



# Respiration and priming effect in different land use types in semi-arid area of northern Ethiopia

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## Introduction

- The addition of easily available organic substances to soils may strongly change the turnover of native soil organic matter (SOM) through alteration of soil microbial activity, in turn accelerating (positive PE) or retarding (negative PE) C release from soils (Kuzyakov 2010).
- Thus, PE in these semi-arid C-limited land use systems could be linked to the capacity of the soils to function as source or sink of atmospheric CO<sub>2</sub> based on the response and activity of the soils microorganisms.

## Material and methods

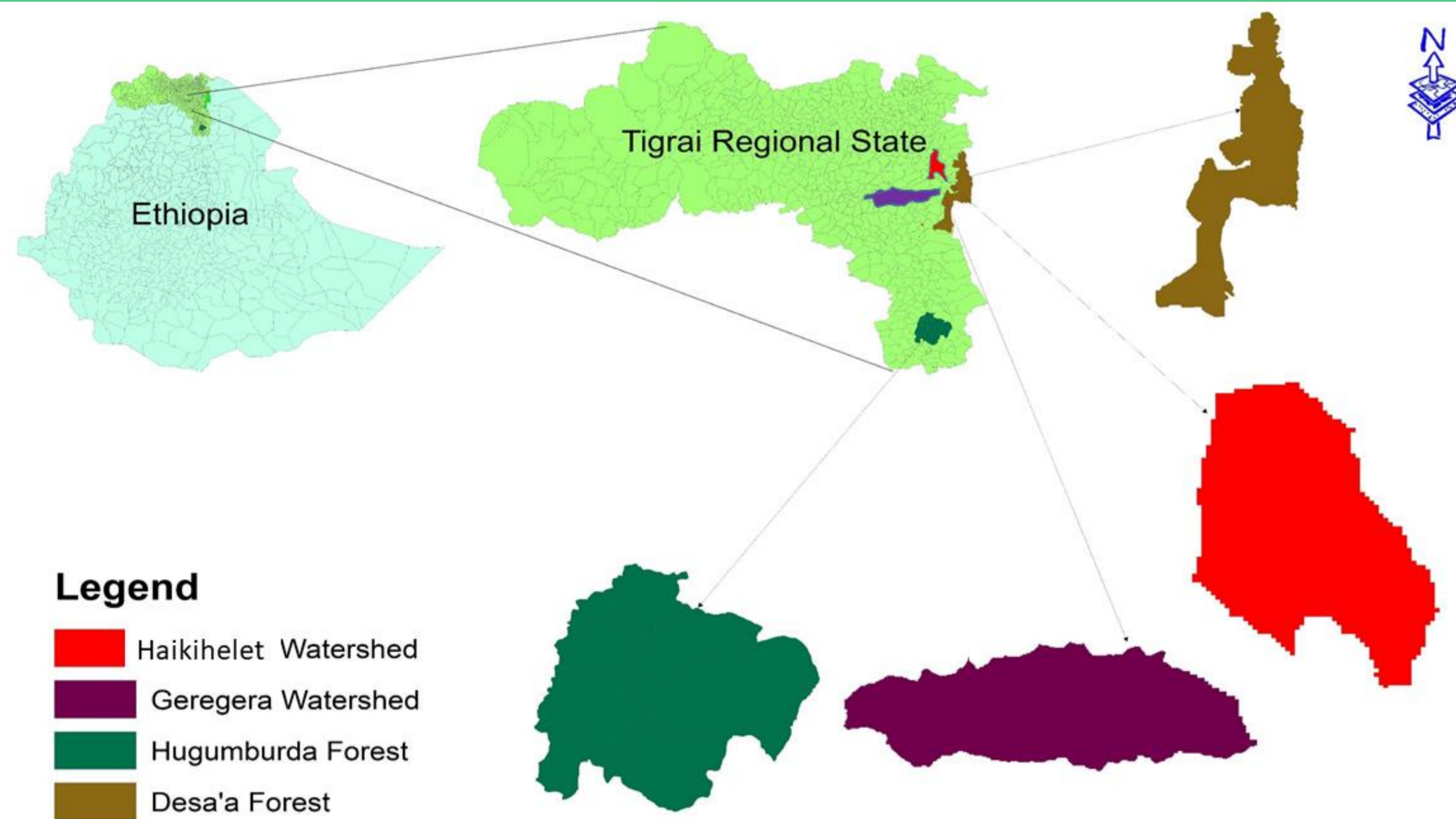


Figure 1 : Location map of the study area

### Land use types/soil types across locations

#### Desa'a and Hugumburda

- Forest, Grazing land and Cropland

#### Geregera and Hugumburda

- Exclosure, Grazing land and Cropland

#### Soil sampling

- 0-30, 30-60, 60-90 cm, in 3 replicates
- 23 days incubation period

#### Analysis

- Microbial biomass carbon and nitrogen
- Total carbon and total nitrogen
- CO<sub>2</sub> measurement

#### Calculation

$$PE = (Total\ CO_2 - substrate\ derived\ CO_2)_{AS} - (Total\ CO_2)_{CS} \quad Eq. (1)$$

where the subscripts AS and CS indicate amended soil with substrate and control soil, respectively.

## Results and Discussion

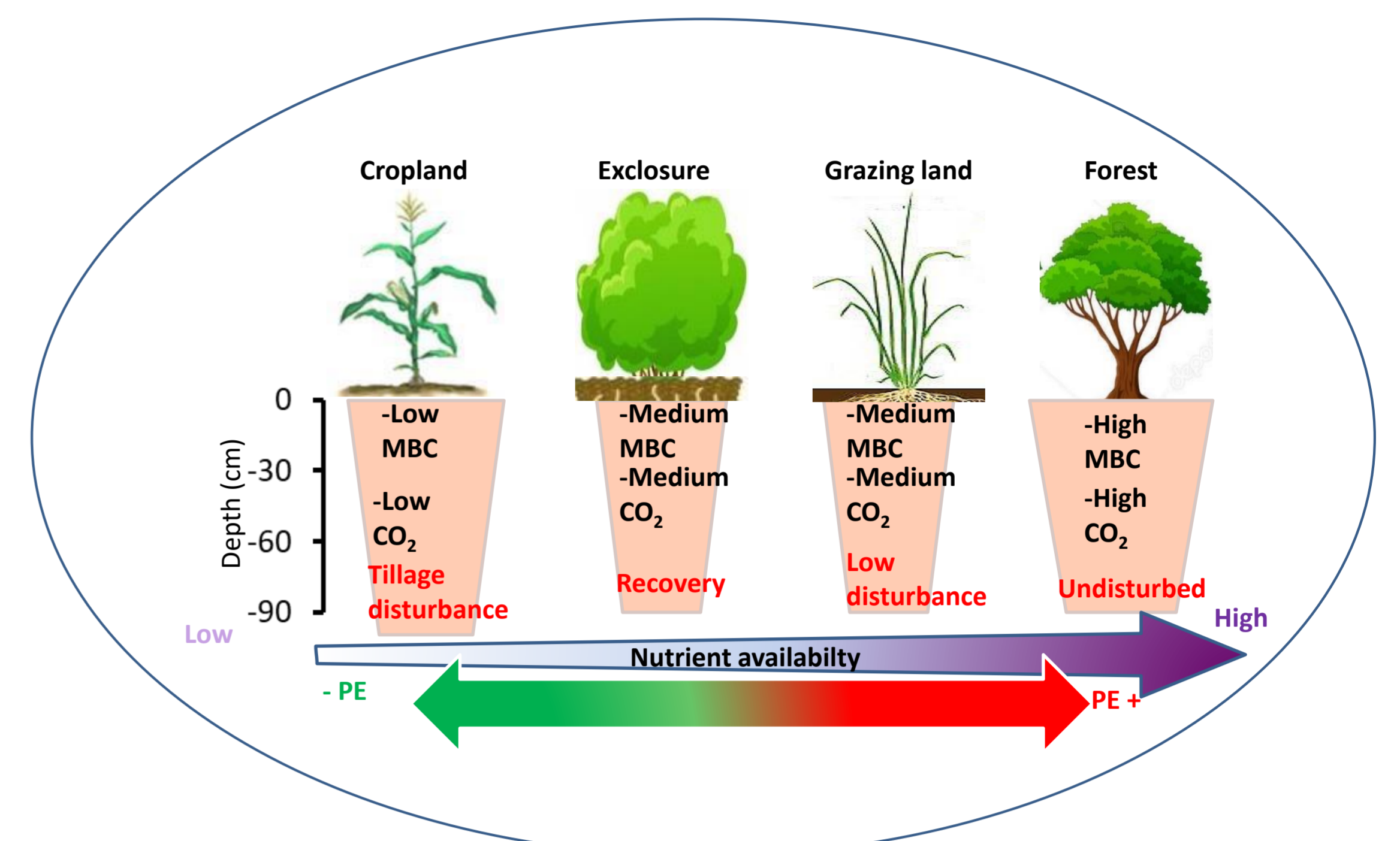


Figure 2: Conceptual diagram summarizing respiration and priming effect (PE) under different land use types in semi-arid area of northern Ethiopia

- The CO<sub>2</sub> respired was 30–63% lower in sub than in topsoil with most expressed depth gradients in croplands.
- The temporal dynamics of PEs involved a strong positive peak for the first five days after glucose addition and a second smaller peak 10 days after glucose addition in natural ecosystem, corresponding to apparent and real PE, respectively.
- The weak negative PEs in subsoil is an indication of highly stabilized C.
- Lack of positive correlation between PEs and C/N ratio ruled out the N-mining hypothesis, but a positive correlation between PE and MBC suggests co-metabolism as possible mechanism behind the real PE (Okolo et al. 2022).
- Higher priming in natural ecosystem compared to cropland is an indication that conversion of natural ecosystem to continuous cropping system leads to depletion of the “primable” C pool in dryland soils.

## Conclusion

- Highest priming effects was induced in forest soils with least occurring in cultivated lands.
- Organic matter decomposition was more pronounced in topsoil, with lower respiration rates at depth due to labile C depletion.
- N-mining hypothesis could not explain patterns of priming effect in semi-arid soils, instead it was related to microbial biomass.

## References

Kuzyakov, Y. (2010) Priming effects: Interactions between living and dead organic matter. *Soil Biol Biochem* 42:1363–1371

Okolo, C.C., Bore, E., Gebresamuel, G., Zenebe, A., Mitiku, H., Nwite, J. N., Dippold, M. A. (2022). Priming effect in semi-arid soils of northern Ethiopia under different land use types. *Biogeochem.* 158, 383–403