Averting Degradation in the Abbay/GERD Basin: current trends, potential interventions and investment needs

Essayas Ayana, Semu Moges and Liya WeldeGebriel

Overview

- Degradation in the Abay basin (by Essayas Ayana)
- Reverting the trend (by Liya Weldegebriel)
- Cost of rehabilitation (by Semu Moges)

Degradation in the Abbay basin

Essayas Ayana (Ph.D.)

Degradation in Abay Basin

- Sheet, rill, and gully erosion
- Watersheds suffers from severe or very severe erosion risk ranging from 80 t/ha/yr to 125 t/ha/yr (Bewket & Teferi, 2009)
- Average soil loss rate of 27.5 t/ha/yr and a gross soil loss of ca. 473 Mt/ha/yr (Haregeweyn et. al. 2017)
- Land use/Land cover change as main driver
- Significantly affected soil quality (Organic matter and bulk density) (Teferi, Bewket & Simane, 2016)

The metrics

- Sustainable Development Goal (SDG) 15

"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss"

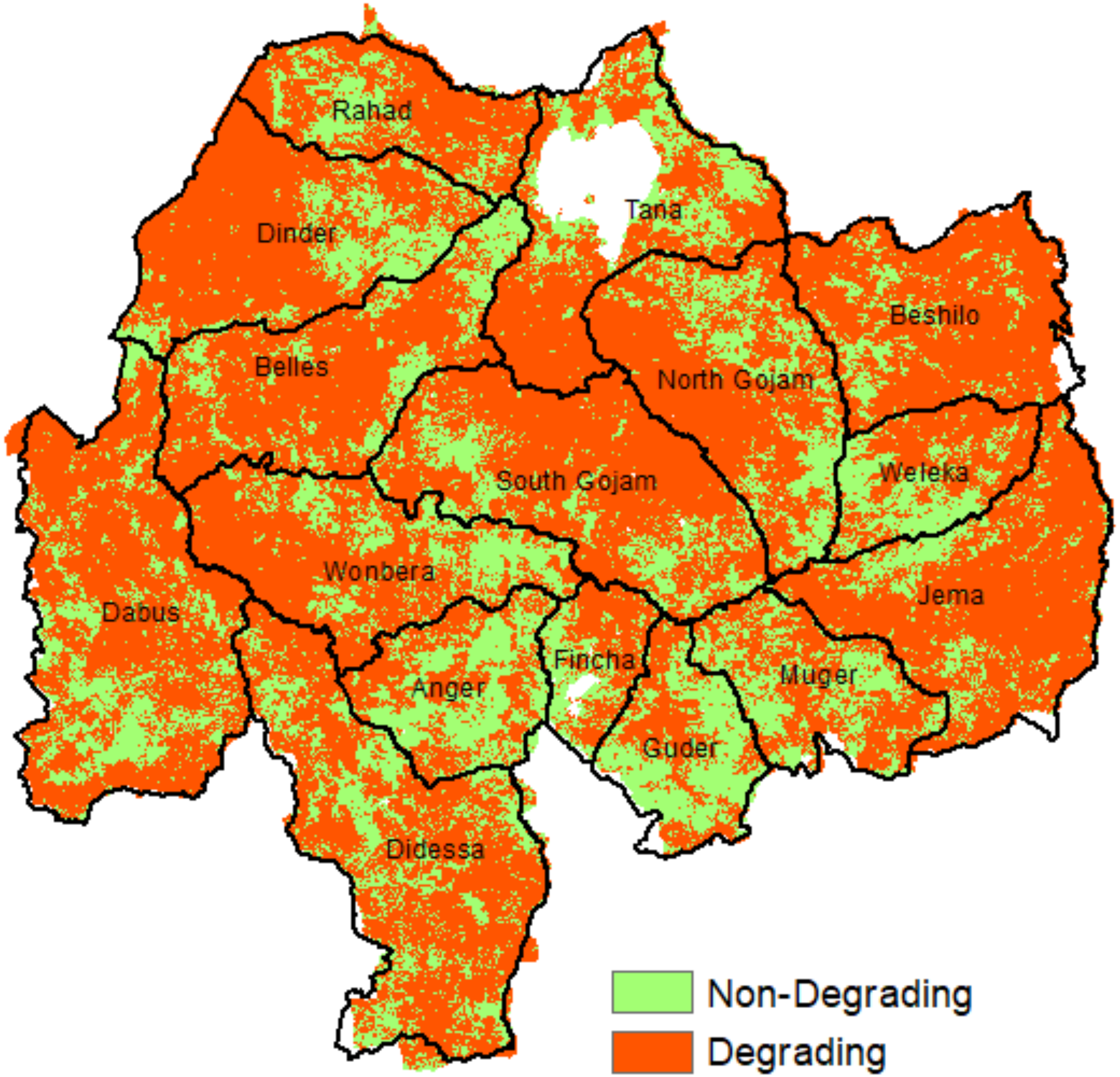
- Target

"By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world"

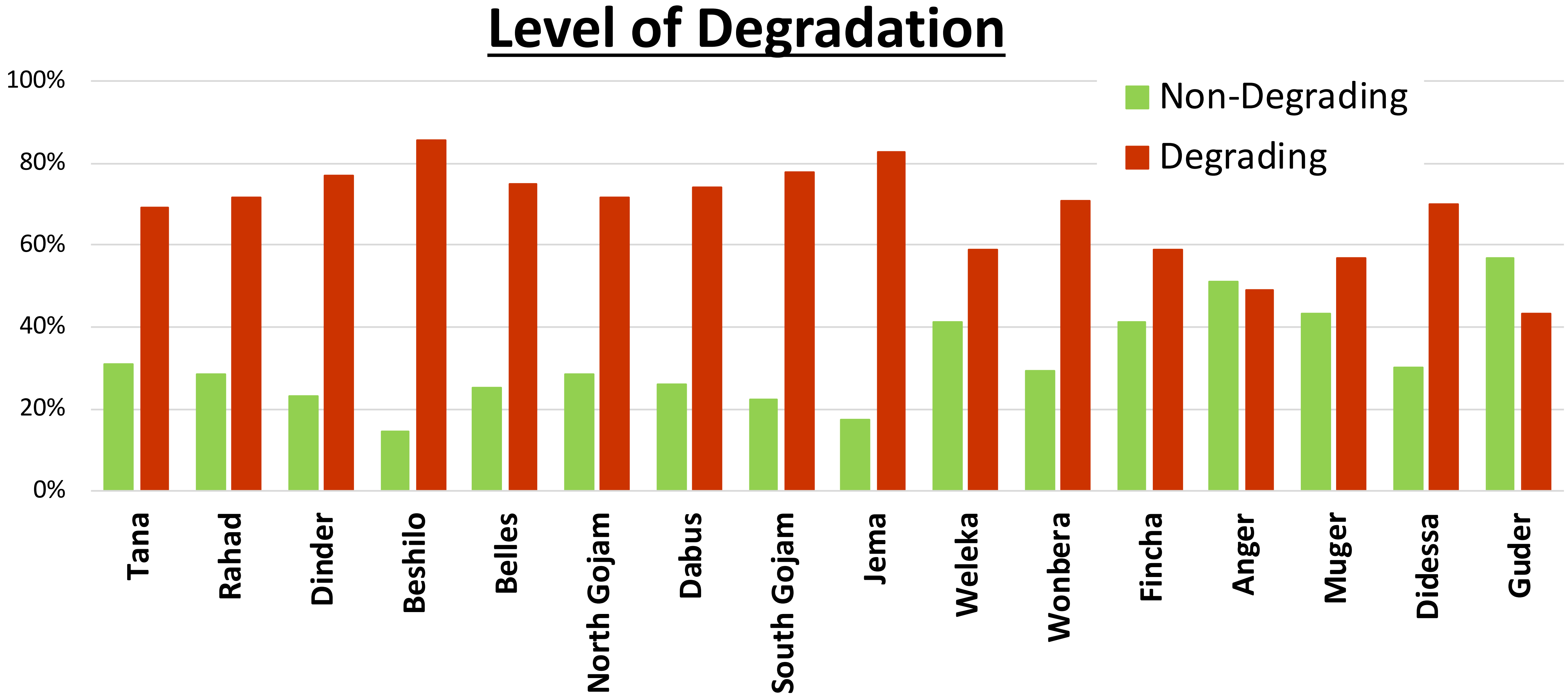
- 3 sub-indicators: Vegetation productivity, Land cover, Soil organic carbon

Vegetation productivity

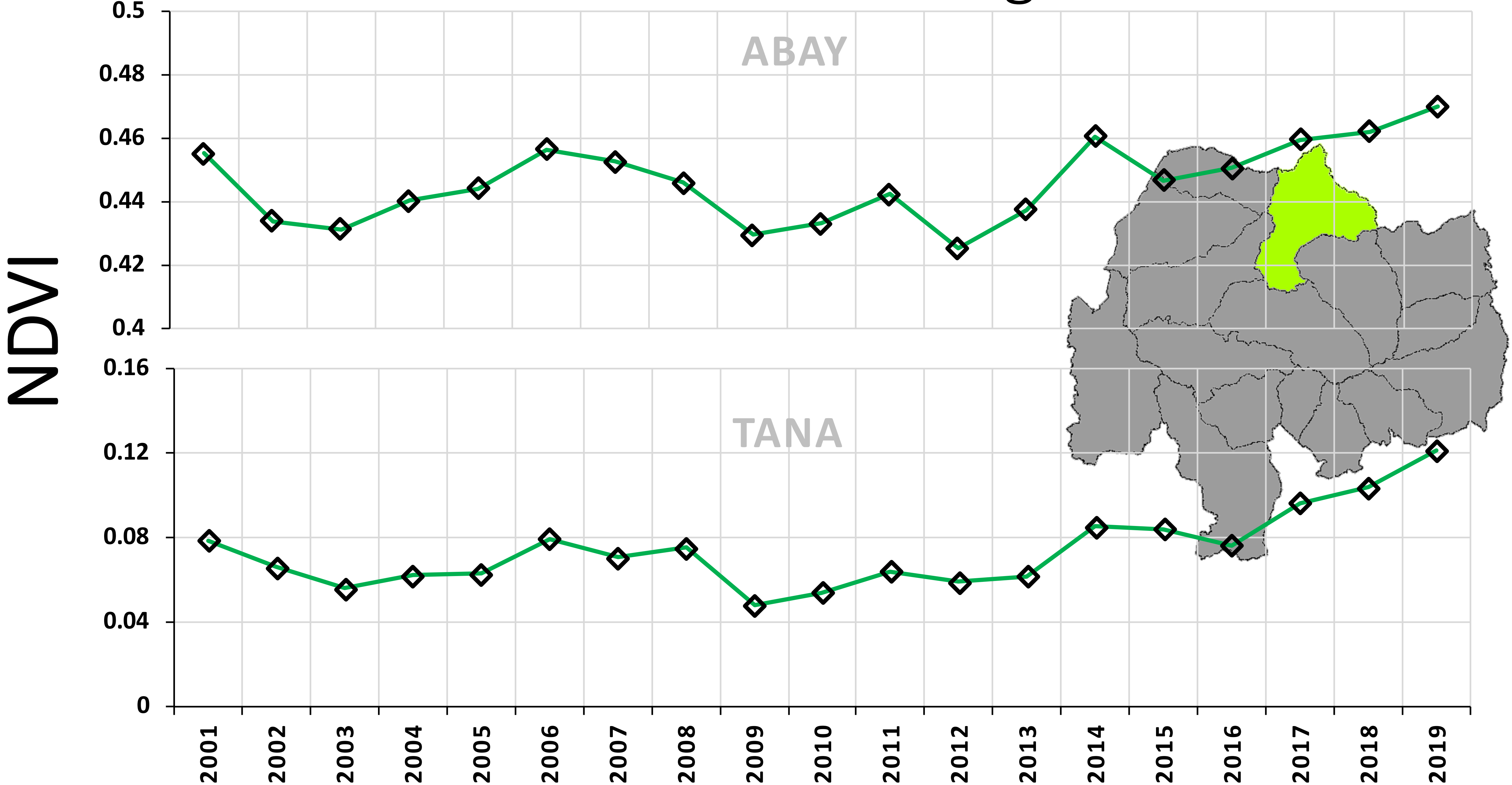
- Using a trend fit on MODIS FPAR in GEE
  - 71% of the basin area currently in a degradation trend



The degradation metrics



Vegetation cont'd…



Current forest cover

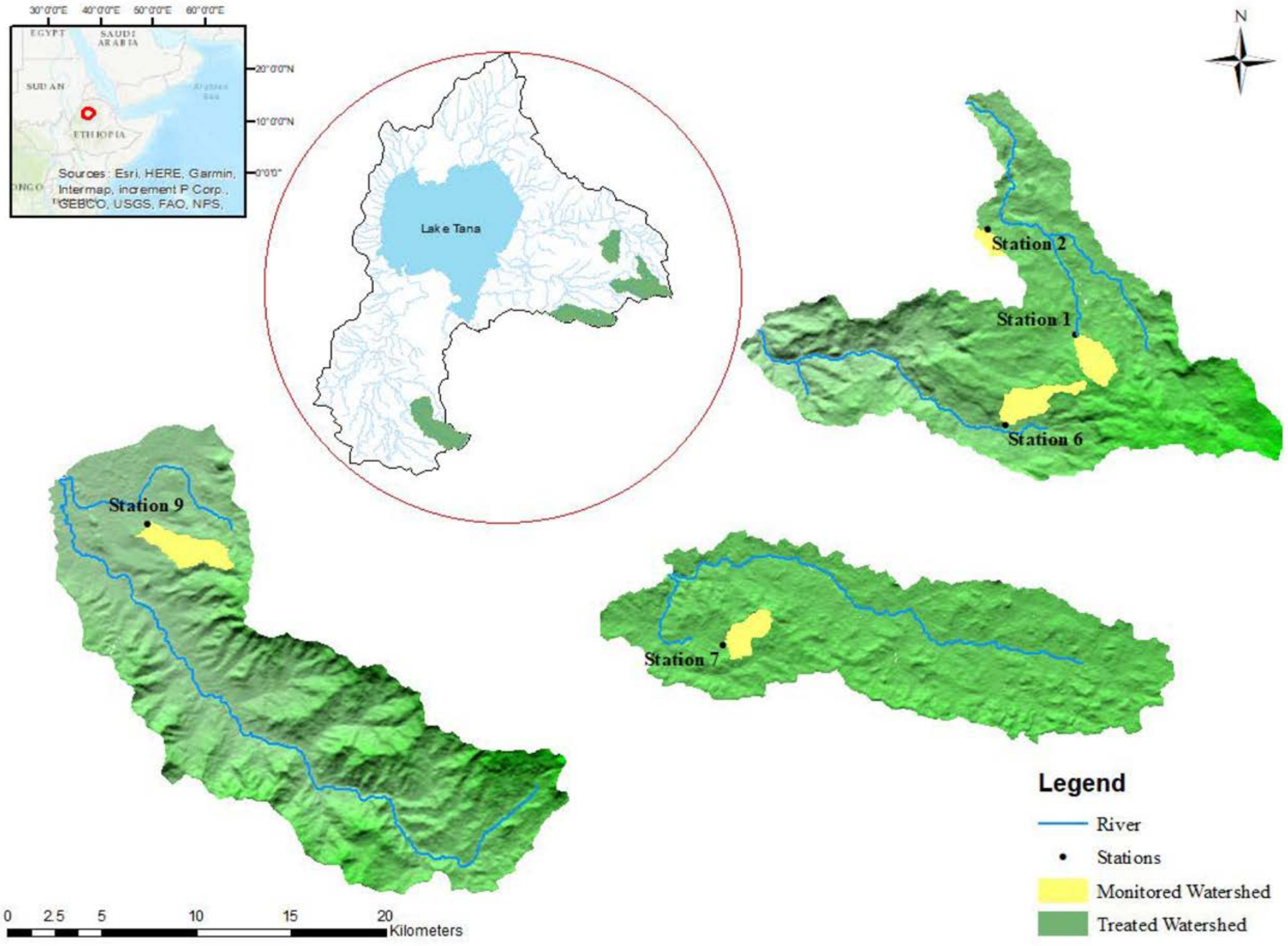
https://www.globalforestwatch.org/

Subbasin	Forest (Kha)	Non-forest (Kha)
Abay	3370	16700
Anger	260	535
Beles	438	988
Beshilo	4.48	1330
Dabus	796	1310
Didessa	888	1090
Dinder	201	1290
Fincha	6.42	405
Guder	20.4	685
Jema	2.29	1590
Muger	2.3	822
North Gojam	2.03	1450
Rehad	11.6	819
South Gojam	85.6	1600
Tana	0.497	1210
Woleka	0.135	646
Wonbera	655	646

Reverting Degradation Trend: Lessons learned from soil and water conservation (SWC) projects in Lake Tana basin

Liya Weldegebriel,
PhD Candidate
Ecohydrology
UC Berkeley

Tana Beles Integrated Water Resource Development Project (TBIWRDP)



SWC practices implemented in TBIWRDP

Terraced hillslopes with agroforestry

Detail of stones terrace

Gabion check-dam

Detecting short term impact of SWC practices

1. Using Stage as a proxy to assess change in runoff ratio

- *Stage height* data lacks complete stage-discharge rating curve to asses impact of SWCPs on *Discharge* and *Runoff ratio*.

- Logarithmic linear regression of *Stage height* and *Rainfall* results in an intercept term, ***K*** , that includes Runoff ratio.

2. Separating rainfall-runoff relations by season

Rainfall - Runoff Tsedey ⟷ Rainfall - Runoff Kiremt

Impact of SWC practices on runoff ratio

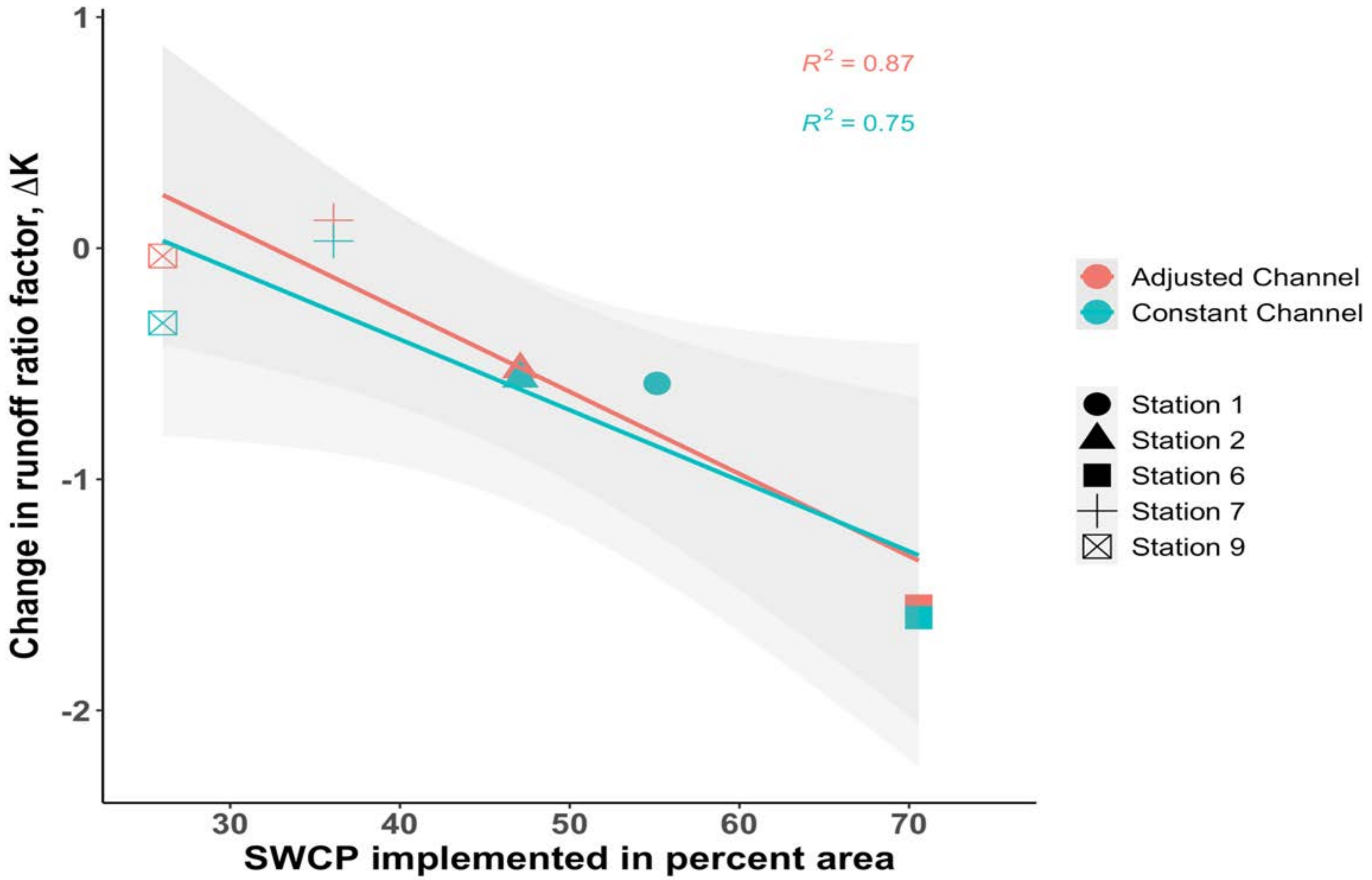


Figure 1. Density of SWC practices vs change in runoff ratio factor between 2010 and 2012 in Kiremt (wet) season

Impact of SWC practices on sediment concentration

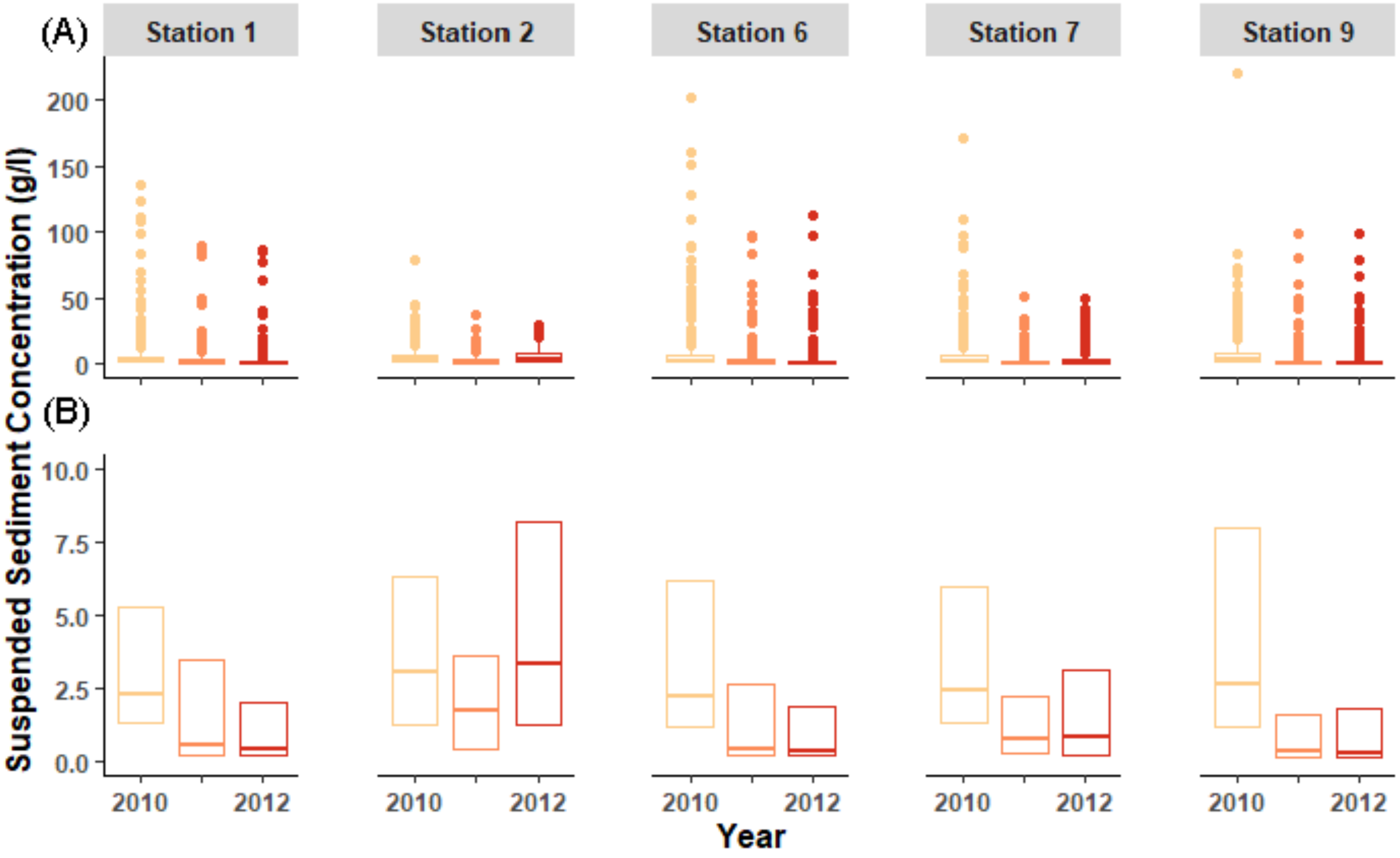


Figure 2. Suspended sediment concentration (g/l) for Kiremt season from 2010 to 2012. (A) including outliers, (B) without outliers

Long term impact of SWC practices on land cover

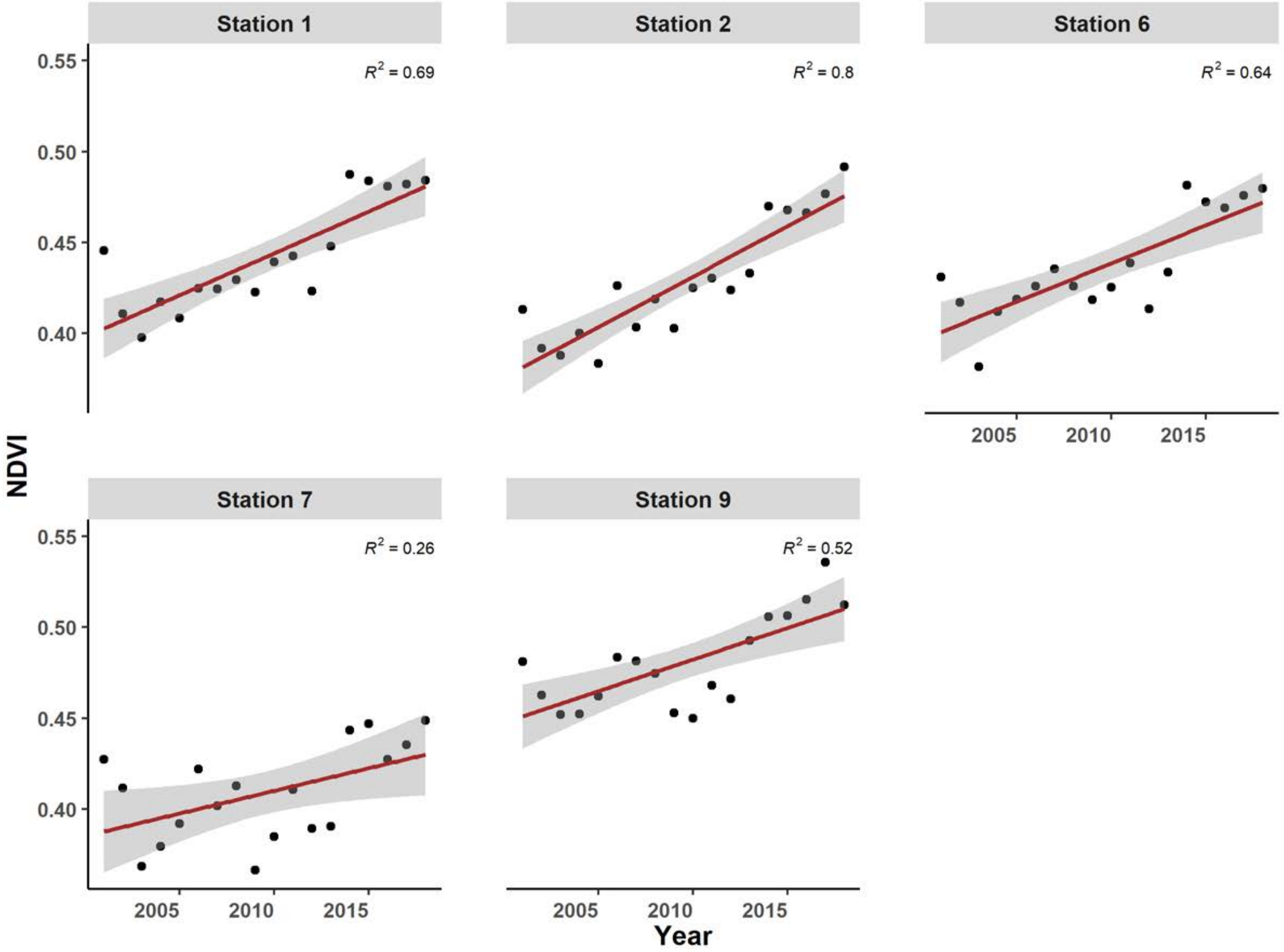


Figure 3. NDVI trend from 2001 to 2018

Lessons learned from TBIWRDP Project

- Stage height, sediment concentration and vegetation indices (NDVI) can be used to detect impact of SWC practices
- Terraces, check dams and agroforestry has shown positive short-term impact by reducing runoff and soil erosion in small scale watersheds
- “No free grazing” policy has increased vegetation cover in the long term

Cost of rehabilitation

Semu Moges (Ph.D.)

Guidelines for watershed rehabilitation and cost breakdown for a standard watershed – 500ha for five years (Zeleke, 2014)

No	Major Activities with % contribution of communities	Cost (USD)	% of the total cost
1	Participatory Watershed Development Planning	16,000	5
2	Preparation for implementation including equipment & initial training	17,600	5.5
3	Area closure with HT, T (up to 70% comm. cont)	17,600	5.5
4	SWC on cultivated lands (70% comm. cont)	16,000	5
5	Feeder roads (60%)	18,240	5.7
6	Gulley rehabilitation (40% cont)	30,080	9.4
7	Spring & shallow well dev. For water supply (20% cont)	9,600	3
8	Nursery (20% cont)	50,560	15.8
9	Woodlot and other plantations (65% cont)	9,600	3
10	Homestead Dev. (60% cont)	64,000	20
11	Shallow wells for Irrigation linked to Homesteads (50% cont)	9,600	3
12	Ponds, Roof Water Harvesting & SS-dams (20% cont)	17,920	5.6
13	Irrigation diversions and canals (20% cont)	16,000	5
14	On the job training for ED activities	11,200	3.5
15	ME and operation costs	16,000	5

Cost of rehabilitation of degradation

Non-Degrading	Degrading	Non-Degrading	Degrading	Cost of Rehabilitation, Billion USD
1905	11209	15%	85%	0.717
2770	13076	17%	83%	0.837
3789	13239	22%	78%	0.847
3500	11581	23%	77%	0.741
3615	10831	25%	75%	0.693
5387	15385	26%	74%	0.985
4158	10512	28%	72%	0.673
2407	6040	28%	72%	0.387
3830	9315	29%	71%	0.596
5767	13530	30%	70%	0.866
3707	8324	31%	69%	0.533
2680	3853	41%	59%	0.247
1598	2293	41%	59%	0.147
3508	4627	43%	57%	0.296
4100	3909	51%	49%	0.25
3865	2924	57%	43%	0.187
56585	**140649**	**197233**		**9.002**

- Research indicates watershed rehabilitation cost in Ethiopia is **320000 USD/500** ha (Zeleke, 2014)
- Total rehabilitation cost ~ **9 Billion USD**

Conclusion and Recommendations

- Abay basin suffers from severe soil erosion
- Diverse SWC approaches need to be integrated to reverse land degradation
- Monitoring impact of SWC is essential for sustainable and appropriate upscaling of interventions
- Rehabilitation of the Abay basin could extend the useful life of GERD but requires significant research and investment

References

- Bewket, W., & Teferi, E. (2009). Assessment of soil erosion hazard and prioritization for treatment at the watershed level: case study in the Chemoga watershed, Blue Nile basin, Ethiopia. Land Degradation & Development, 20(6), 609–622.
- Gete Zeleke (2014). Exit Strategy and Performance Assessment for Watershed Management: A Guideline for Sustainability. WLRC, Addis Abeba, Ethiopia
- Haregeweyn, N., Tsunekawa, A., Poesen, J., Tsubo, M., Meshesha, D. T., Fenta, A. A., Nyssen, J., & Adgo, E. (2017). Comprehensive assessment of soil erosion risk for better land use planning in river basins: Case study of the Upper Blue Nile River. Science of the Total Environment, 574, 95–108.
- Teferi, E., Bewket, W., & Simane, B. (2016). Effects of land use and land cover on selected soil quality indicators in the headwater area of the Blue Nile basin of Ethiopia. Environmental Monitoring and Assessment, 188(2), 83.