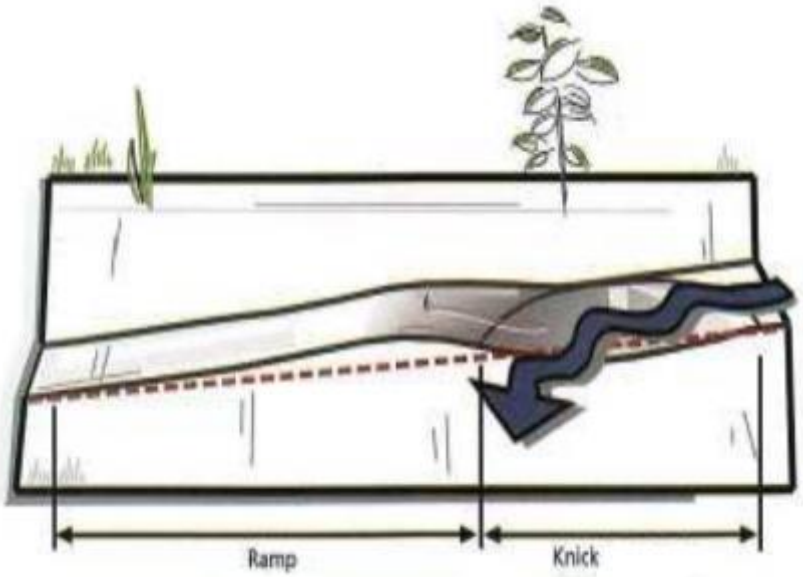
1. Road side tree planting
2. Reuse excavated bed material from roads for soil improvement
3. Sand harvesting along roads
4. Controlling rodents
5. Avoiding sand dune movement

ROAD SIDE PONDS

ROAD SIDE CISTERNS

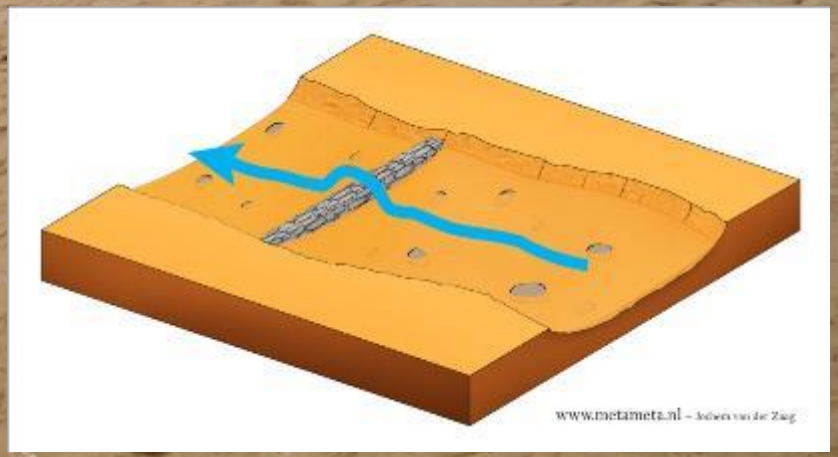
SPRING CAPTURE

ROLLING DIPS/ WATER BARS ON UNPAVED ROADS FOR WATER HARVESTING



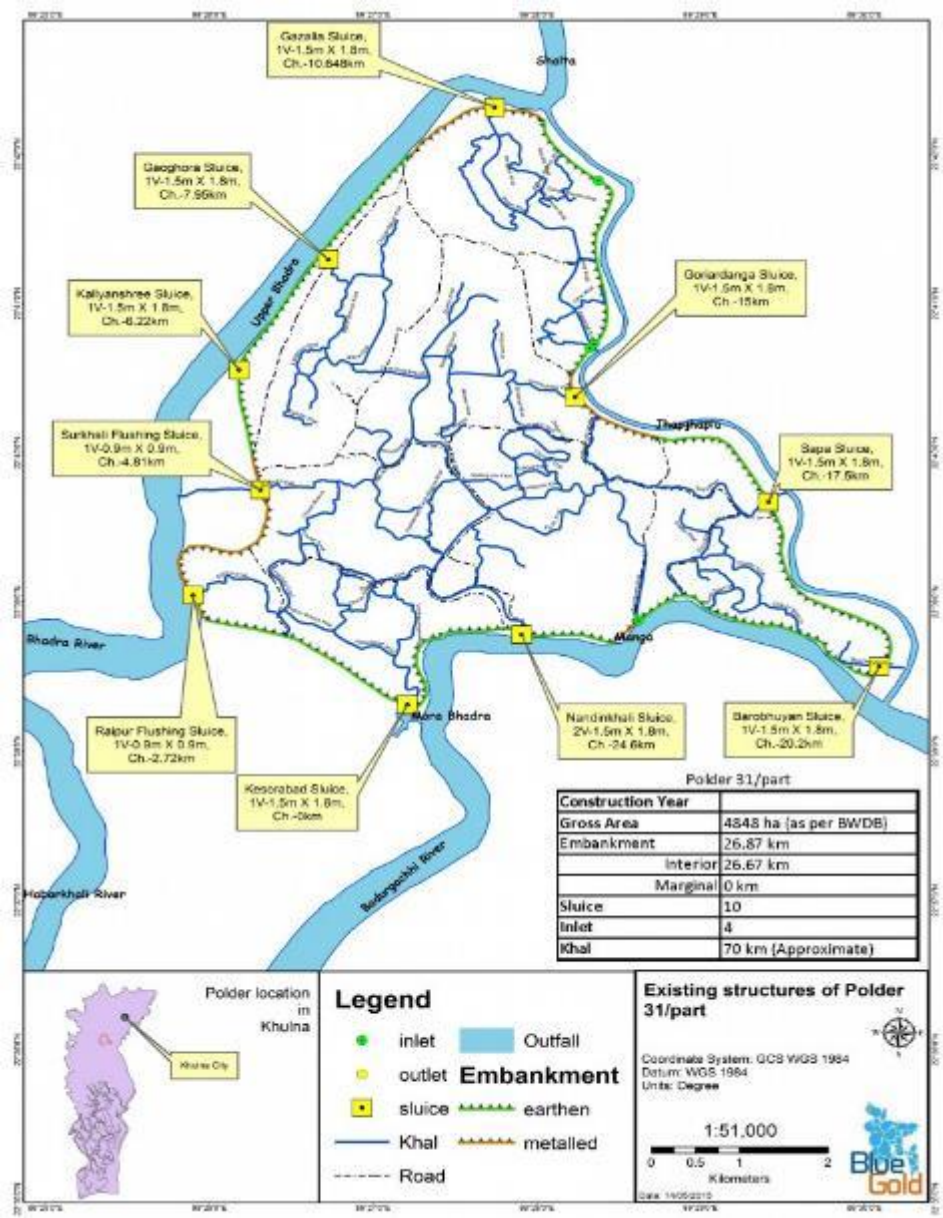
NON VENTED DRIFTS ACTING AS SAND DAMS

DRIFT AS BED STABILIZER



ROAD BODY = RESERVOIR EMBANKMENT

POLDER MANAGEMENT THROUGH CULVERTS



RETHINKING ROAD ALLIGNMENT AND CROSS DRAINAGE

Optimize

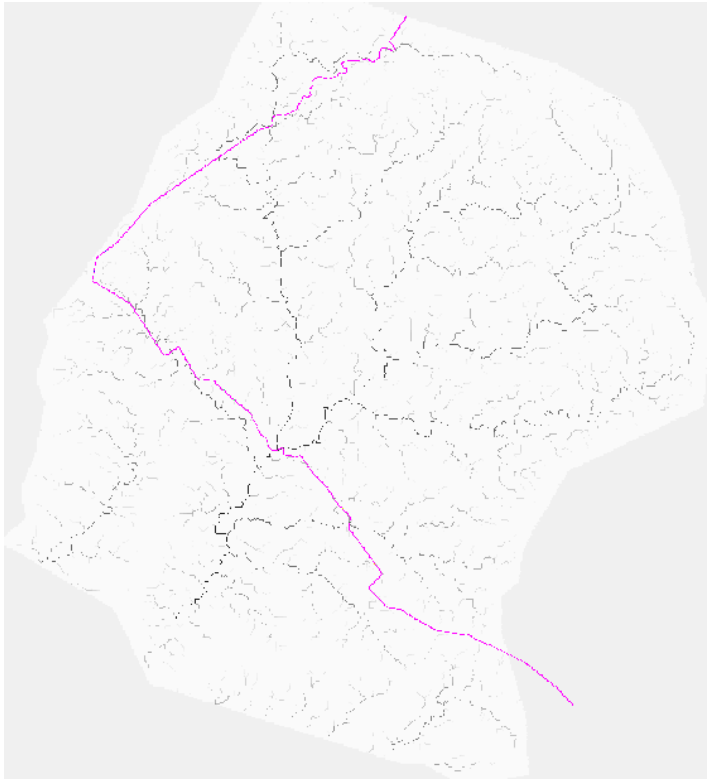
-Ability to harvest

-Flood risk

-Roadside scouring

-Risk of gully initiation/development

-Costs



ON-GOING CAMPAIGNS IN AMHARA AND TIGRAY

- Implemented since 2014
- Engaged 0.75 M and 1.5 M people in 2015 campaigns
- Monitoring
  - Impact specific to location and specific intervention, compared with base year in different locations
  - Soil moisture content increases (30-60%)
  - Shallow groundwater levels increases (>1.9 M)
  - Control of flood run-off (discharge reduced Surface water storage
  - Water quality (not traceable)

SNAPSHOTS FROM ON-GOING CAMPAIGNS

Spreading water from culverts – avoids gullies and increases soil moisture

Construction of Deep trenches at downstream side of roads to recharge the groundwater and improve moisture conditions of soils.

Road side ponds to recharge groundwater and enhance in-situ moisture in soils.

Road side runoff is channeled into farmlands (used to improve soil moisture and reduce runoff to downstream areas).

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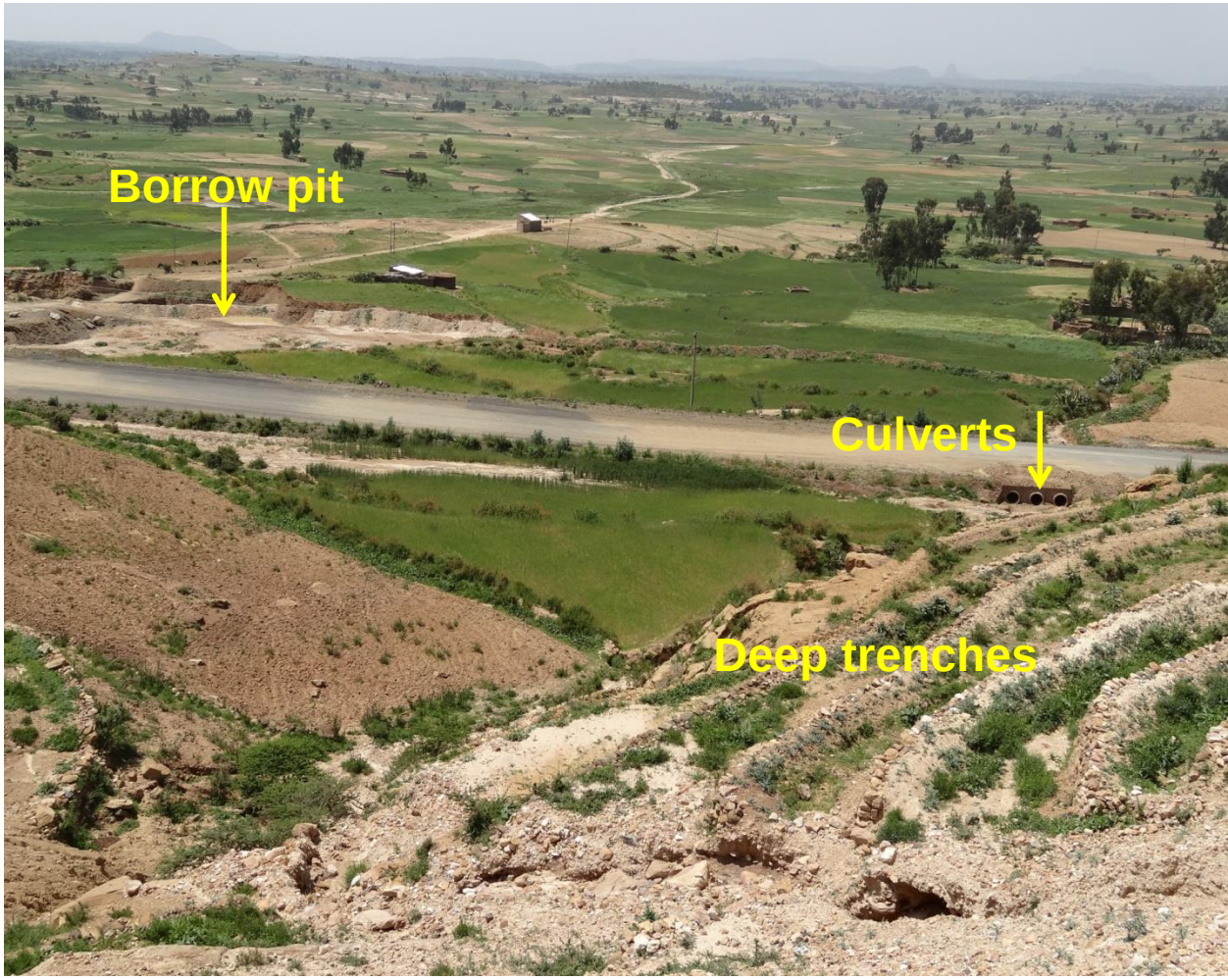
(Runoff from a town is managed through a number of options:

- Construction of deep trenches to reduce runoff and enhance groundwater recharge.
- Diverting water from culverts into a borrow pit for surface water storage and groundwater recharge.

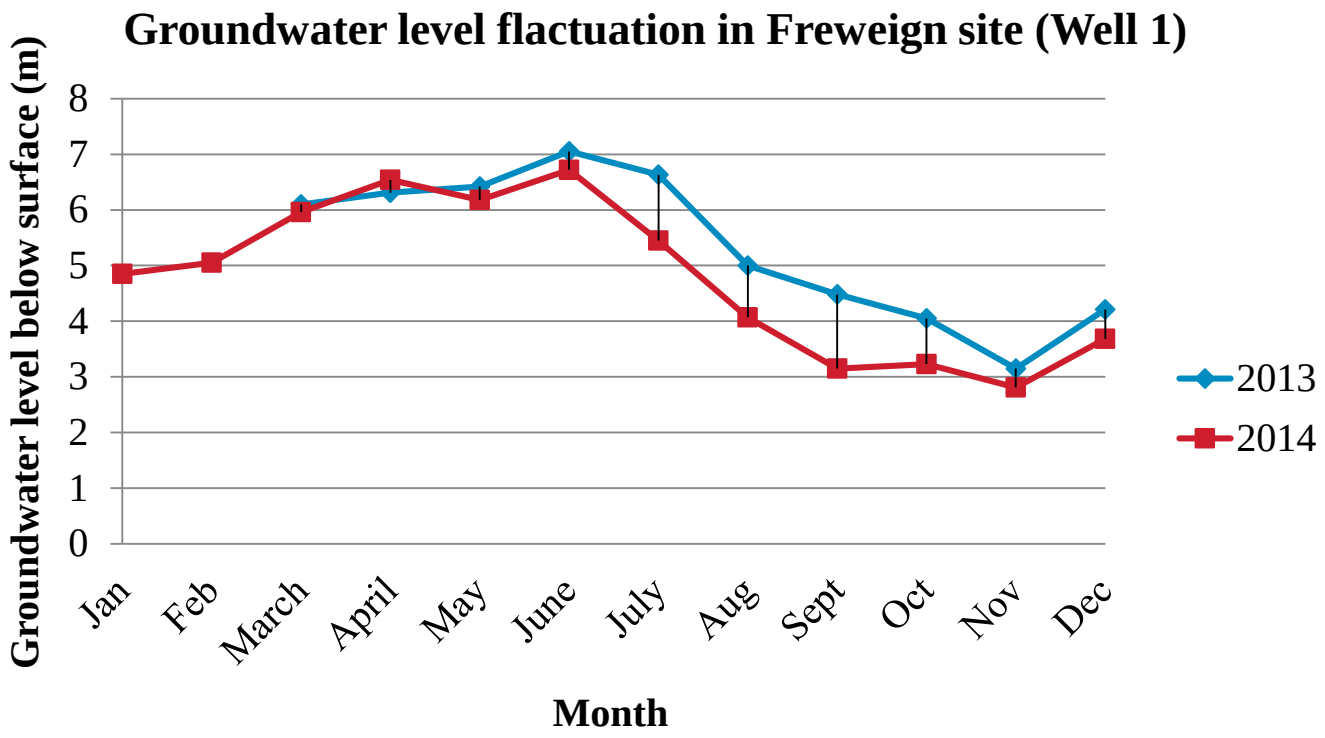


Communities which used to have been affected by flooding are saved from flooding.

Example: Effects on Groundwater Levels

Water from a culvert and road side drainage channeled into a pond:

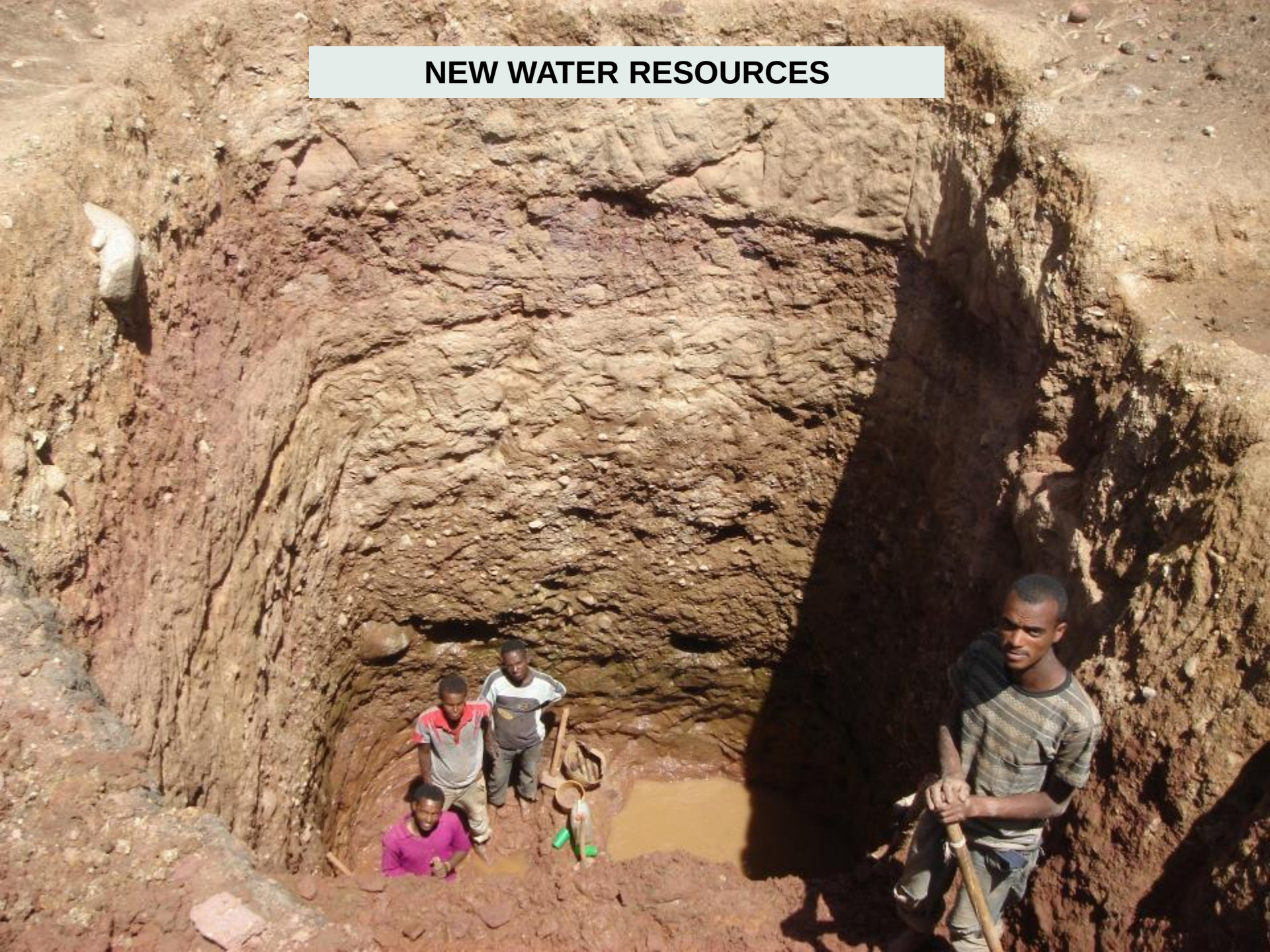
- Enhanced the shallow groundwater.



Note: Borrow pit was used as water storage in the month of July 2014.

Yield impacts of road form water in Singata

NEW WATER RESOURCES



Observations

- Climate resilient roads should not only mean making more costly and weather-proof roads, but (at zero net cost) make the entire area resilient

- Institutionally there is often no link among water, road and land sectors but this should change
  - In modified guidelines and designs
  - In budget procedures
  - In capacity building and governance

- Need to create in different condition close linkages – requires different techniques

Need to balance

Road costs

Road functionality

Road safety

Reduced/ zero damage to surrounding area

Optimized water use around roads (depending on the area)

Drainage design and road surfaces

- Location of drains
- Length of drains
- Sand harvesting from drains

Design of culverts and associated structures for beneficial water use

- Culvert placement (concentrated or distributed road drainage)
- Culvert design
- Culvert size
- Fish passage from culverts
- Downstream erosion control
- Water spreading from culverts
- Protected culvert structures (road side safety)

Roads and flood management

- Contribution of roads to flood control
- Roads as embankments and evacuation areas and flood shelters
- Roads in low lying flood plains – managing water retention

Road side water harvesting structures

- Storage ponds (location and dimensions)
- Infiltration ponds (location and dimensions)
- Deep trenches (location and dimensions)
- Urban soak pits

River crossings

- Using drifts and low causeways as sand dams
- Using fords and low causeways as river bed stabilizer or flood water spreaders
- Blocking/ opening the vents

Spring capture and protection

- Spring protection
- Safe channeling

Reusing borrow pits and quarries for water storage

- Location of borrow pits
- Landscaping and protection of borrow pits
- Use of spill ways
- Borrow pits in high water table areas

Landscape management around roads

- Erosion and run-off control
- Avoiding and preventing landslides
- Avoiding sand dune movement
- Using borrow material

Managing road side vegetation

- Dust capture and sediment control by trees and grasses
- Ensuring visibility for road users
- Distance from roads and bends (road safety)
- Selection of trees
- Selection of grasses and other vegetation
- Management of road side tree plantation

Do's and dont's

Reviewing designs

Ensuring road stability and road safety

Avoiding damage to surrounding areas

Optimizing beneficial use of water

Finding the opportunities:

Roads for harvesting water

Roads for flood protection

Roads for controlled drainage and water table control

Roadside vegetatation

Governance and management

How to integrate?

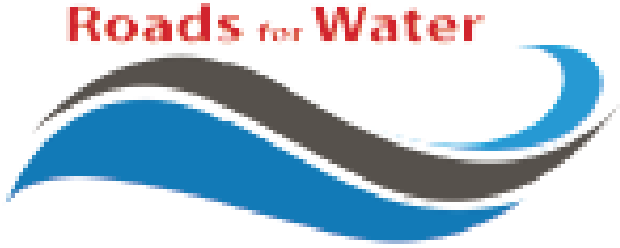
- In modified guidelines and designs
- In planning and budget procedures
- In capacity building and training

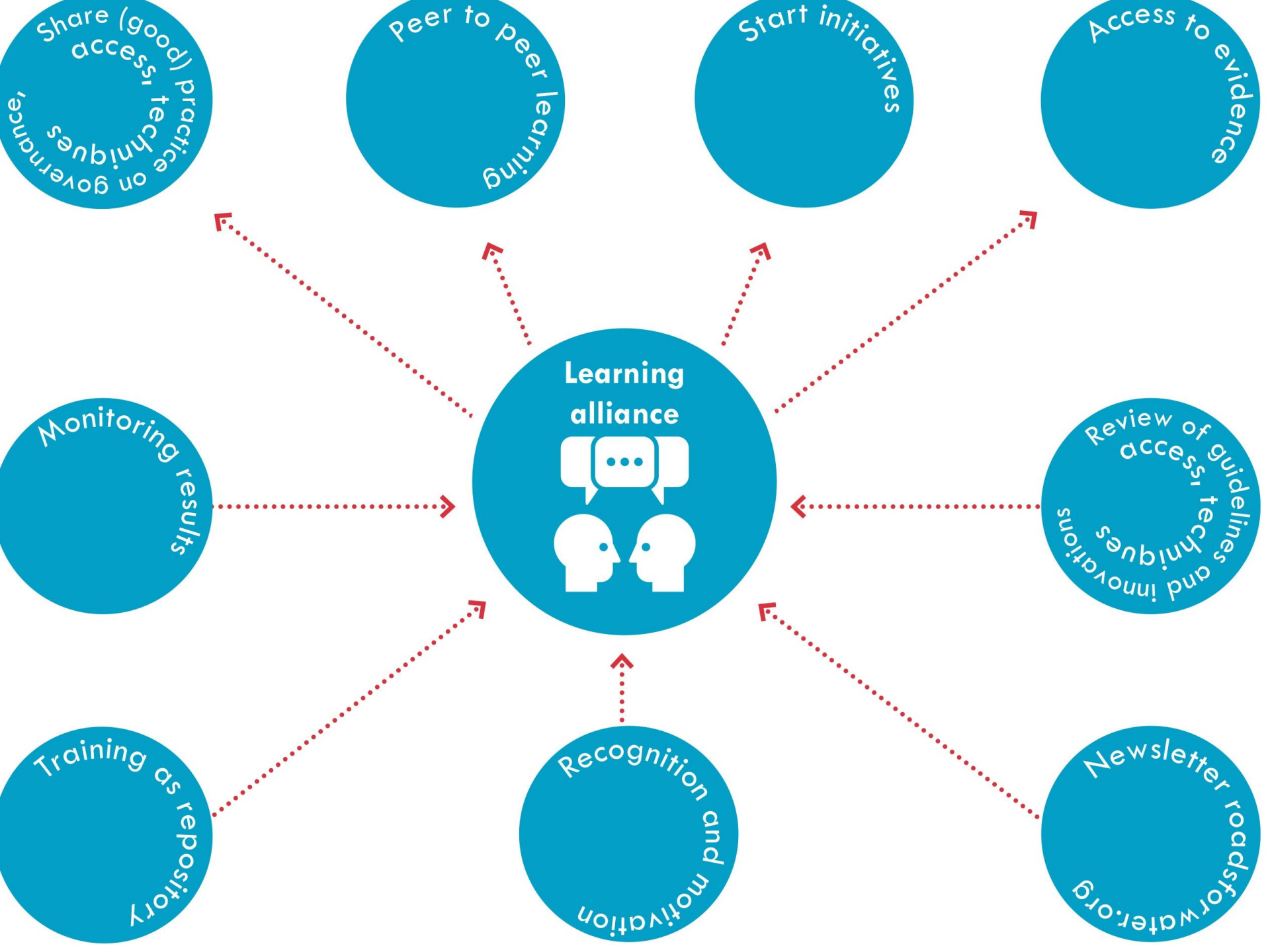
Ideas and experiences?

Roads for Water Initiative

Alliance

1. Work with road programs
2. Work on optimized practices
   - Guidelines and designs
   - Investment budgets
   - Maintenance practices
   - Social interaction and cooperation
3. Capacity building
   - Short courses
   - Guided learning
   - Tools (models)
   - Research
4. www.roadsforwater.org




Share (good) practice on governance, access, techniques
Peer to peer learning
Start initiatives
Access to evidence
Learning alliance
Monitoring results
Review of guidelines and innovations access, techniques
Training as repository
Recognition and motivation
Newsletter roadstorwater.org

Alliance

Please join and contact:

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www.roadsforwater.org