

# Water Harvesting from Roads in Ethiopia: Techniques and Approaches



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# Outline

1. Introduction
2. Road and Water: Interactions and Effects
3. Approaches and Techniques of Road Water Harvesting (RWH)
4. Effects of RWH: Hydrological Monitoring
5. Design considerations for RWH
6. Concluding remarks

# 1. Introduction

- Road development changes the hydrology (surface and groundwater) leading to:
  - Concentrated surface runoff, or
  - Altering groundwater movement.
- Concentrated water flow is a resource, if harvested/managed.
- ***How could roads be used to harvest/manage water?***



# Why water harvesting from roads?

- Road building is one of the largest public investments.
- Unmanaged water from roads often lead to negative effects including to the road itself.
- Water scarcity is a major issue in many parts of Ethiopia, and SSA.
- Managing water from roads has economic, social and environmental benefit; an opportunities to be tapped.



## 2. Road and Water: Interactions and Effects

(a) Increase in erosion of  
local streams and  
road side drainages



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**(b) Sedimentation:  
reservoirs, farm  
lands, roads, etc**



# (c) Water logging/flooding



## (d) Opening springs

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*Spring: road cuts in mountainous area.*

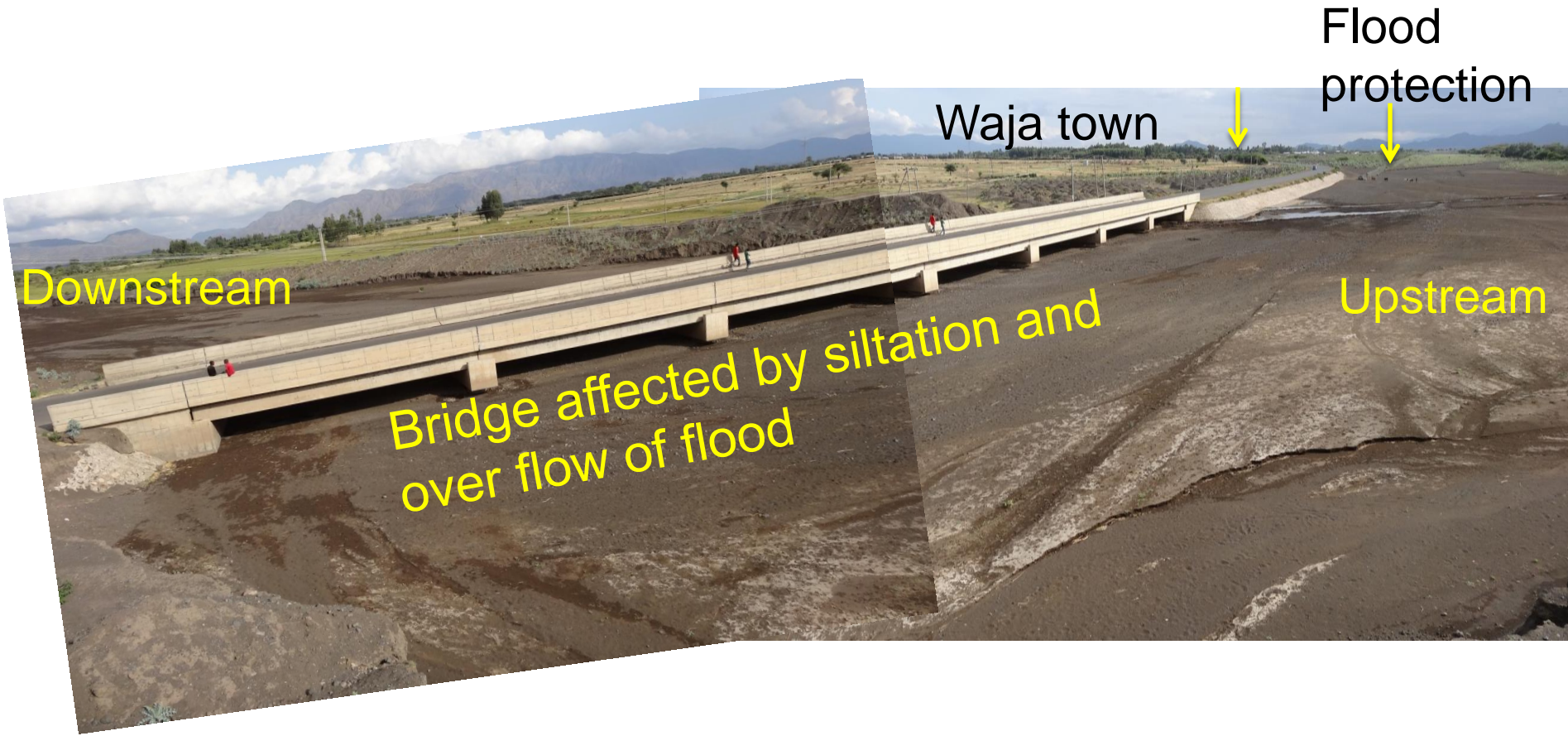


*Spring: in flat areas at soil-rock interface.*





## *Typical Example of a bridge under annual maintenance due to siltation problem*



*Panoramic View of Waja bridge, Waja area, Tigray, Ethiopia*

## **(e) Water-induced hazards**

***Landslides***



***Earth fissures***



# 3. Approaches and Techniques: Water Harvesting from roads in Ethiopia

## 3.1 Approaches

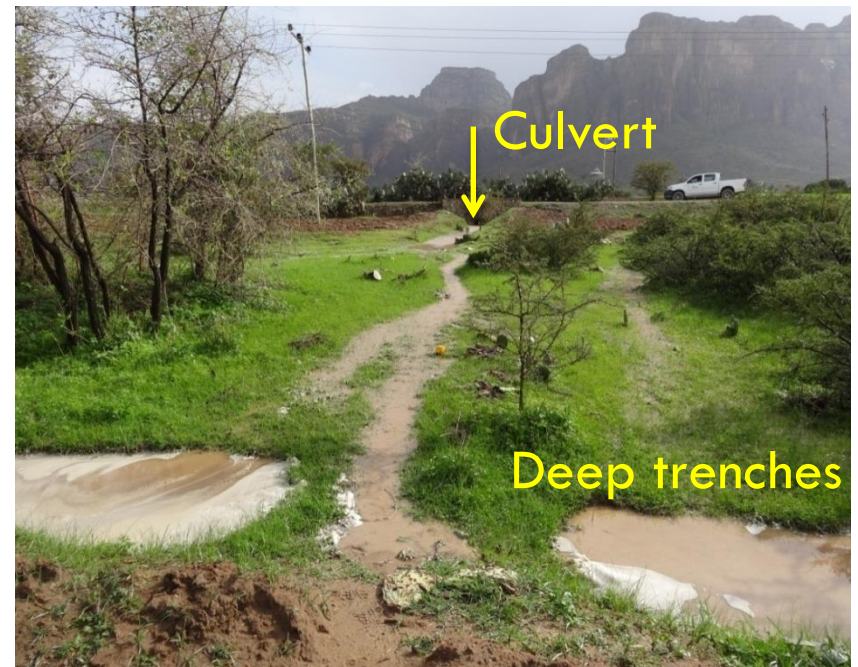
- **Agricultural Offices:** overall lead.
- **Woreda Offices:** coordinating the implementation.
- **Communities:** Implementing the interventions.
- **Road contractors and consultants:** support the overall activity.
- **Research consortium:** capacity building, evidence generation, and sharing.



## 3.2 Techniques Used

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



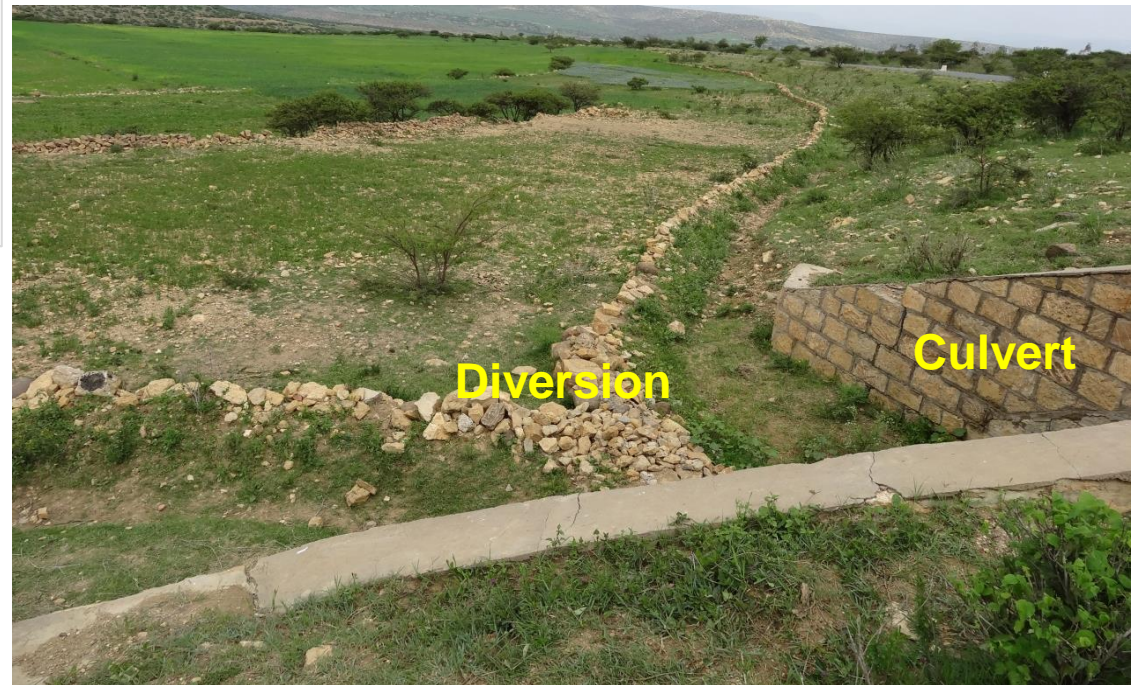
(b) Road side ponds/  
pits to recharge  
groundwater and  
enhance in-situ  
moisture in soils.



(c) Road side runoff or water from culverts stored in ponds for surface water storage and groundwater recharge.



(d) Water from culverts channeled into farmlands (used for groundwater recharge and improving soil moisture).



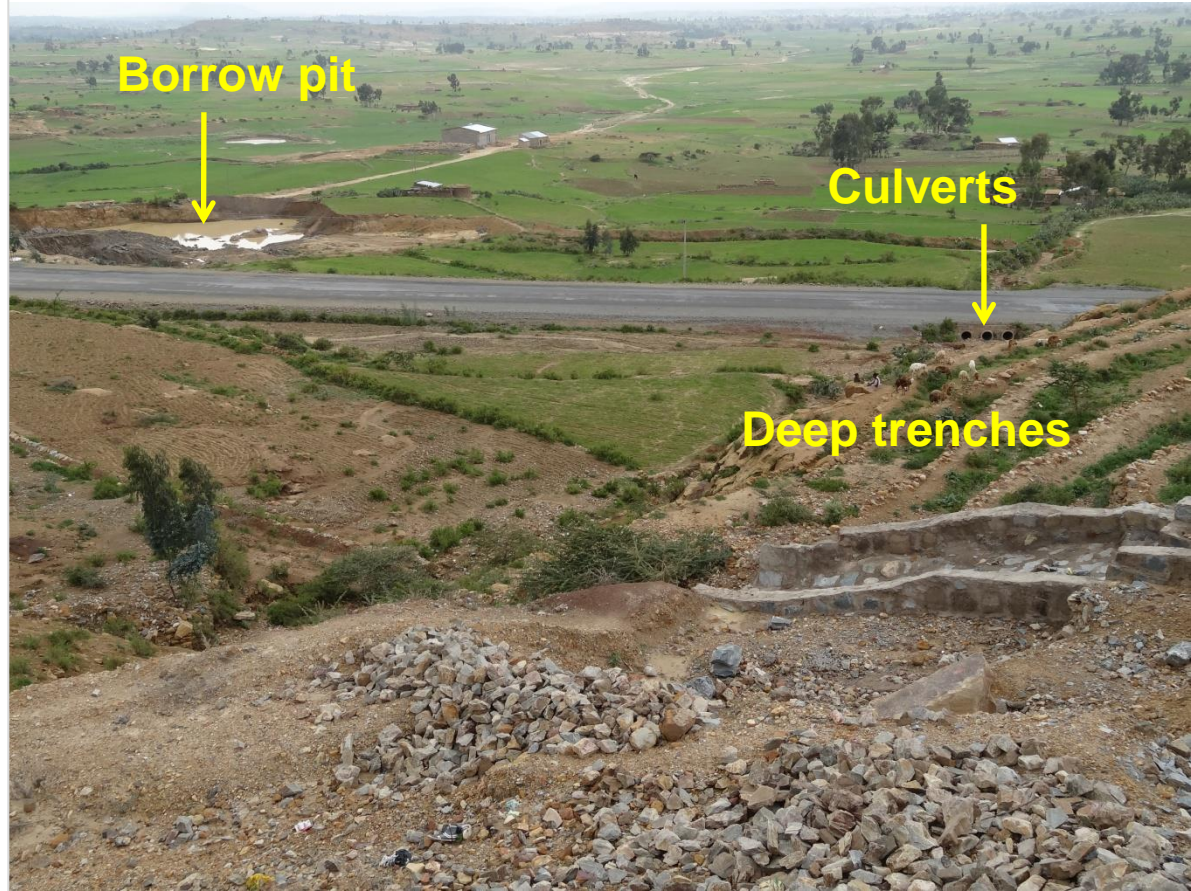
(e) Road side runoff is channeled into farmlands (used to improve soil moisture and reduce runoff to downstream areas).





(f) 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.*

(g) Water from culvert is channeled into check-dams (for surface water storage and groundwater recharge).

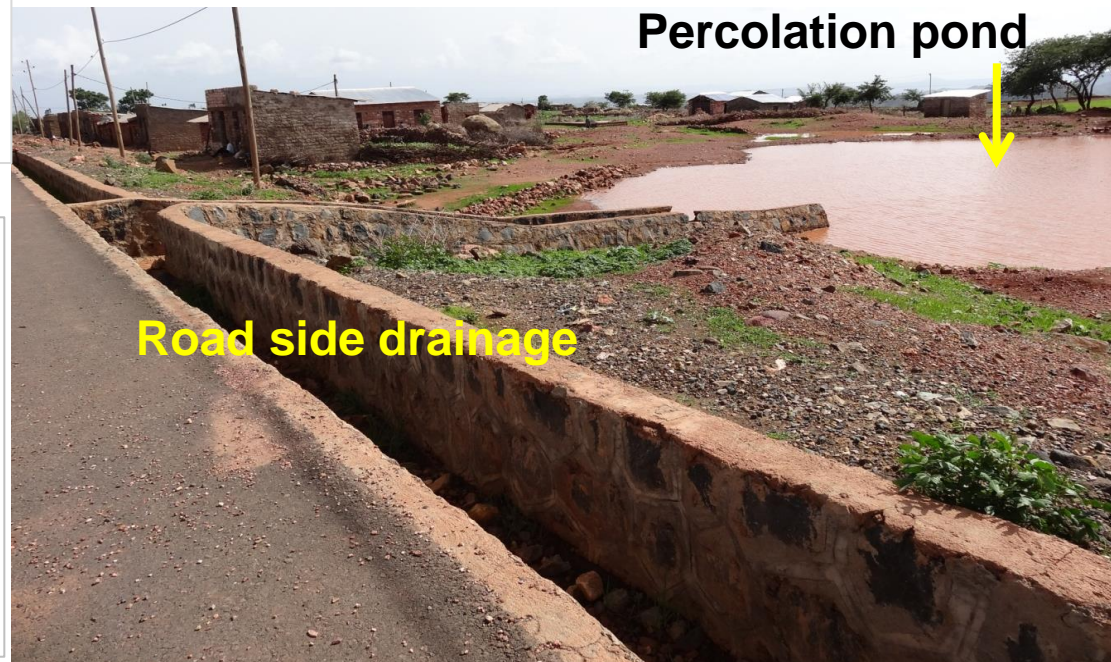


(h) Water from a bridge is spread into series of deep trenches and percolation ponds to recharge groundwater.

- *Hand-dug well which used to be dry became productive after the intervention.*



(i) Road side drainage connected to percolation pond for groundwater recharge.



(j) Hand-dug wells at upstream of Irish Bridge in Megab area, Tigray, Ethiopia.

*Hand-dug well*



*Irish Bridge with hand-dug well at upstream.*

**Irish Bridge**



*Hand-dug well upstream of the Irish Bridge*

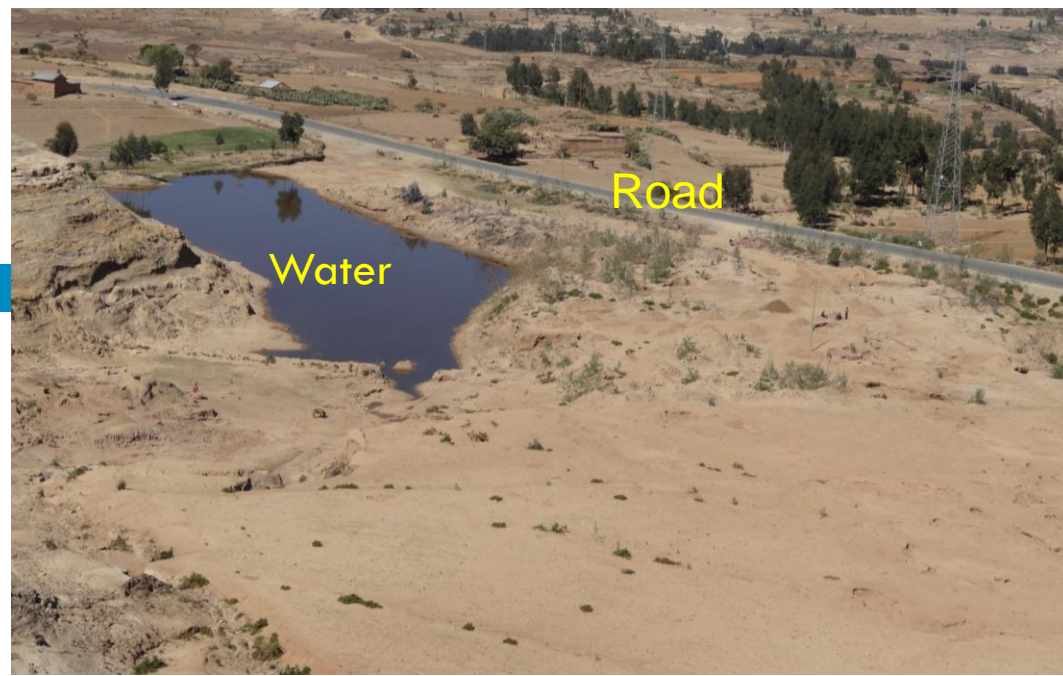
(k) A pond developed for harvesting water from culverts and Bridges in Northern Ethiopia:

- *To enhance water availability during the 2015/2016 droughts.*



(I) Roads as dam embankments; used for:

- *Surface water storage,*
- *Sediment/Sand storage.*
- *Groundwater recharge.*



# 4. Effects of Road Water Harvesting: Hydrological Monitoring

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## **Positive effects:**

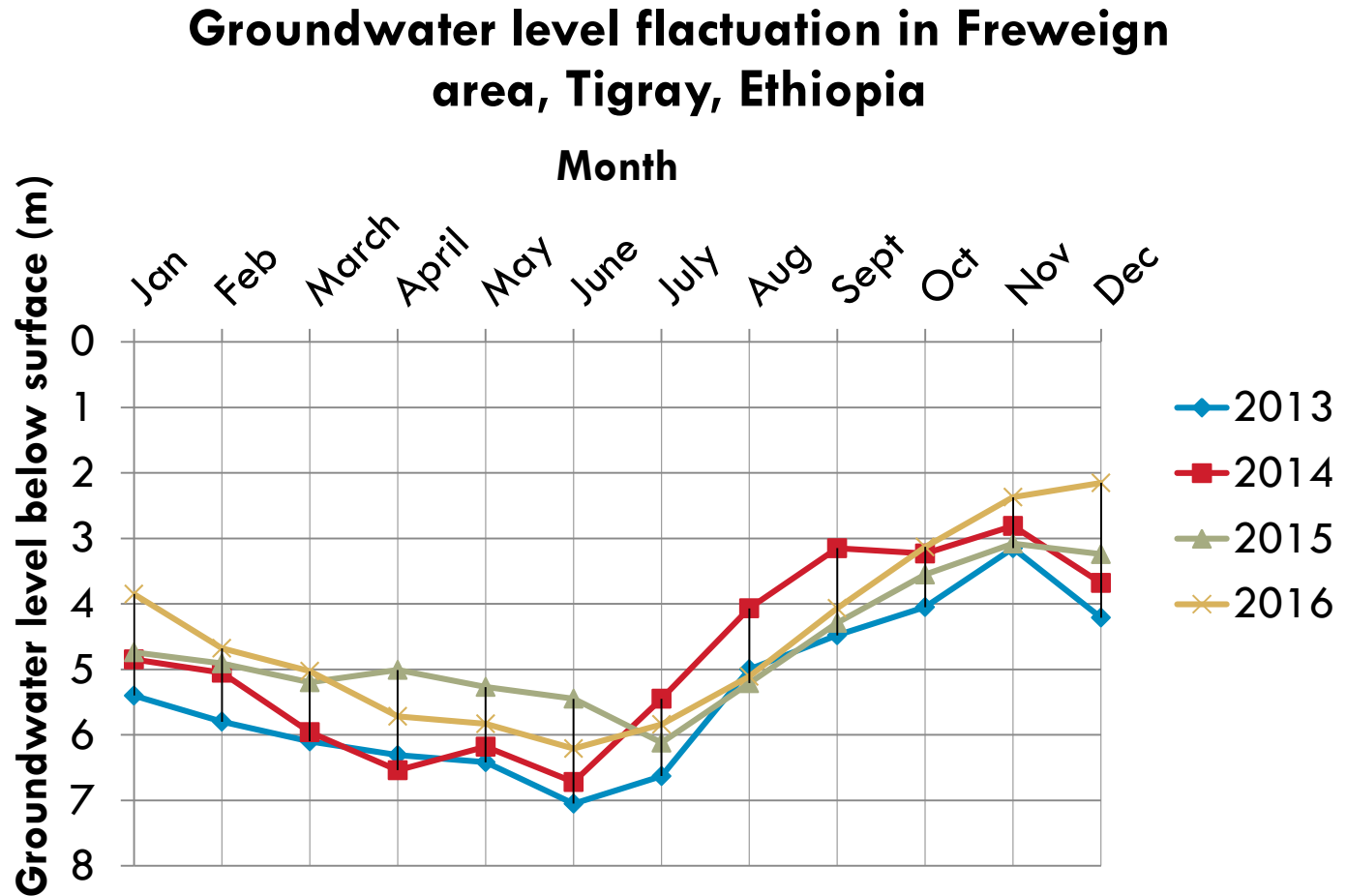
- Enhancing recharge to shallow groundwater,
- Enhancing soil moisture (in-situ),
- Cessation of gully expansion,
- Reduction in flooding,
- Enhancing productivity as supplementary irrigation,
- Sources of water in drought periods.

## 4.1 Effects on groundwater level

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

- Enhanced the shallow groundwater

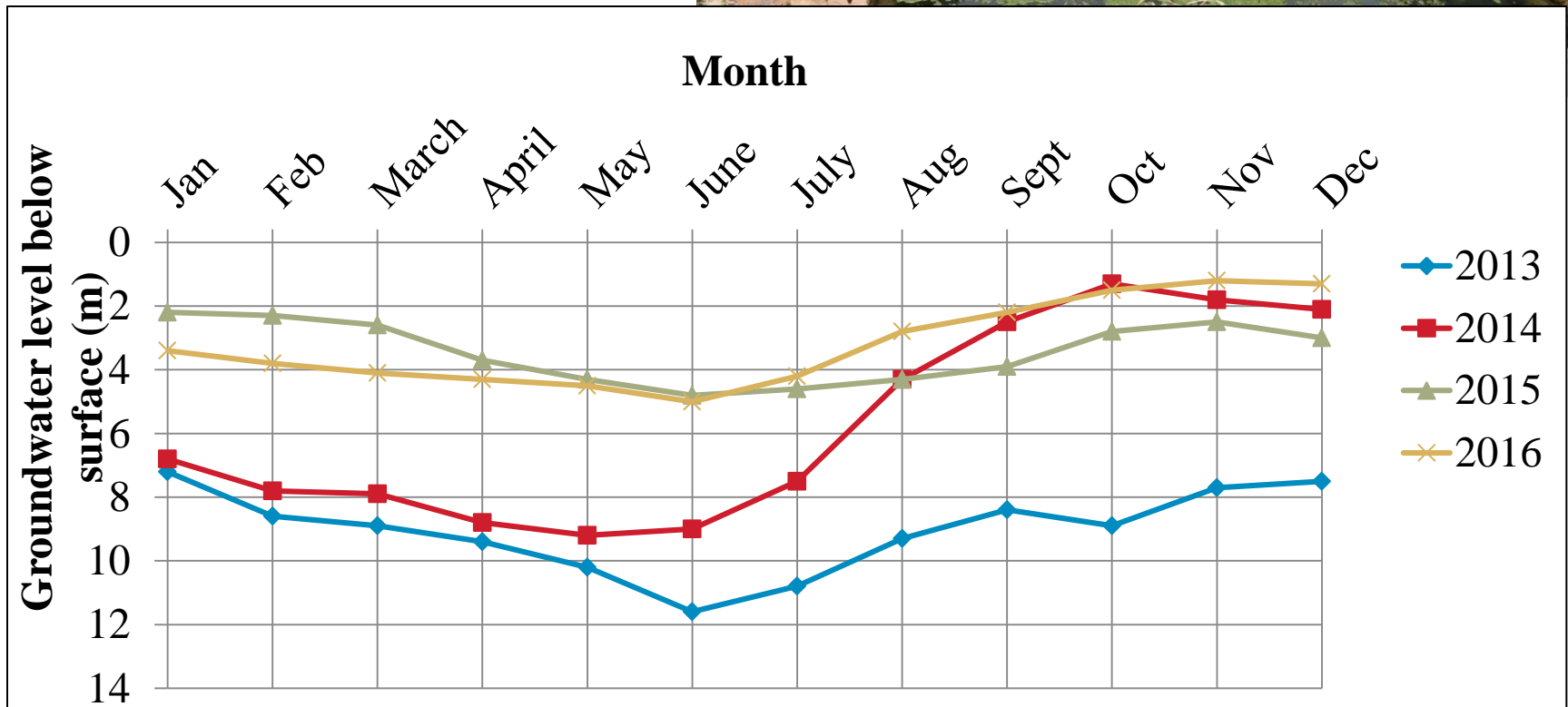


*Note: Borrow pit was used as water storage in the month of July 2014.*



## 4.2 Effects of check-dams

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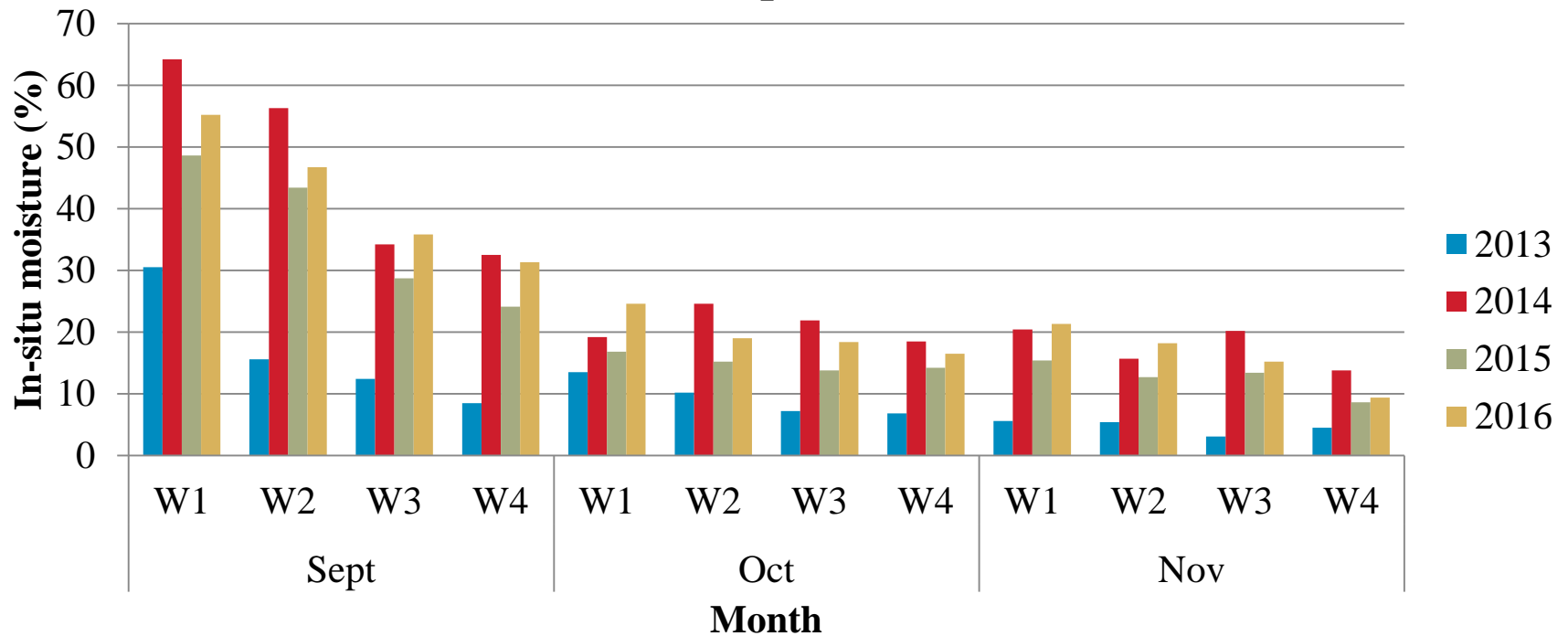


## 4.3 Effects on soil moisture

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**In-situ moisture distribution in soils (Megab area, Tigray, Ethiopia)**



## 4.4 Supplementary irrigation

2 Diverting water from culverts and roadsides are important sources of water for supplementary irrigation.

- Productivity has increased by 50% in 2014/2015 harvest season.



## 4.5 Sources of water in dry periods

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Ponds are important sources of water in dry periods: as witnessed in 2015/2016 drought periods.



# 5. Design considerations for RWH

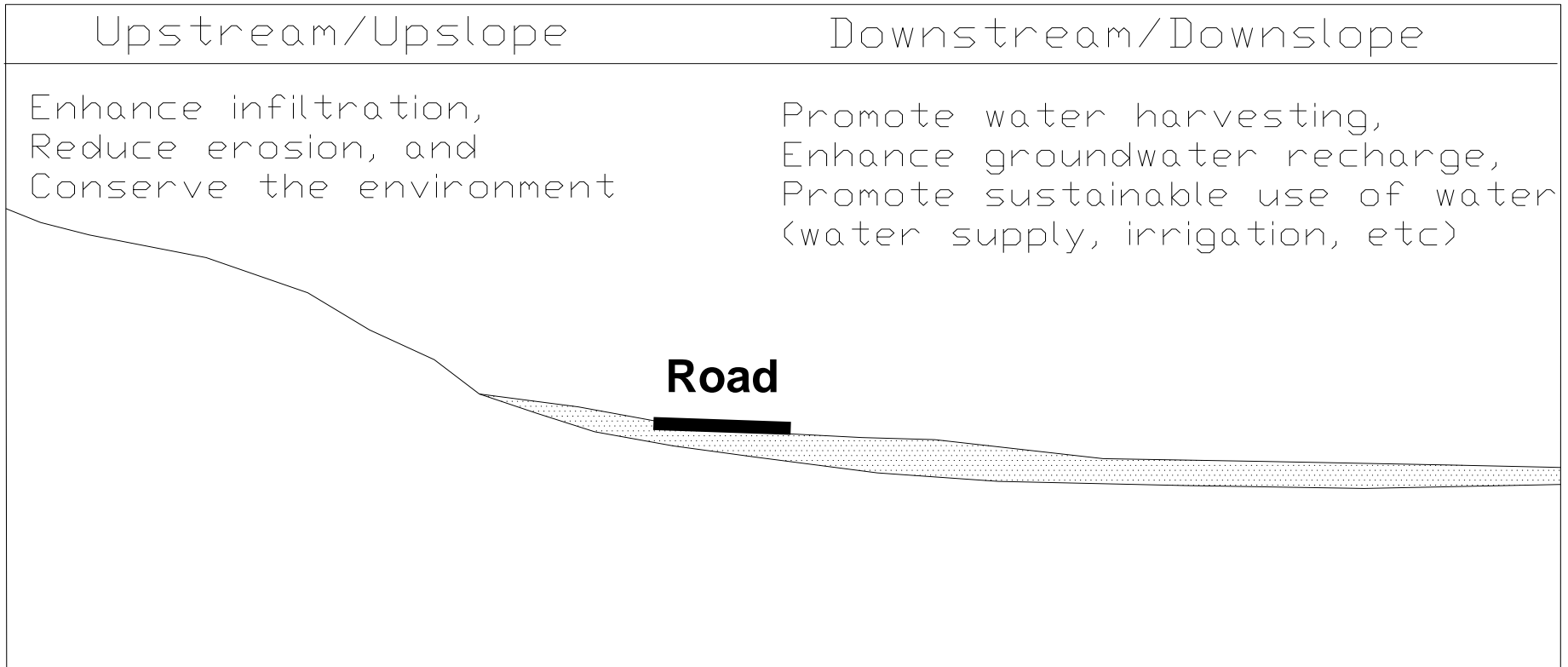
## 5.1 Scenarios and approaches

Three options could be considered:

- Use existing roads to harvest/manage water.
- Design modifications to existing roads.
- Adapt and implement new design approach: integrate road water harvesting options:
  - Guideline/standard.



# *In all the three options, a landscape continuum approach is preferred:*



- *Road development: based on landscape continuum water management model.*
- *Different techniques along the landscape: **upstream, integrated with roads, and downstream of roads.***

## 5.1.1 Techniques at Upstream/Upslope

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### Techniques that:

- Enhance infiltration,
- Reduce erosion, flooding and siltation,
- Enhance soil moisture and groundwater recharge.

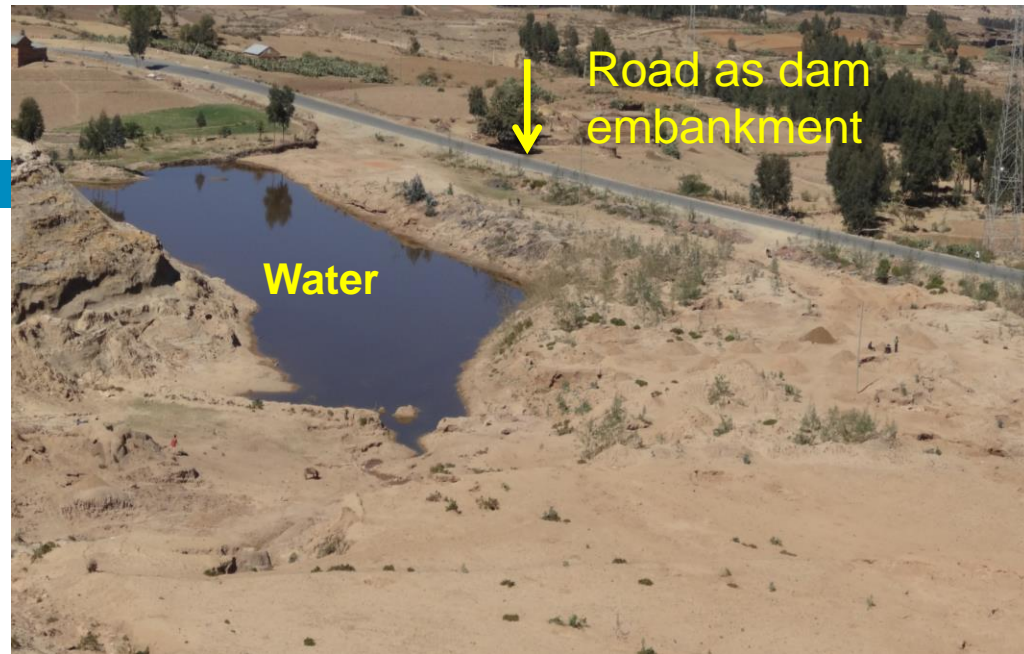


*Example: Surface runoff has reduced by 80% as a result of the upstream intervention.*

## 5.1.2 Techniques integrated with the roads

Roads: as water storages and diversions.

River crossings: water buffering.





## 5.1.3 Techniques at Downslope/ Downstream

Promote technologies that:

- Storage surface water,
- Enhance groundwater recharge,
- Control flooding,
- Reduce negative effects: erosion, siltation, etc
- Enhance sustainable/ productive use of water.



## 6. Concluding remark

- a. There is a great potential to **turn the negative effects** (of water from roads) **to positive** through introduction of appropriate technologies.
- b. **Road development** is part of **land use planning**: need for collaboration among various sectors.
- c. **Towards multi-functional and climate resilient roads**: adapt landscape continuum based water management.
- d. **Develop guidelines and standard procedures** for road water management.



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# Let us be champions in promoting road water management for resilience

