



Mekelle University Florence University



Soil and water conservation and soil fertility management in different agro-ecosystems of northern Ethiopia

By: Shimbahri M.



Outlines

1. Brief introduction about Mekelle University
2. Brief introduction about my PhD
3. **‘Soil and water conservation and soil fertility management in different agro-ecosystem of northern Ethiopia’**
 - Video of SWC in Ethiopia (Tigray, Northern Ethiopia)
 - **‘Impacts of bench terraces on soil fertility’** considering selected key soil physico-chemical properties.
 - **PhD thesis**
 - a) **Estimate nutrient balances at farm level among wealth categories**
 - b) **Modeling Quantitative Soil Nutrient Supply, Fertilizer Recommendation and Yield Response of Wheat, Barley and Tef crops in Tigray, northern Ethiopia**

Mekelle University

- Mekelle University ([Tigrinya](#): መቐለ ዩኒቨርሲቲ)
- Is a higher education and training public institution located in [Mekelle](#), [Tigray](#), [Ethiopia](#).
- Mekelle University is one of the largest public universities in Ethiopia.
- It has seven colleges, eight institutes, and more than 90 undergraduate and 70 postgraduate programs.
- The student intake capacity of Mekelle University has reached 31,000.

Colleges

- College of Dryland Agriculture and Natural Resources Management
- College of Natural and Computational Sciences
- College of Law and Governance
- College of Social Sciences and Languages
- College of Business and Economics
- College of Health Sciences and Ayder Referral Hospital
- College of Veterinary Medicine

Institutes

- Ethiopian Institute of Technology - Mekelle (EiT-M)
- Institute of Paleo-Environment and Heritage Conservation
- Institute of Geo-Information and Earth Observation
- Institute of Environment, Gender, and Development Studies
- Institute of Water and Environment
- Institute of Climate and Society
- Institute of Pedagogical Sciences
- Institute of Energy (IoE)
- [Mekelle Institute of Technology](#) (MIT-MU)

Land Resource Management and Environmental Protection

- **(LaRMEP)** has three under graduate programs
 - ✓ Soil Resource and Watershed Management
 - ✓ Forestry and Nature Conservation
 - ✓ Water Resource and Irrigation Management
- **Five MSc programs**
 - ✓ Tropical Land Resource Management
 - ✓ Soil science
 - ✓ Sustainable Watershed Management
 - ✓ Agroforestry and carbon management
- **Two PhD programs**
 - ✓ Soil science
 - ✓ Dry land ecology

Activities done by Mekelle University

- Teaching and learning
- Researches
- Community Services
- Consultancy works
- Supporting schools
- Supporting research institutes
- Knowledge and technology transfers

PhD program

- **PhD in climate and food system**
- **Collaboration of five universities**
 - ✓ Two universities from South Africa
 - ✓ University of Accra (Ghana)
 - ✓ University of Tanzania (Darselam)
 - ✓ Mekelle University (Ethiopia)
 - ✓ Three components of value chain
- ❖ **Resource based soil fertility management strategies for enhancing agricultural production and climate change adaptation**

Short-term effects of bench terraces on selected soil properties: landscape improvement for hillside farming in semi-arid areas of northern Ethiopia

1. Introduction

- **Land degradation** is one of the most serious problems (Budry and Curtis, 2007) with consequence of reduced **soil fertility, crop yield, economic decline** and **social stress** (Tadele et al., 2013).
- **Land degradation** in developing countries such as Ethiopia has been a serious concern for its negative implications for the livelihood of the rural community and the environment on which they largely depend
- Depletion of **soil fertility is one of the challenges** in Tigray due to mountainous and hilly topography that accelerate soil erosion (Sitienei *et al.* 2017).



Cont...

- To tackle this several initiatives have been implemented rehabilitation activities (Nyssen et al., 2008; Haregeweyn et al., 2015).
- Construction of SWC structures such as **bench terraces** reduce slope steepness, flooding risks and closure areas create suitable environment for agriculture (Petanidou et al., 2008)
- Though, many hilly areas have been conserved with bench terraces (Tadele et al., 2013), it **disturbs** the soil and **translocate** plant nutrients during installation
- Hence, there is a need to look into impacts of Terraces on soil properties and over all opportunities and challenges of terraces



2. Objectives

- Quantify impacts of bench terraces on soil fertility considering selected key soil physico-chemical properties.
- Investigate opportunities and challenges of bench terraces

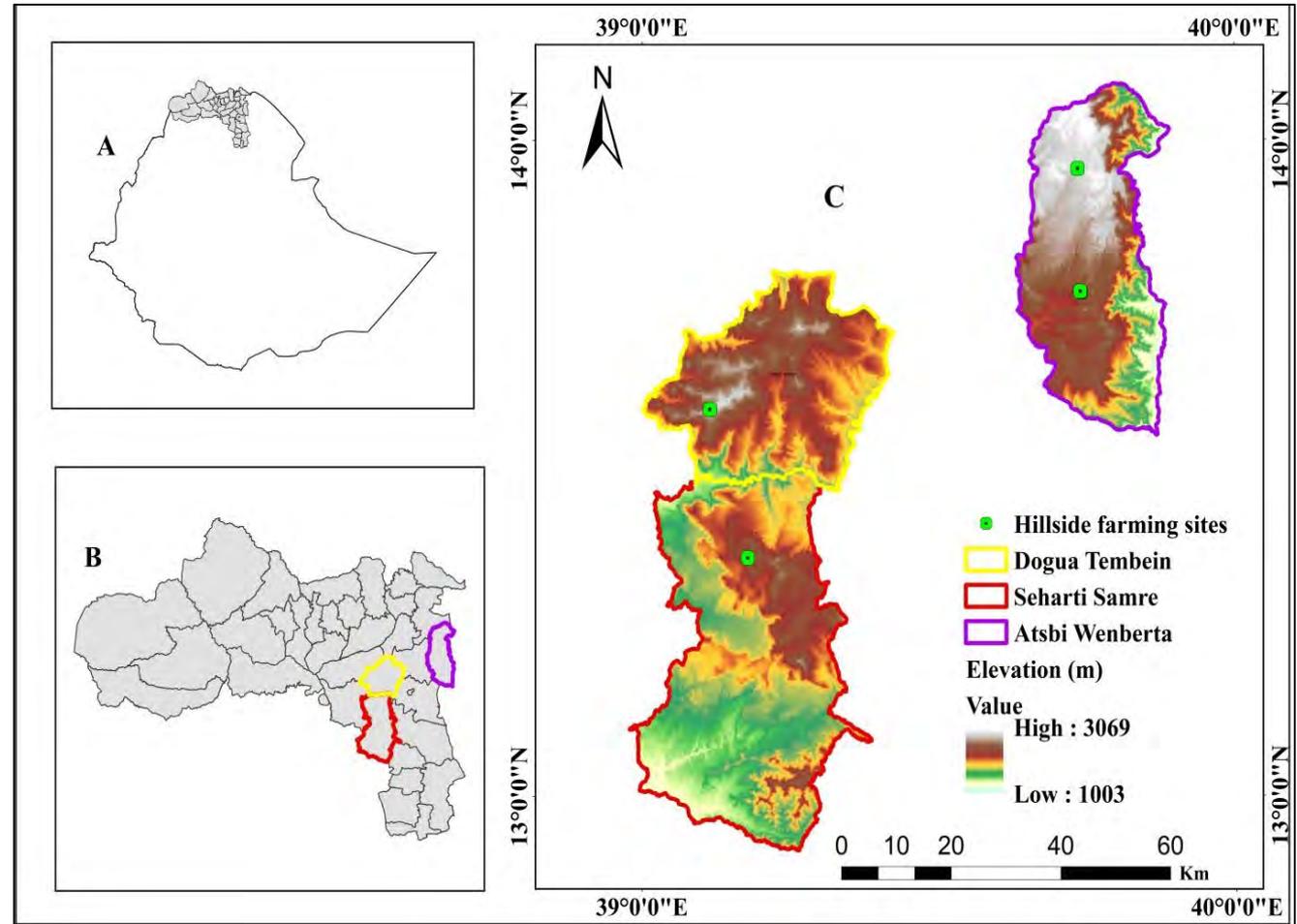


3. Study area

- Sahrta-Samre, Atsbi-Wenberta & Degua-Tembien

- The average daily air T° for SS, AW and DT is 23°C , 16°C and 17°C

- Long-term MARF of 558 mm, 745 mm and 726 mm respectively (Nyssen et al., 2007; Taye et al., 2013)



Bench terrace description and hillside farming characterization

- Bench terraces are a **series of level strips** running across the slope and are supported by steep banks or risers.
- The main purposes of the bench terraces are **to reduce slope length and gradient, prevent run off** and change steep slopes into suitable agricultural lands
(Lasanta et al., 2001).



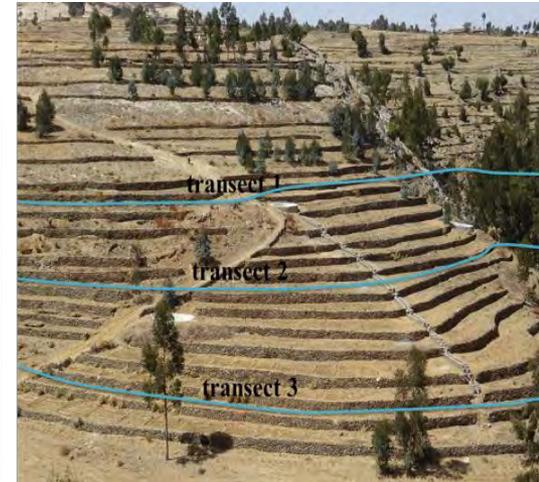
4. Methodology

4.1 Site selection and sampling techniques

- Four hillside farming sites were selected
- The hillside farming sites were classified into three slope classes.
- Composite soil samples were collected per transect at foot, mid and upslope of the hillside farming and untreated adjacent hillsides



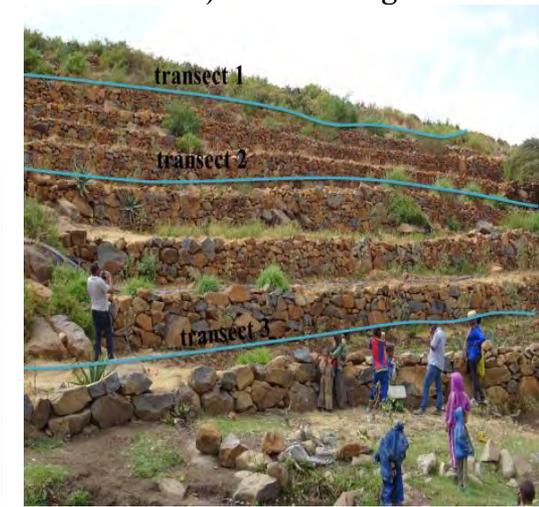
a) Teshi



b) Ruba-Feleg



c) Michael-Emba



d) Enda-Chena

Soil properties analysis

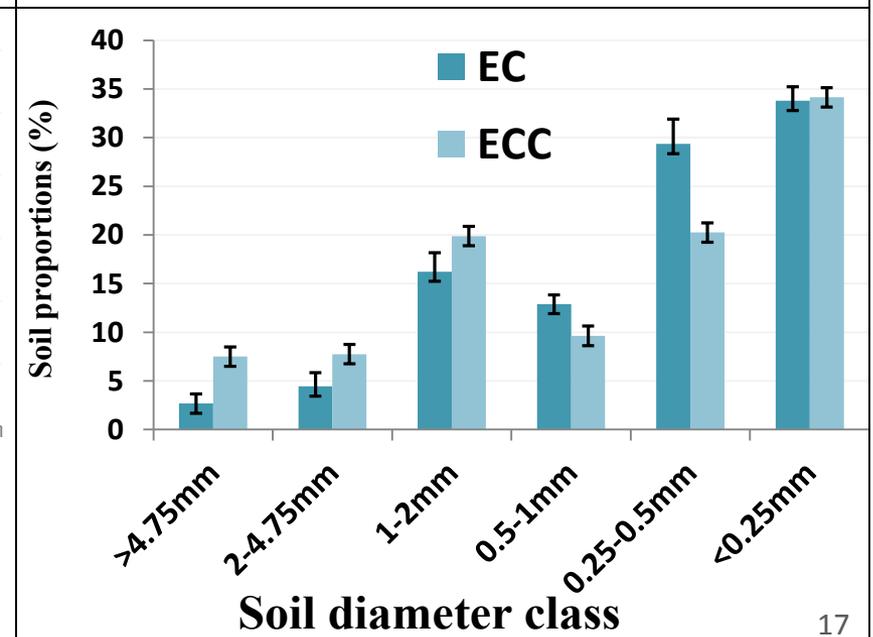
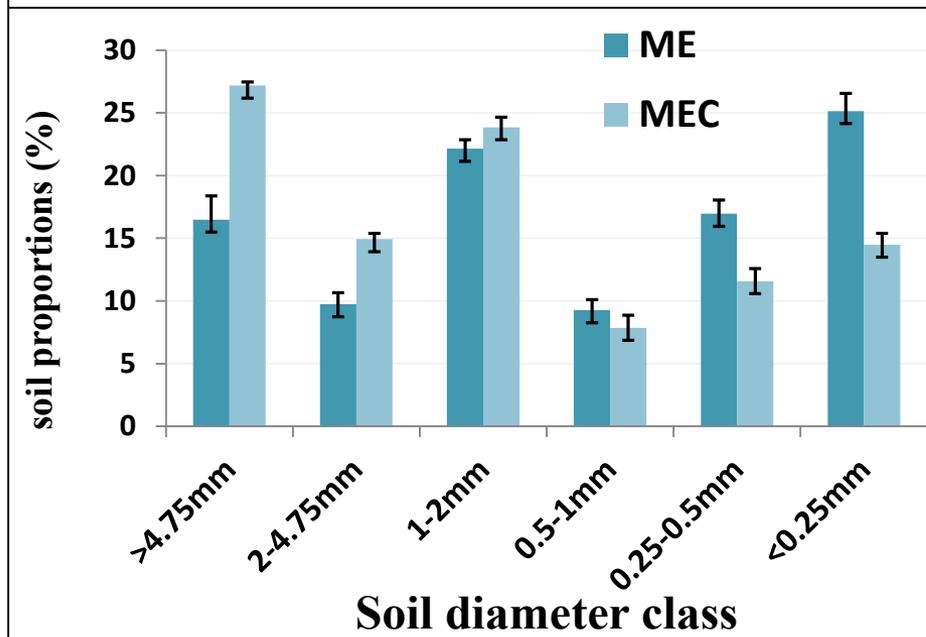
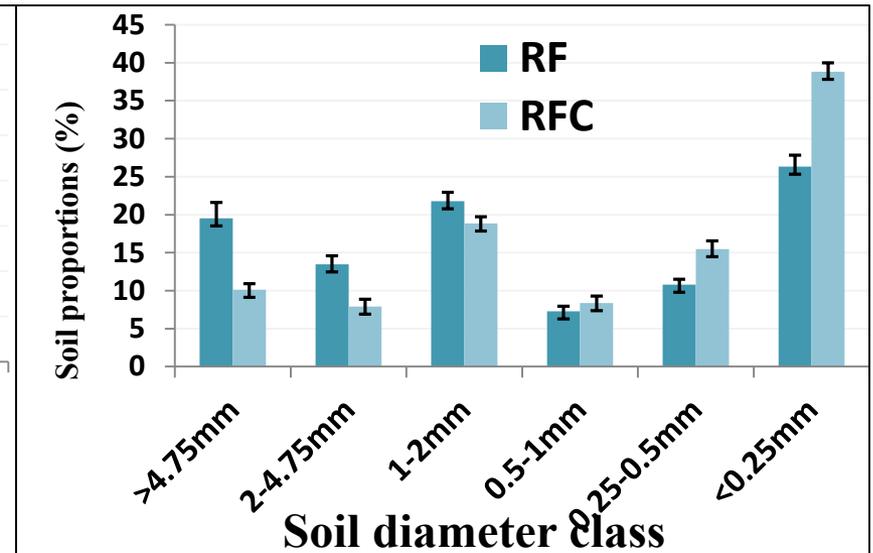
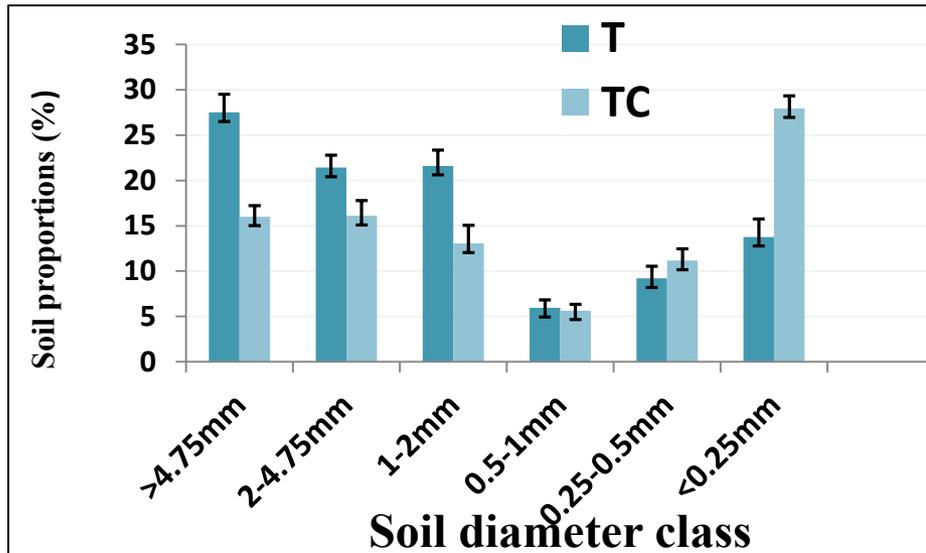
Soil properties	Method	Reference
Soil texture	hydrometer method	Gee and Bauder, 1986
Soil aggregate stability	Sieving method	Cambardella and Elliott, 1993
Soil pH	pH meter	Peech, 1965
Organic carbon	Walkley and Black	Walkley and Black, 1934
TN content using	Kjeidahl method	Bremmer and Mulvaney, 1982
Av. P	Olsen method	Olsen <i>et al.</i> , 1954
Av. K and Na	flame photometer method	(Jackson, 1958),
Basic cations (Ca, Mg)	Titration method	

5. Result and discussion

Texture

- Since texture is an inherent soil property derived from the parent material, it is **not surprising** to observe very little influences of bench terracing on soil texture in short period of time.
- However, it was **expected** that installation of bench terraces can mix up the particles & resulted in texture variations

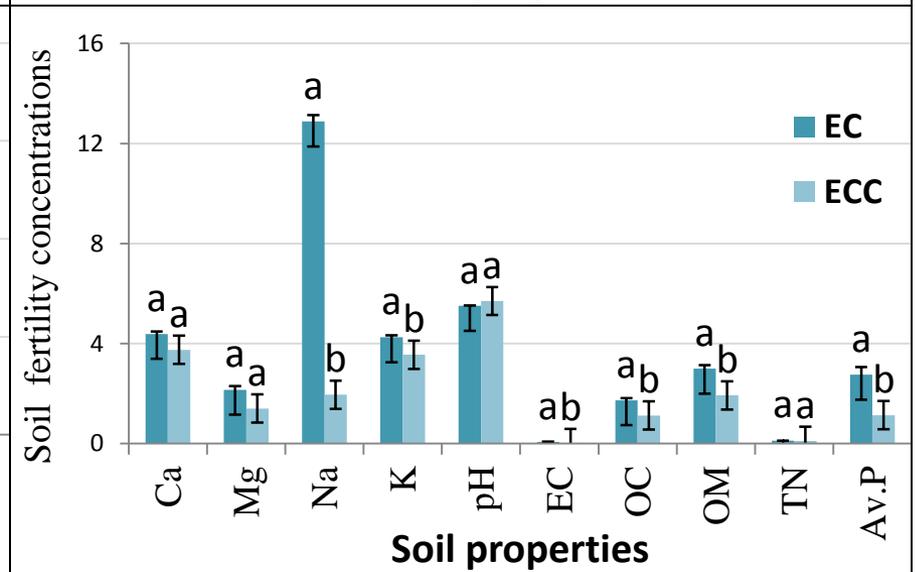
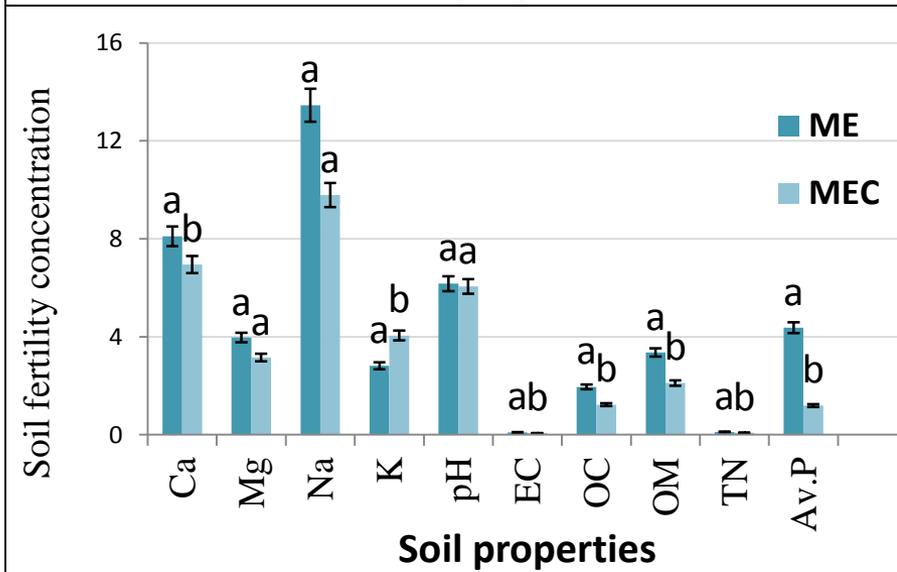
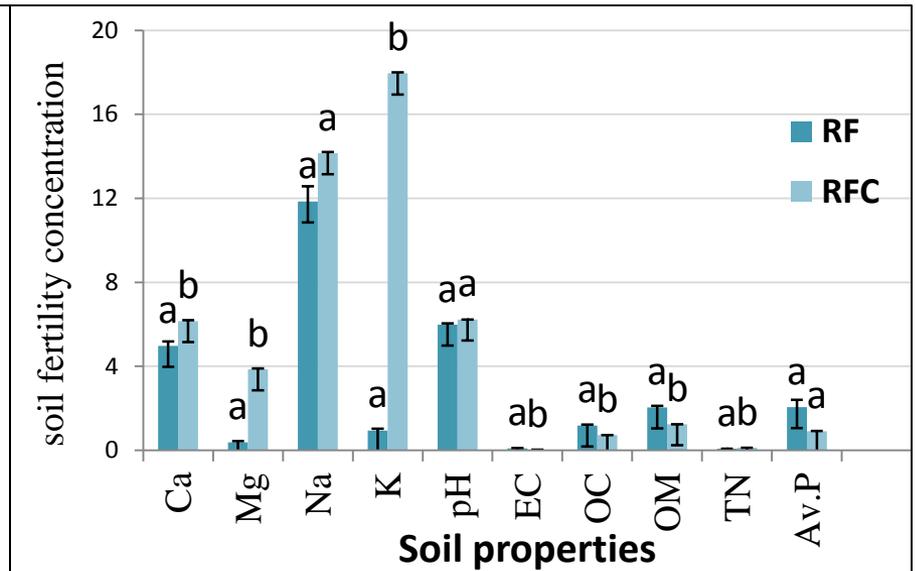
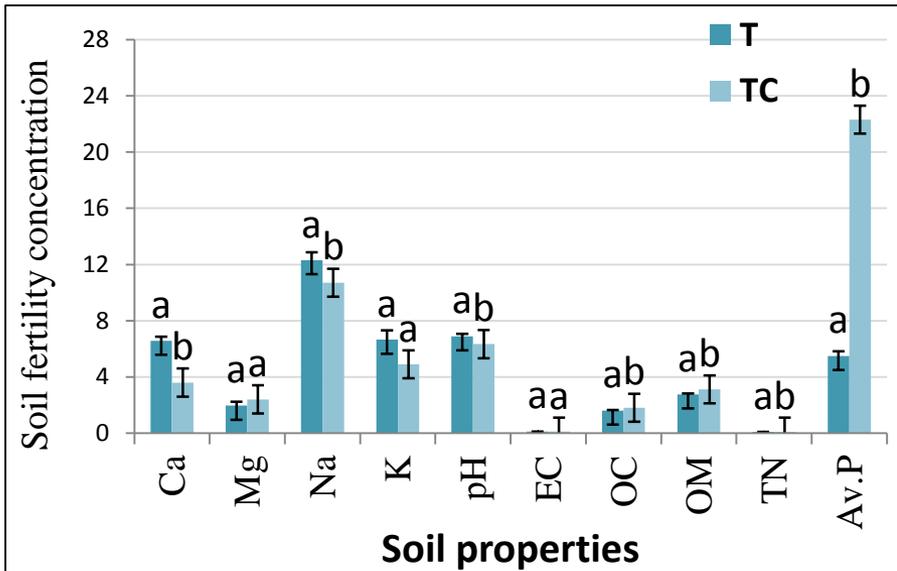
Soil aggregate size distribution and stability



Cont...

- Relatively high proportion of large stable aggregates size in both Teshi and Ruba-Feleg hillside farming sites than the control sites; . **better soil management practices and better cover.**
- But, low proportion of aggregates size in both ME and EC hillside farming sites were found than the control sites; **disturbances and poor** soil management
- The benched area is also frequently **disturbed** which results in further soil disturbance and break down of soil aggregates.

Soil Chemical Properties



Cont...

- Though bench terraces play important roles for conserving soil, it has some negative consequences on soil nutrients during the **first few years**.
- This is inline with Andrew et al., (1995) and Tadesse et al. (2016) that suggested terraces area remain with poor physical characteristics (structure, aggregate stability and tendency to soil crusting) for the few years after construction.
- Therefore, this problem could be reversed in a short time if **proper soil fertility management practices** such as application of manure, compost and addition of organic materials.

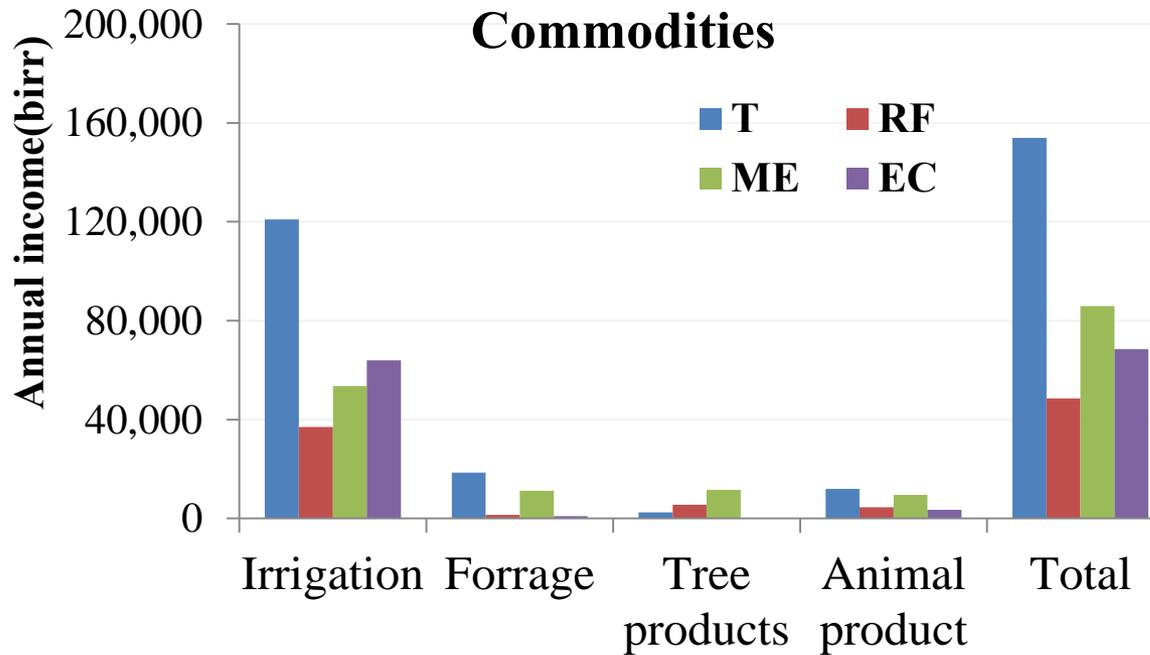
Cont...

- The higher SOM content, TN and Av.P in hillside farming sites is due to soil management practices, erosion reduction and biomass accumulation (Million, 2003).
- Mulugeta & Stahr (2010) also found **higher SOM** content (3.69%) for conserved catchment as compared to non- conserved one (2.24%).
- Whereas the **lower SOM, TN and Av.P** in some hillside farmings is due to soil disturbance and poor soil fertility management practices (Siriri et al., 2005; Yihenew; 2007).
- The **higher concentrations of basic cations** in the hillsides farming are due to the conservation and deposition effects of the bench terraces

Cont...

- The over all soil fertility analysis showed that some of the hillsides farming sites are less fertile than their controls due to top soil rich in nutrient is **turned down during cut and fill.**
- While some of the hillsides farming sites have shown a better soil fertility than the control sites due to **better short term soil fertility managements.**
- This bench terrace installation is a promising technology in mountainous area; reduce erosion and create suitable environment for hillside agriculture
- The promotion of bench terraces in combination with **irrigation practices** and **improved soil management** might prove productivity of hillside areas
- Mountain development is an opportunity for **NRM** of the **marginal lands** and is an **employment** for landless young people in the rural.

Socioeconomic contribution of hill side farming



The opportunities developed in the studied hillside farmings are;

- Degraded communal land start to become productive
- Conserve soil and water and prevent land degradation
- Many landless youths have got access for land and started introducing income generating activities and produce cash crops
- Help youths to become stable in their locality,
- Contribute to provide irrigation products to local markets.

The main challenges of the studied hillside farmings are;

- Shortage of water lifting devices,
- Topographic difficulties to access for water,
- Less input to enrich the fertility of the land (manure planting materials),
- Low soil fertility due to burying of top fertile soils,
- Less extension services,
- Less capital
- Less inputs such as fertilizer, motor pumps, seeds/seedlings etc.

Photos, 2017



Photos, 2017



Photo, 2017



Photos, 2017



Photos: Feb 26, 2017



Photos ; 24, 2017



Remarks

- Though, the hillside farmings have the above problems, their contribution to economy of the landless youths is **promising**.
- This terracing is regarded as a major **adaptive strategy** for land use in mountainous and hilly areas (Ramos et al., 2007)
- Provide different **functions** such as; reduce runoff and conserve moisture, reduce soil loss, increase crop yield and increase income.
- Bench terraces have a great role for **enhancing food security** and sustainable NRM.

Conclusion

- The variation in soil properties among treated **hill-slopes and control** sites; this is attributed mainly to soil disturbances during terraces installation.
- Bench terrace constructions with some improvement on soil fertility at the beginning of hillside farming practices is a good option for changing most **unproductive mountains of Tigray** into productive ones.
- Beside reducing soil erosion rate, hillside treatment using bench terraces contribute towards increasing cropped area through transforming hill-slopes into **suitable environment for agriculture** development.
- We recommend further study on **economic aspects** of terraces including quantifiable economic returns and **environmental services of terrace** implementation in the region with short, medium and long-term.

Thank you