



# **A NINE-YEAR STUDY ON THE BENEFITS AND RISKS OF SOIL AND WATER CONSERVATION PRACTICES IN THE HUMID HIGHLANDS OF ETHIOPIA: THE DEBRE MAWI WATERSHED.**

**Demesew A. Mhired ,Benjamin F. Zaitchik, Seifu A. Tilahun, Tammo S. Steenhuis .**

# Outline

- ❖ Soil erosion in the Ethiopian highlands
- ❖ The study area
- ❖ Experimental findings
- ❖ Conclusions



## Key findings

- ❖ Catchment runoff and sediment showed decreasing trend
- ❖ Periodically saturating bottomlands cause gully formation
- ❖ Gullies are identified as critical sources of catchment soil loss
- ❖ Upland infiltration furrows filled up with sediment and were ineffective
- ❖ Eucalyptus trees decrease the direct runoff and thereby the erosion. At the same time they dry out the watershed and springs

## Soil erosion in the Ethiopian highlands

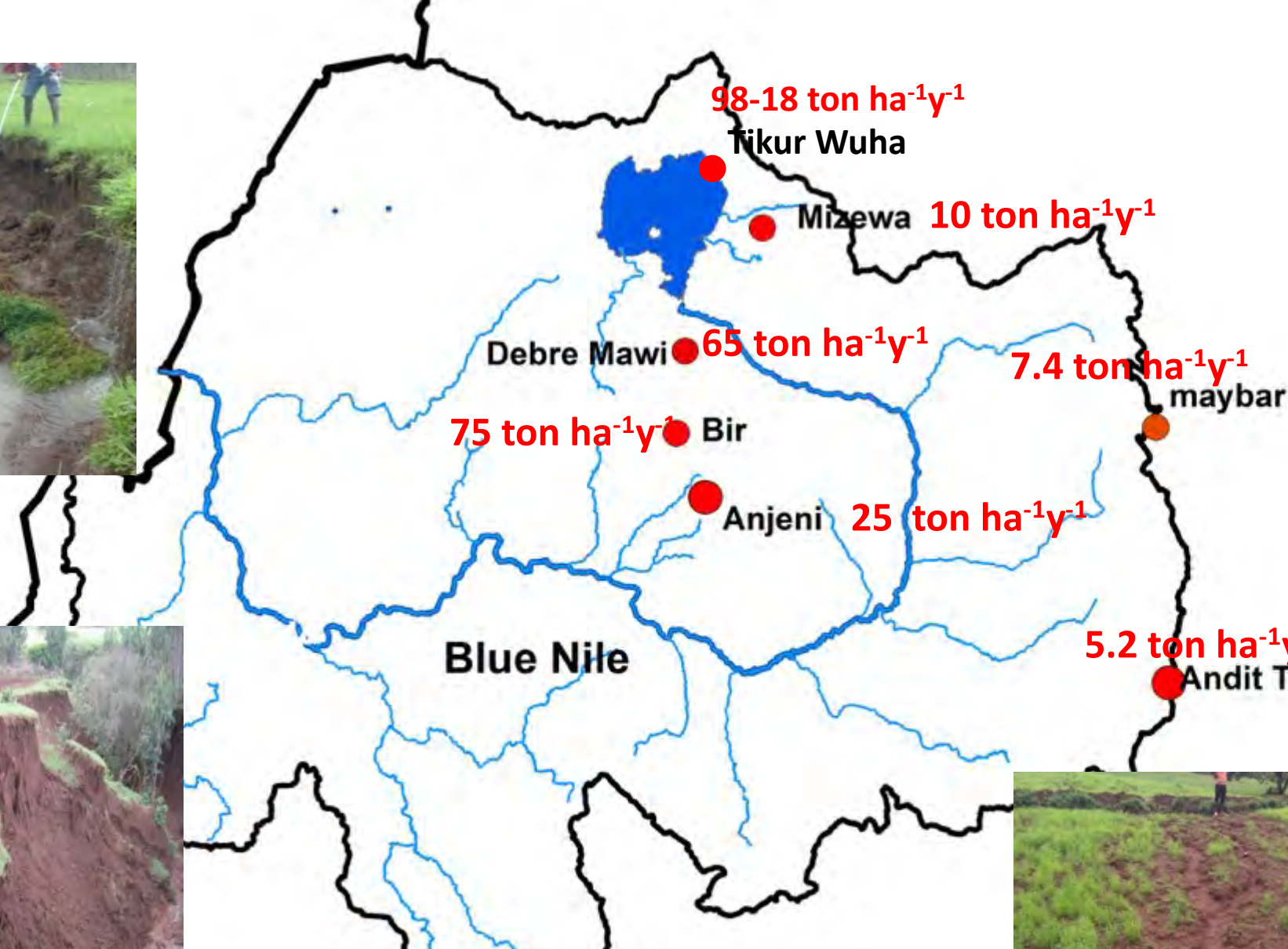
- ❖ Soil erosion is a devastating problem in the Ethiopian highlands.
- ❖ Soil degradation-hardpan formation-soil saturation-gully formation.
- ❖ Soil loss in Ethiopia ranges up to 300 t  $\text{ha}^{-1} \text{yr}^{-1}$ .





## Soil erosion in the humid Ethiopian highlands

- ❖ Translated to a monetary value of USD 1 - 2 B  $y^{-1}$
- ❖ 1.5 million tons of grain per year
- ❖ Bottom lands saturate during the rainy season and gullies are formed.
- ❖ Watersheds with gullies have annual soil loss greater than 20 ton/ha/yr



**Watersheds with gullies deliver up to 20 times more sediment than upland erosion**

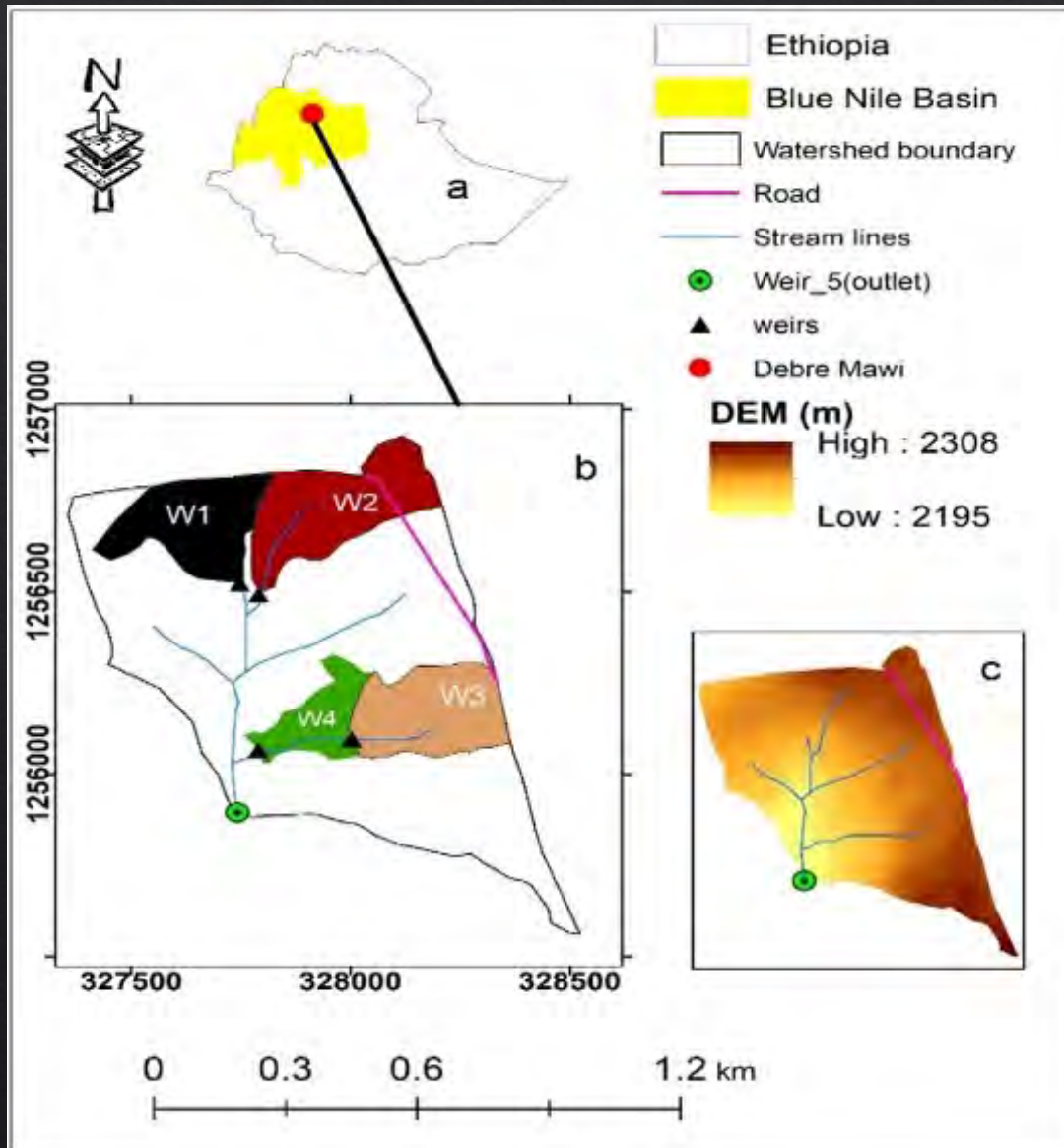


## Soil and water conservation practices

- ❖ Soil erosion should be reduced by effective SWCPs
- ❖ In response, SWCPs have been implemented widely in Ethiopia.
- ❖ Few studies were carried out based on the long-term field data, we initiated this study in watersheds of the Upper Blue Nile basin.
- ❖ Evaluating the long-term performance of SWCPs is vital to increase food self-sufficiency.



## Study area



Debre Mawi watershed

❖ Area: 0.95 km<sup>2</sup>

❖ Rainfall: 1240 mm

❖ Temperature :20°

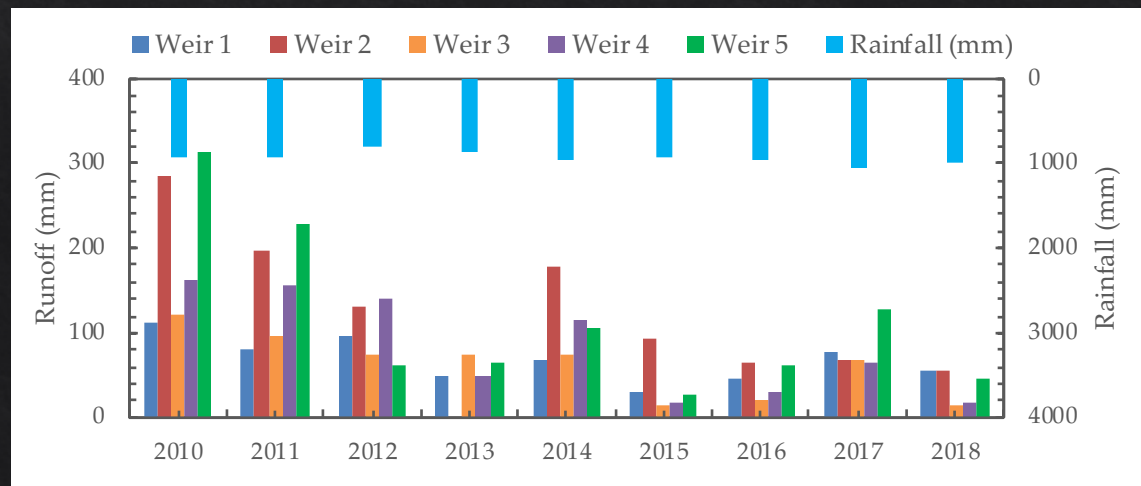
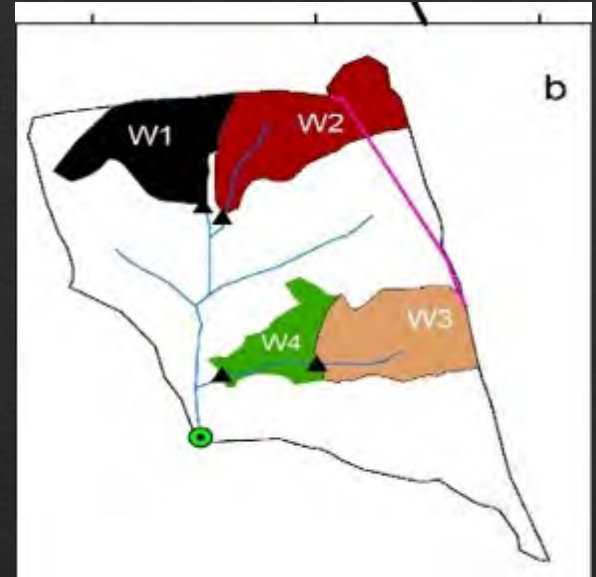


## Data

- ❖ Precipitation
- ❖ Discharge
- ❖ Suspended sediment concentration
- ❖ Perched ground water table uphill and downhill of the infiltration furrows

## Experimental findings

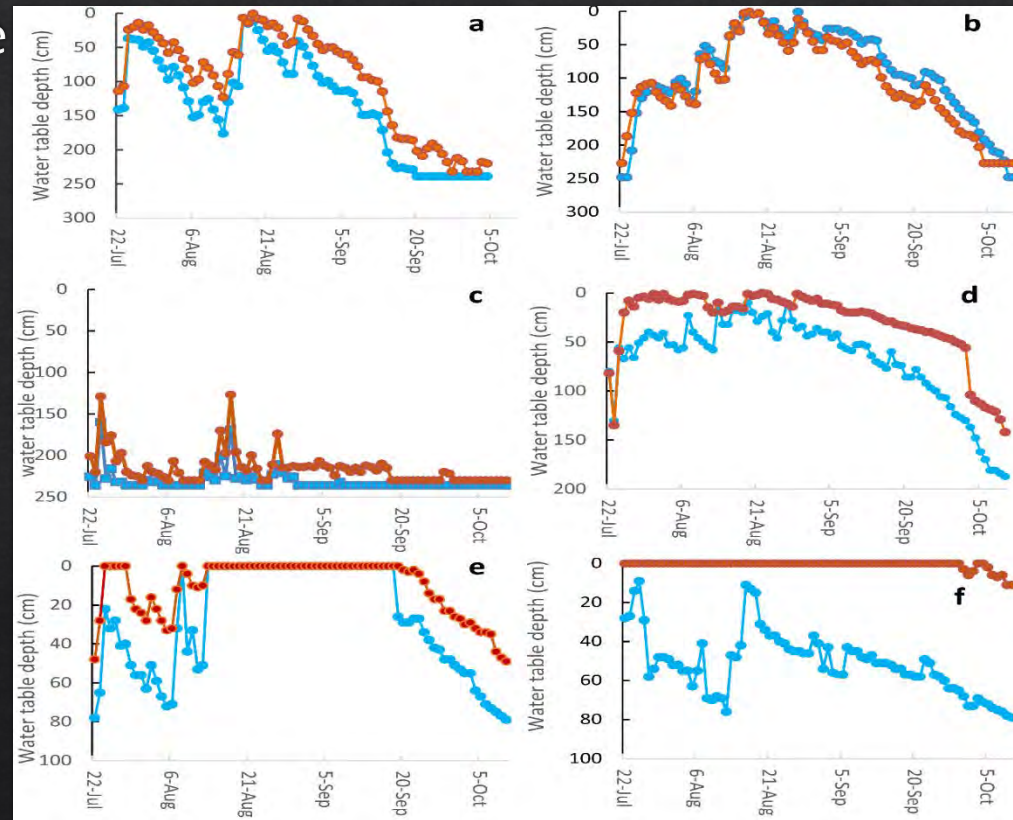
- ❖ Runoff revealed a general decrease but significant only at outlet 2 & 3
- ❖ Sediment concentration at main outlet was greater than its upland parts, indicating that sediment is picked up in the valley bottom.





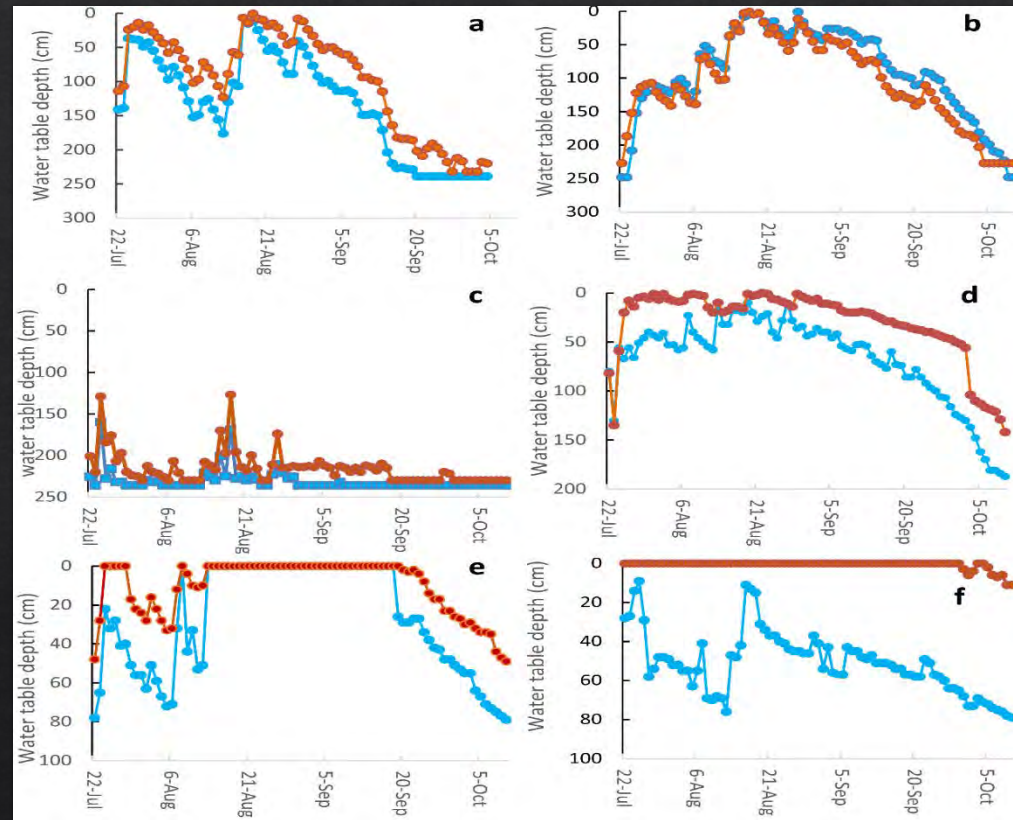
## Water table depth @ uphill and downhill of the infiltration furrows

- ❖ In all piezometers water table depth downhill of the infiltration furrows greater than uphill
- ❖ Only figure b in the midslope highlights an example of the SWCPs functioning as advertised.



## Water table depth uphill & downhill of the furrows

- ❖ However, the water table levels were near the bedrock at upslope (Figure c)
- ❖ In the bottom lands the infiltration furrows increased the water table instead of decreasing it down stream of the furrows.





## Effectiveness of infiltration furrows

- ❖ Since there is no maintenance, upland infiltration furrows have been fill up with sediment.
- ❖ Infiltration furrows did not affect the overall hydrology, and therefore were not effective.
- ❖ Eucalyptus trees decrease the direct runoff and thereby the erosion. At the same time they dry out the watershed and springs

## Gully formed b/c of improper positioning of bunds in the saturated valley floors

- ❖ Infiltration furrows in the downslopes concentrate flow and gully was formed
- ❖ Bunds in the bottomlands contribute directly to saturation and risk of gully formation





## Conclusions

- ❖ Runoff has been reduced across the watershed
- ❖ SWCPs led to greater saturation and potential soil weakening in gully-prone toe slopes of the watershed
- ❖ Downslope SWCPs were ineffective, and potentially problematic
- ❖ Trends will shift in the future if SWCPs are not maintained and/or if the observed increase in saturation of toe slopes results in a large increase in gully erosion
- ❖ In humid Ethiopian highlands, due attention has to be given to the safe removal of excess water from the valley bottoms

Thank you