MAKING ROADS WORK FOR WATER

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Dream and opportunity

To have roads for systematically used for water recharge/retention, storage and water management all over the world, especially in Sub Saharan Africa and Asia and creatre win-wins

Because

- Annual investment 1-2 Trillion 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'

Because

Annual increase of roads: f.i. 70,000 km in SSA

Water is 35% of damage to paved road, up to 80 to unpaved 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

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
- Deficiencies in governance process
  - Missing from guidelines
  - No coordination
  - No interaction with road-side communities

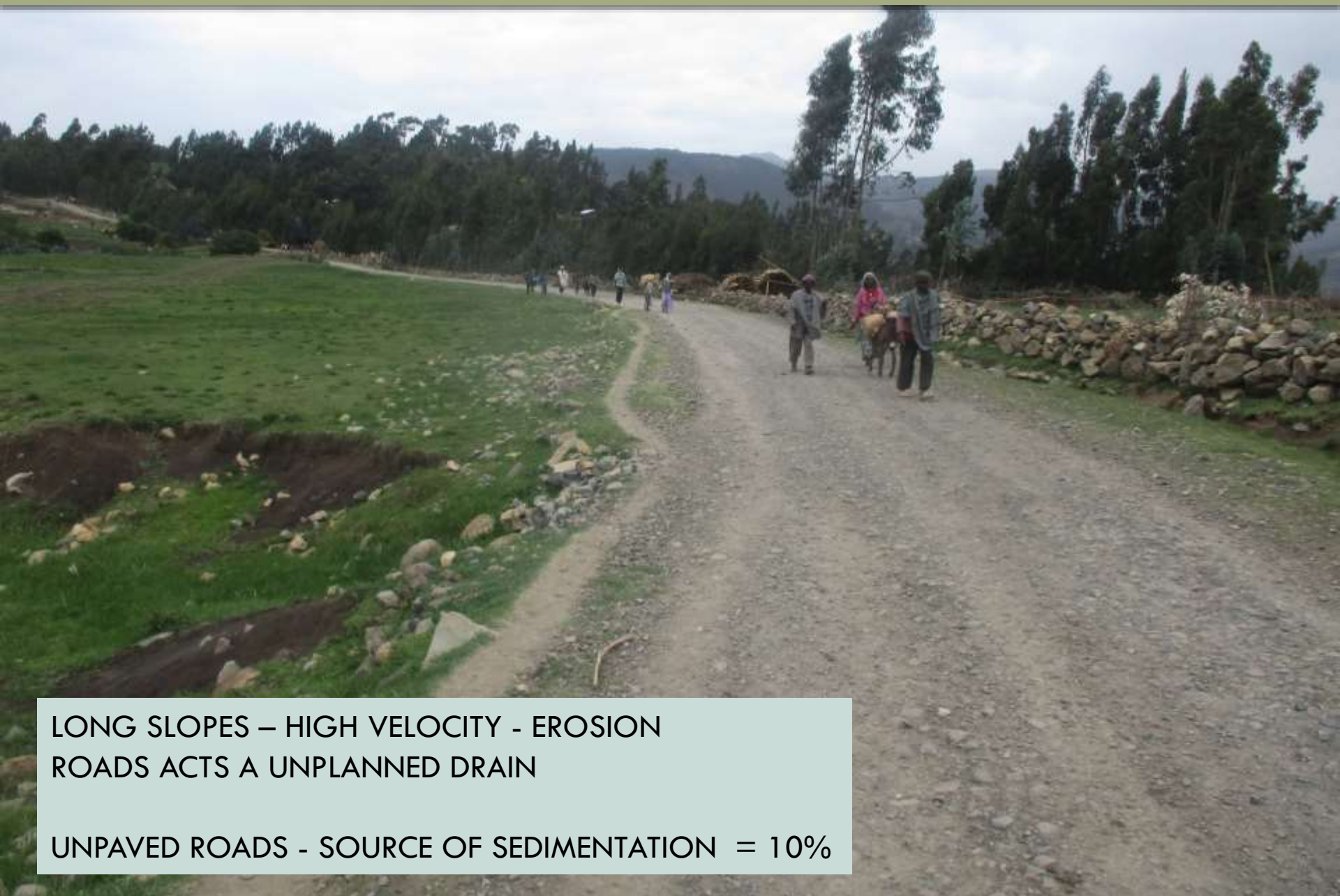
Current situation 'insensitive roads'

- Social impacts
  - Damage to land and houses
  - Dust: health and loss of production
  - Highest negative impact on female headed households
  - No compensation, indirect litigation issues
- 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
  - Most common cause of delay are drainage Issues (ERA)

Urgent need to turn things around

Side gullies – moisture depletion

ROADS AS SOURCE OF SEDIMENTATION



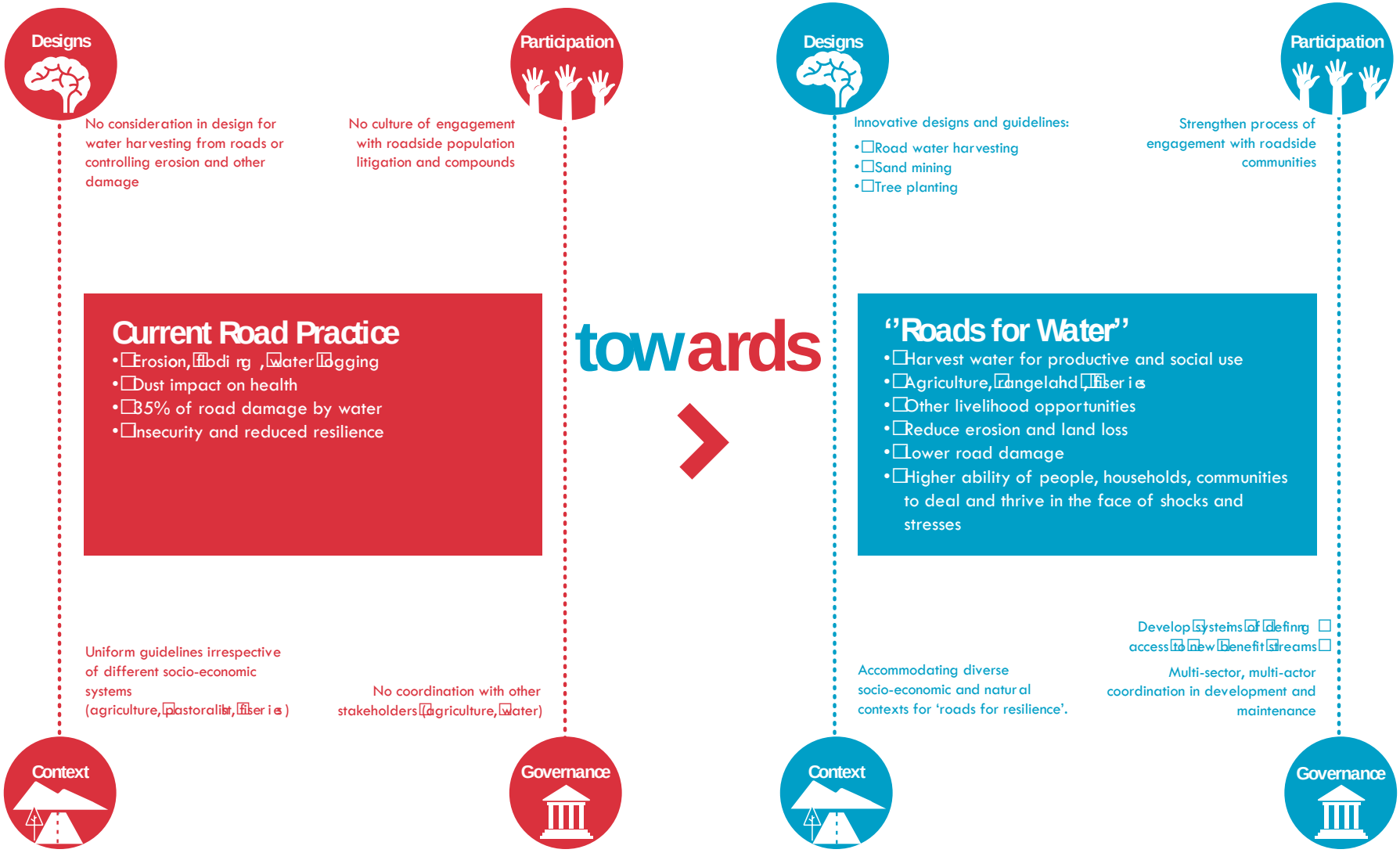
LONG SLOPES – HIGH VELOCITY - EROSION
ROADS ACTS A UNPLANNED DRAIN

UNPAVED ROADS - SOURCE OF SEDIMENTATION = 10%

ROADS AS SOURCE OF SEDIMENTATION

ADD TO THIS GULLIES CAUSED BY ROADS >> 10%

CAN REDUCE LIVESPAN OF MAJOR HYDROPOWER RESERVOIRS


Designs
Participation
No consideration in design for water harvesting from roads or controlling erosion and other damage
No culture of engagement with roadside population litigation and compounds
Current Road Practice
• Erosion, flooding, water logging
• 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
Participation
Innovative designs and guidelines:
• Road water harvesting
• Sand mining
• Tree planting
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

Triple Win

REDUCED WATER DAMAGE TO ROADS (-35%, -80%) AND INCENTIVE FOR FEEDER ROAD MAINTENANCE

REDUCED DAMAGE FROM ROADS THROUGH FLOODING, EROSION AND SEDIMENT DEPOSITION

WATER MANAGED FOR PRODUCTIVE USE

RISING GROUNDWATER LEVELS

INCREASED SOIL MOISTURE

WATER RETENTION

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

THE NETHERLANDS: SWALLOW for RECHARGE

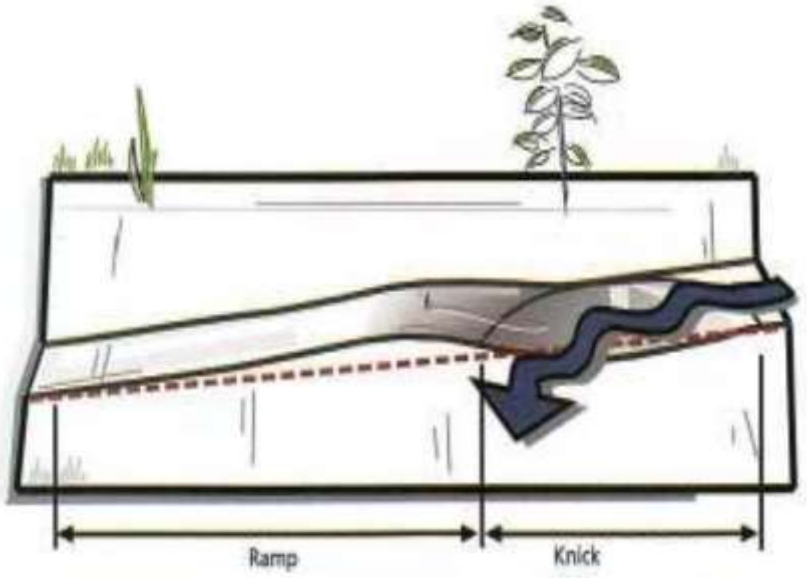
CHINA: ROAD SIDE PONDS

YEMEN: ROAD SIDE CISTERNS

TIGRAY, MULEGAT: SPRING CAPTURE

ROLLING DIPS
FOR UNPAVED ROADS

- Reliable cross drain for low standard roads
- Used to drain roads having grades between 3 and 15%
- Function: collect surface runoff from the roadway and/or road ditch and direct the flow across and away from the roadway
- Can feed local road waterharvesting and incentive local maintenance

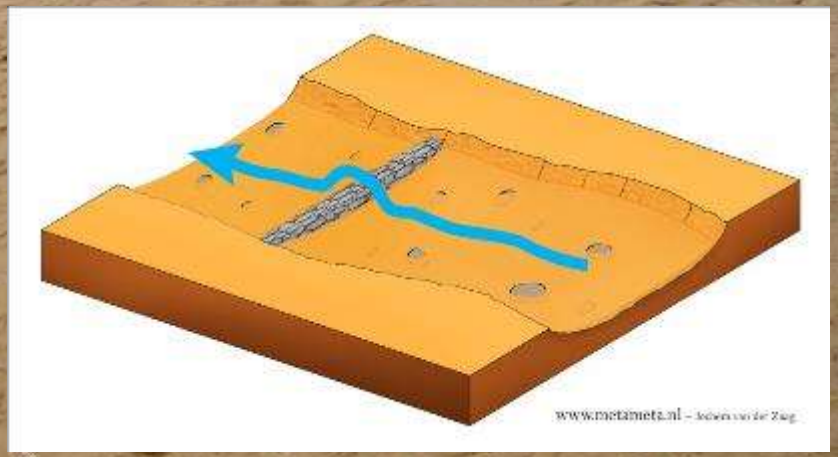


AMHARA – LEAD OUT DRAIN FOR WATER HARVESTING

KENYA – ADVANTAGES OF NON VENTED DRIFTS

KENYA – ROAD CROSSING CAN TURN INTO SAND DAM

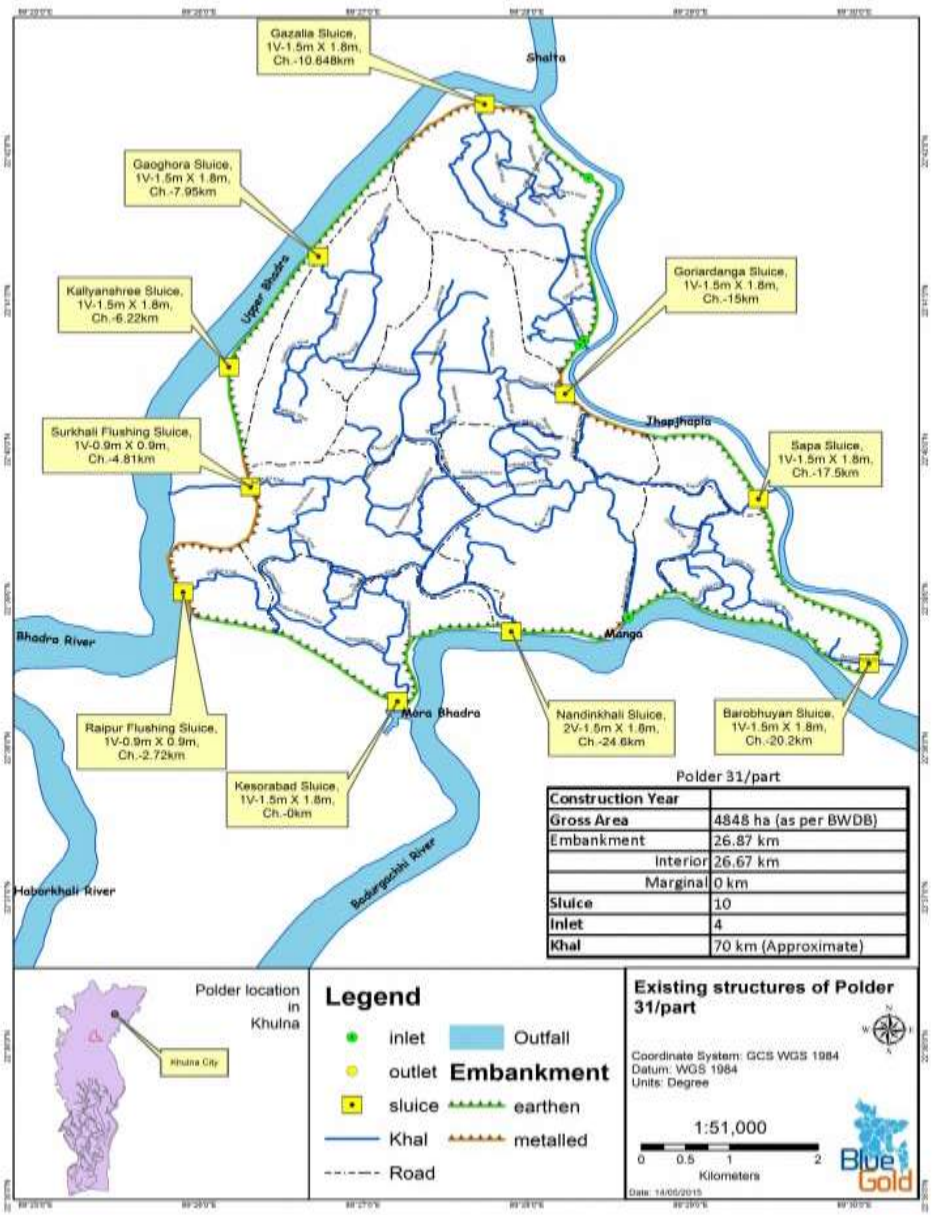
PAKISTAN: ROAD = SPATE IRRIGATION BED STABILIZER



MALI – ROAD EMBANKMENT = RESERVOIR

SOUTH SUDAN: CROSS DRAINAGE REGULATES SOIL MOISTURE, REGULATES BURNING AND REGENERATION: CULVERT PLACEMENT

BANGLADESH – POLDER MANAGEMENT THROUGH CULVERTS



RETHINKING ROAD ALLIGNMENT AND CROSS DRAINAGE

Optimize

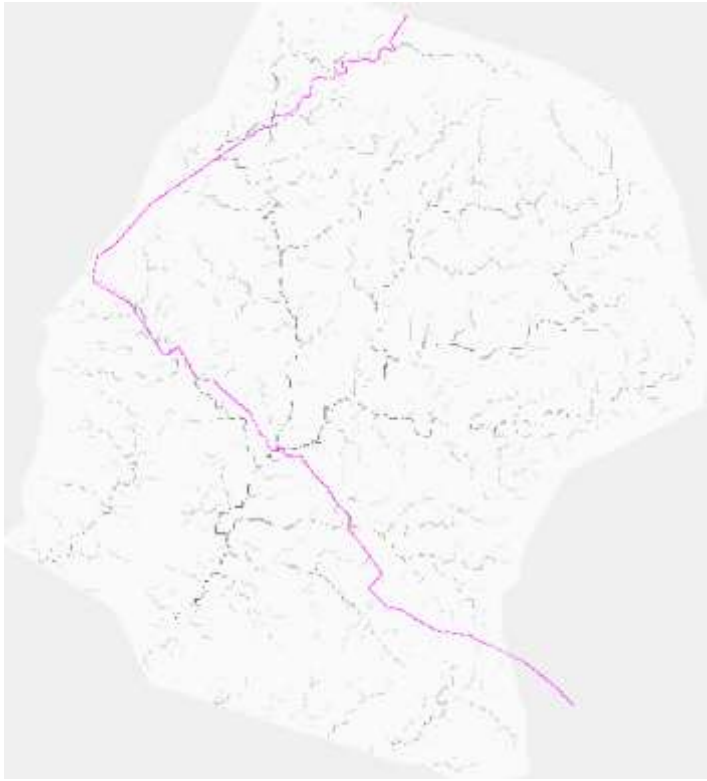
-Ability to harvest

-Flood risk

-Roadside scouring

-Risk of gully initiation/development

-Costs



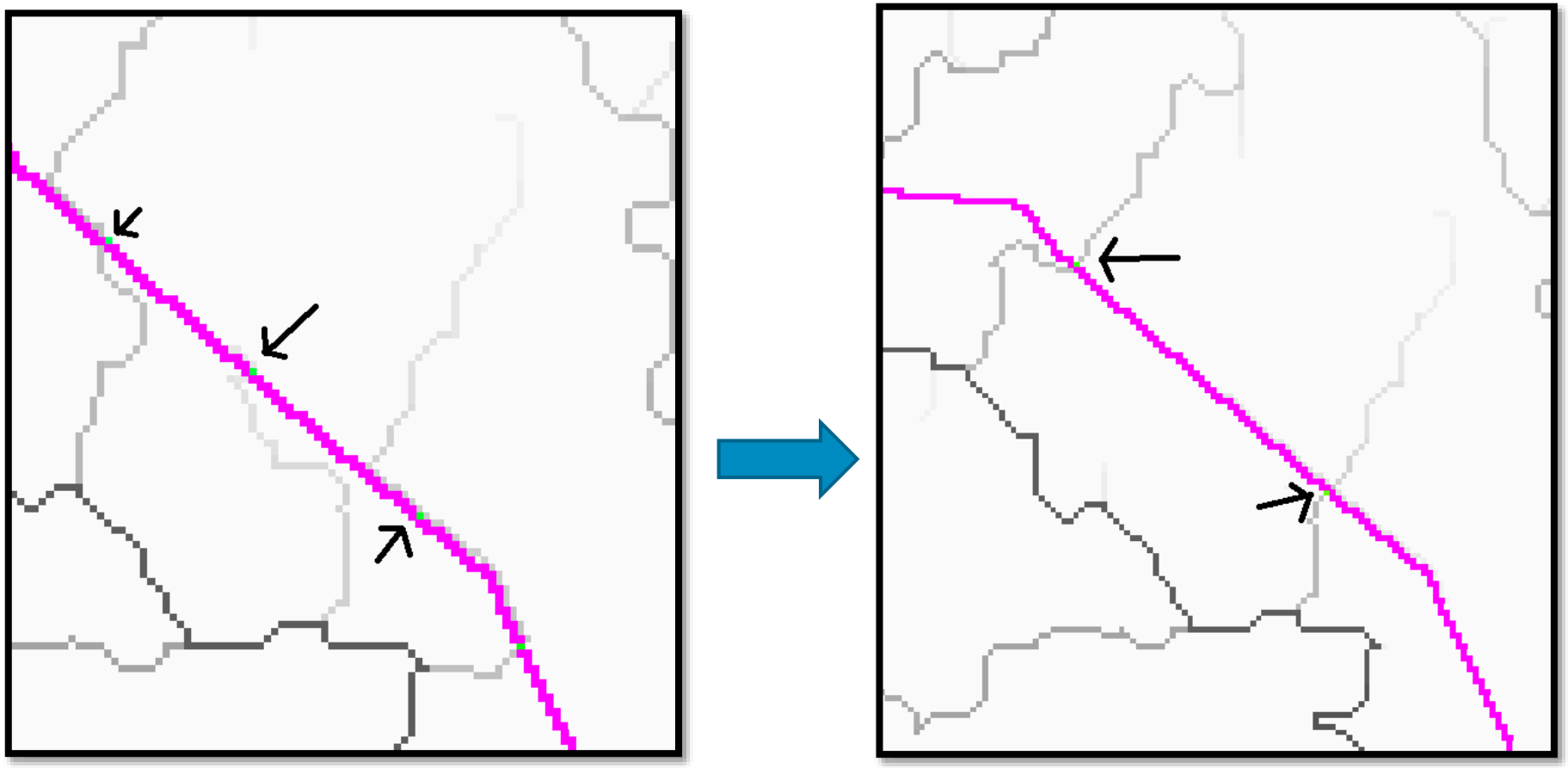
EXAMPLE 1: Effect of culvert locations

Original culvert design:

- One culvert is almost useless
- Presence of roadside scouring
- Water builds up on the upstream side, risk of flooding

Adapted culvert design:

- Just 2 culverts
- Lower roadside scouring
- Culvert locations more adapted to natural drainage pattern



Road alignment affects:

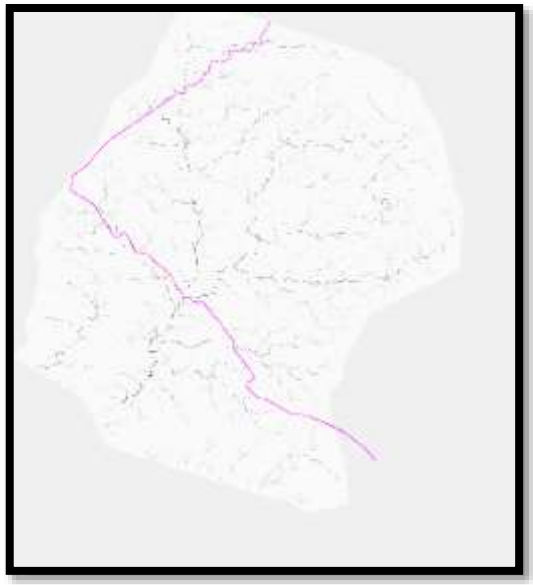
Amount of runoff, potential to capture water

Erosion

Gully initiation/development

EXAMPLE 2: Effects of road alignment on erosion

Original route :



Route 1:

Total sediment deposition **over whole area = -1%**

Route 2:

Total sediment deposition **over whole area = -2%**

EXAMPLE 1: Effect of culvert locations

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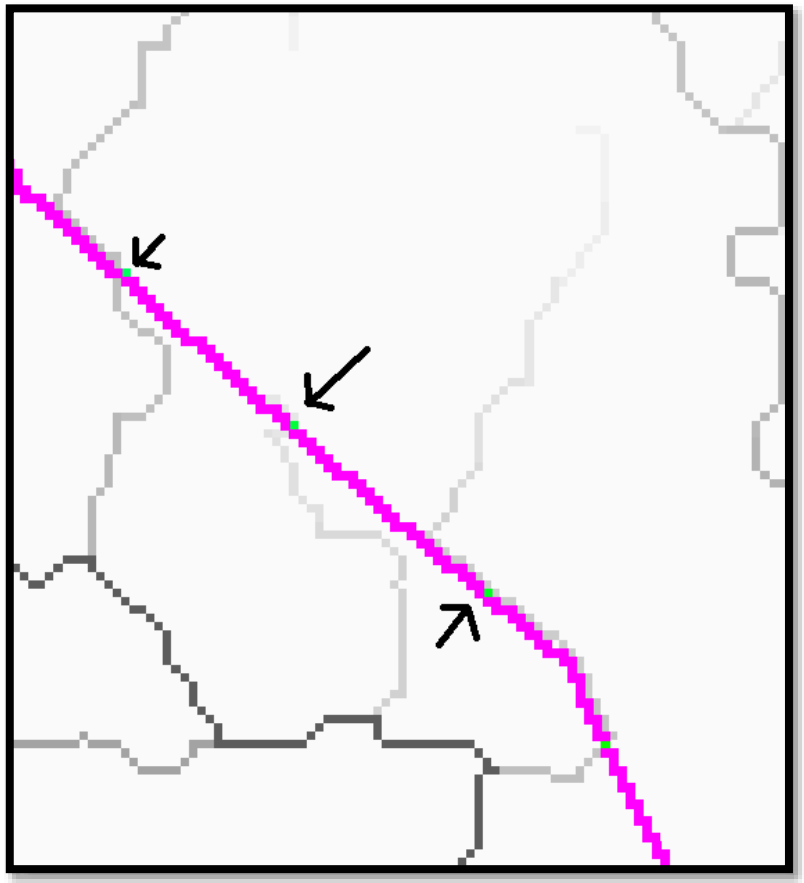
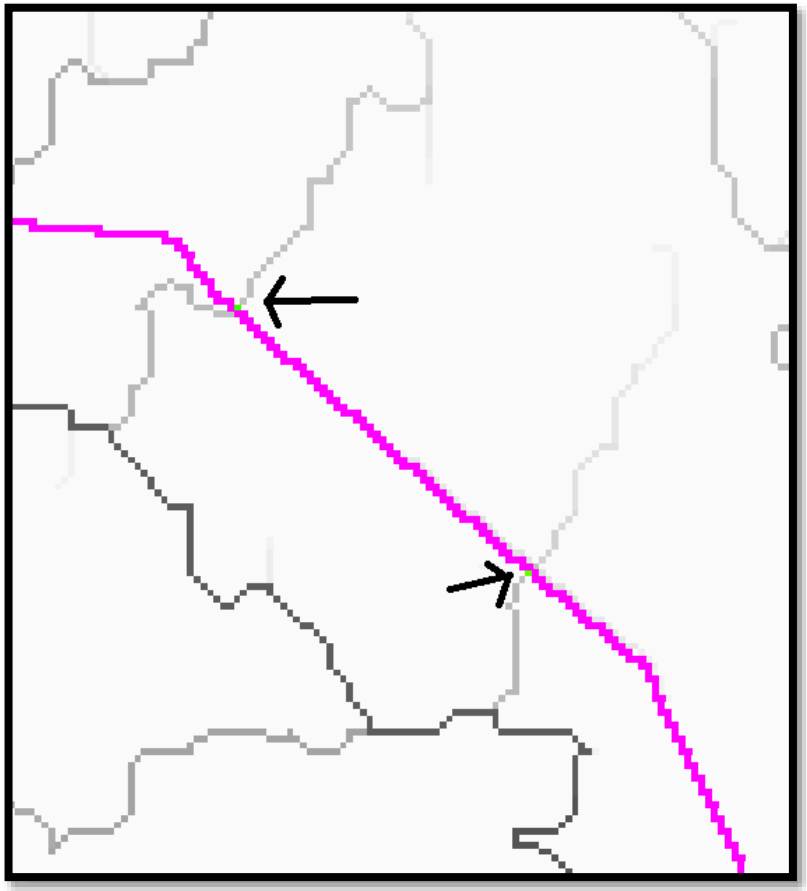
- One culvert
- Roadside scouring
- Water builds up on the upstream side, risk of flooding



Adapted culvert design:

- Just 2 culverts
- Lower roadside scouring
- Culvert locations more adapted to natural drainage pattern
- Easier to harvest water



Adapting road alignment

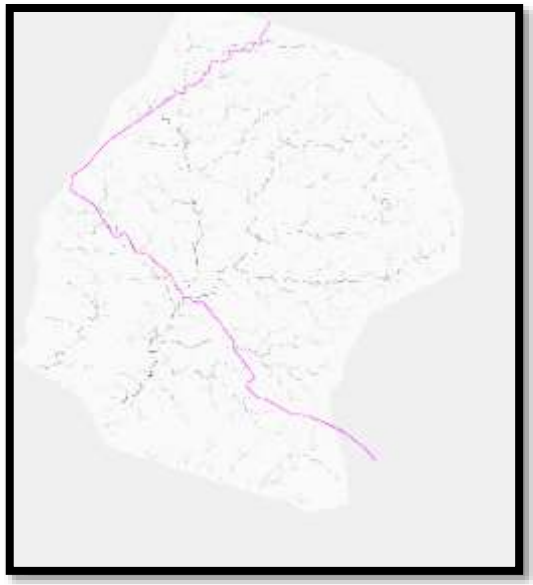
Erosion

Gully initiation/development

Route to water stressed or recharge areas

EXAMPLE 2: Effects of road alignment on erosion

Original route :



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Total sediment deposition **over whole area = -2%**

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

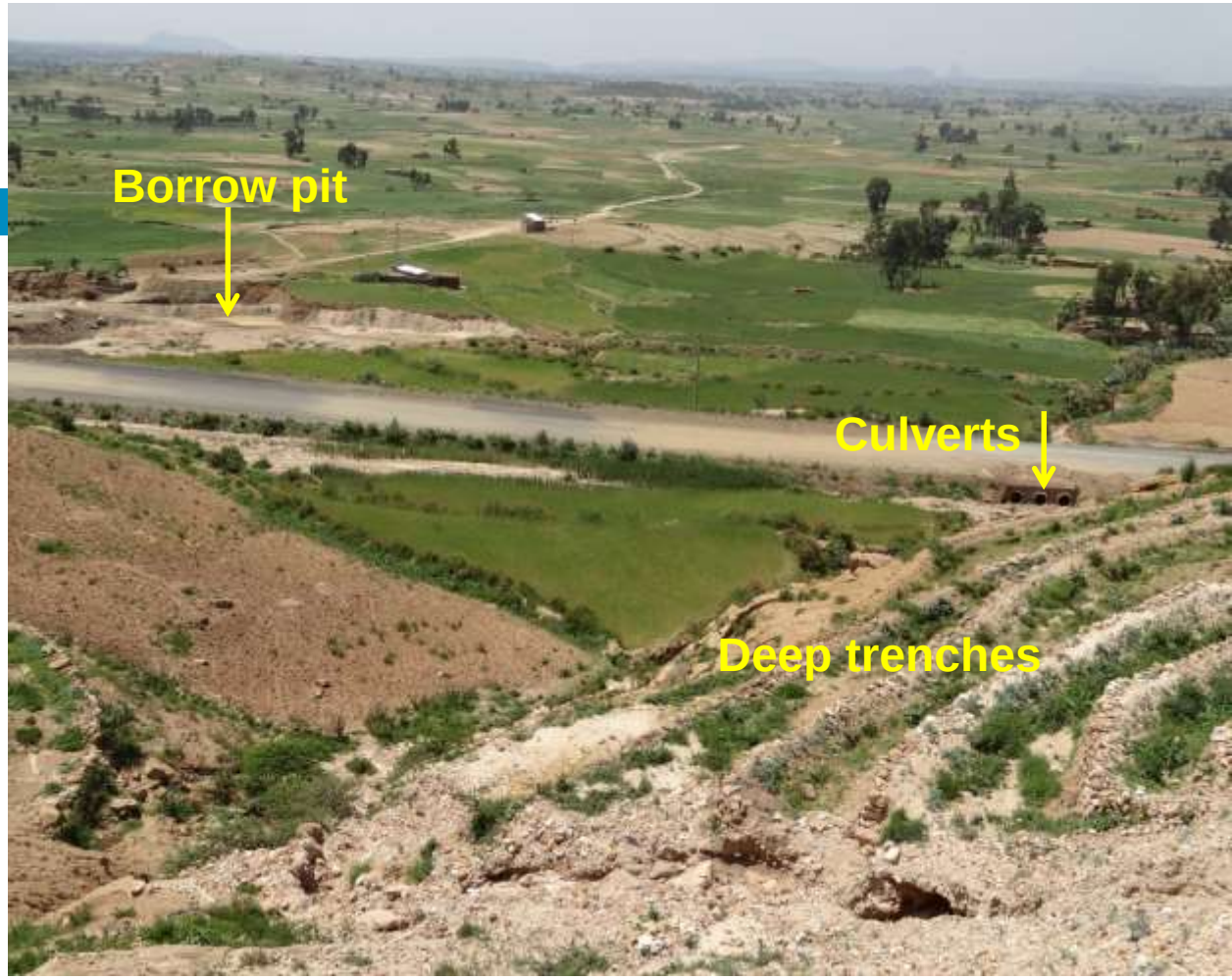
Construction of Deep trenches at downstream side of roads to recharge the groundwater and improve moisture conditions of soils.

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).

(Runoff from a town (Freweign) 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.

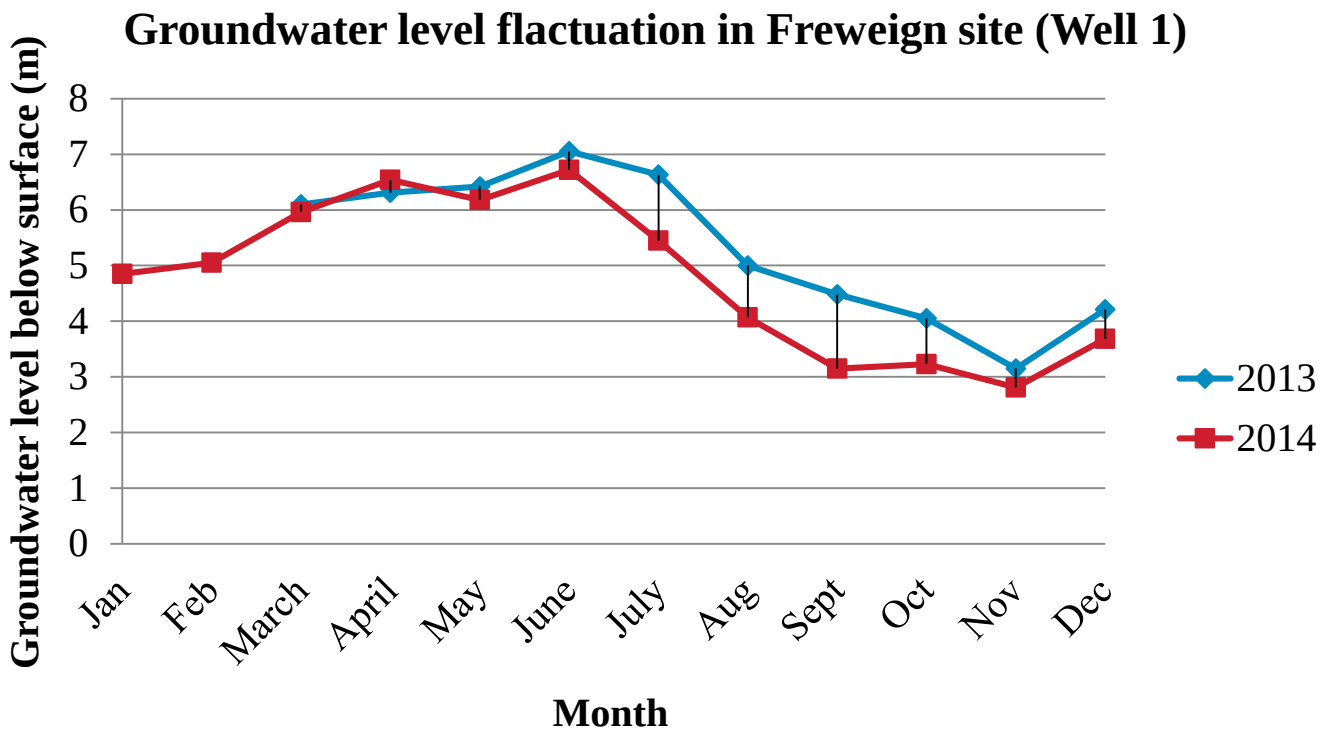

Diverting run-off to
infiltration trenches

Upstream storage pond diverted from road breaching place

Example: Effects on Groundwater Levels

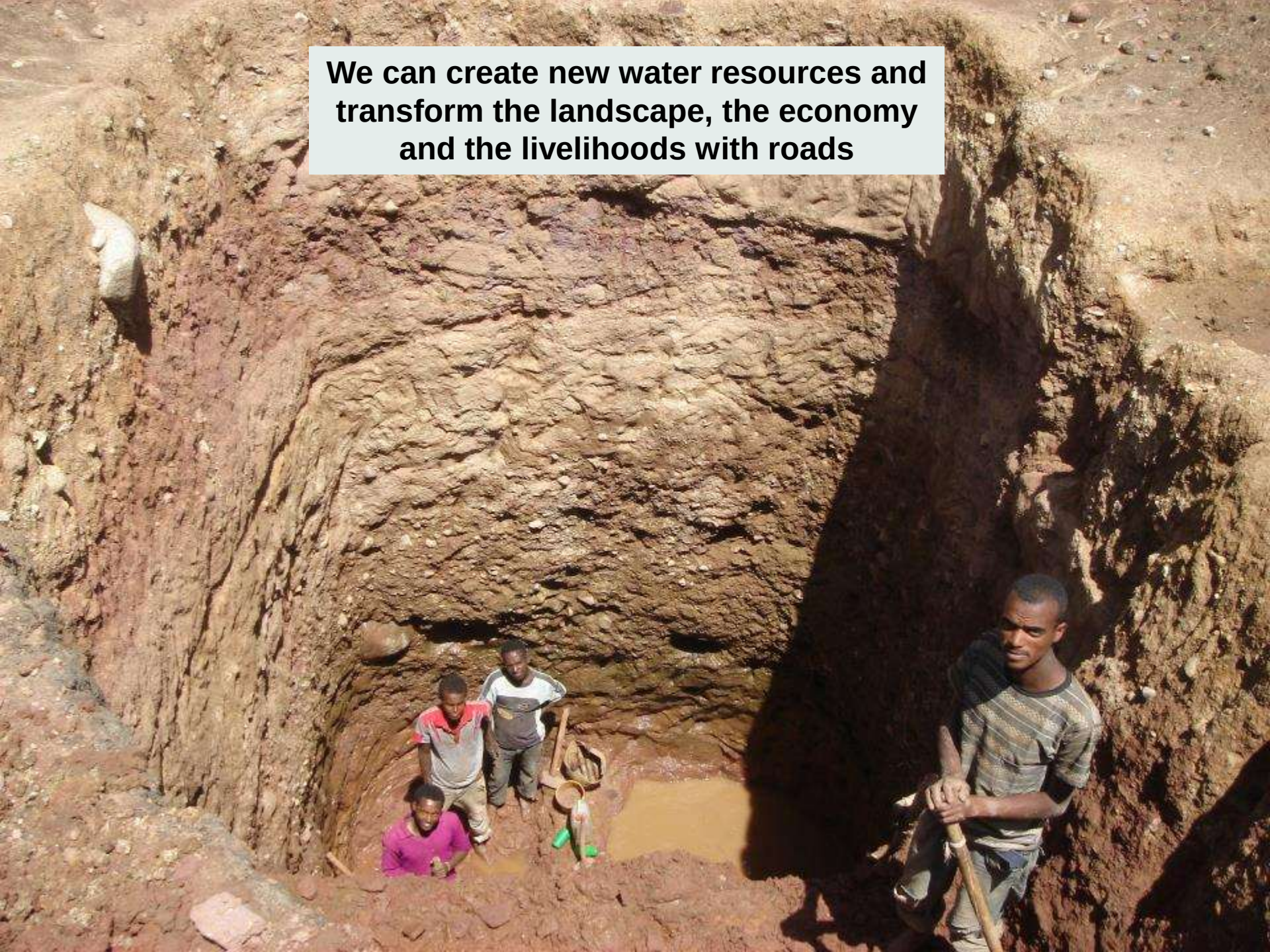
Water from a culvert and road side drainage channeled into a pond:

- 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


We can create new water resources and transform the landscape, the economy and the livelihoods with roads

Different perception on climate change adaptation

Rather than making roads climate/ water proof, (which is costly and one can built less roads)>

we should optimize road development for climate resilience

Roads for Water Initiative

Learning 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

Learning alliance

Please join and contact:

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www.roadsforwater.org