How do soil organic carbon stocks vary within forest and following conversion to other land uses?
A study in an afromontane landscape

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Introduction

- Soils-largest OC reservoirs in the terrestrial C cycle -3 times more carbon than vegetation & 2 times the atmosphere (Batjes and Sombroek, 1997)

- C storage in soil is the balance of ecological processes (Sun *et al.*, 2004)

- Spatio-temporal variation of SOC is influenced by environmental factors e.g. topography, parent material, soil depth, and land use/cover (Fu *et al.*, 2004)

- Conversion of natural vegetation for agric. affects SOC quantity (Cotler and Ortega-Larrocea, 2006)

- With advances in climate change mitigation through REDD emphasis has been put on above ground carbon (Cerbu *et al.*, 2010) and little attention given to carbon stocks below ground (Navar, 2009).

- This may be explained by lack of substantial data on SOC stocks (Gibbs *et al.,* 2007).

- This study assessed SOC stocks in a protected forest landscape of BINP and the adjacent land uses/cover types, analyzed as the effect of forest cover change on SOC stocks.
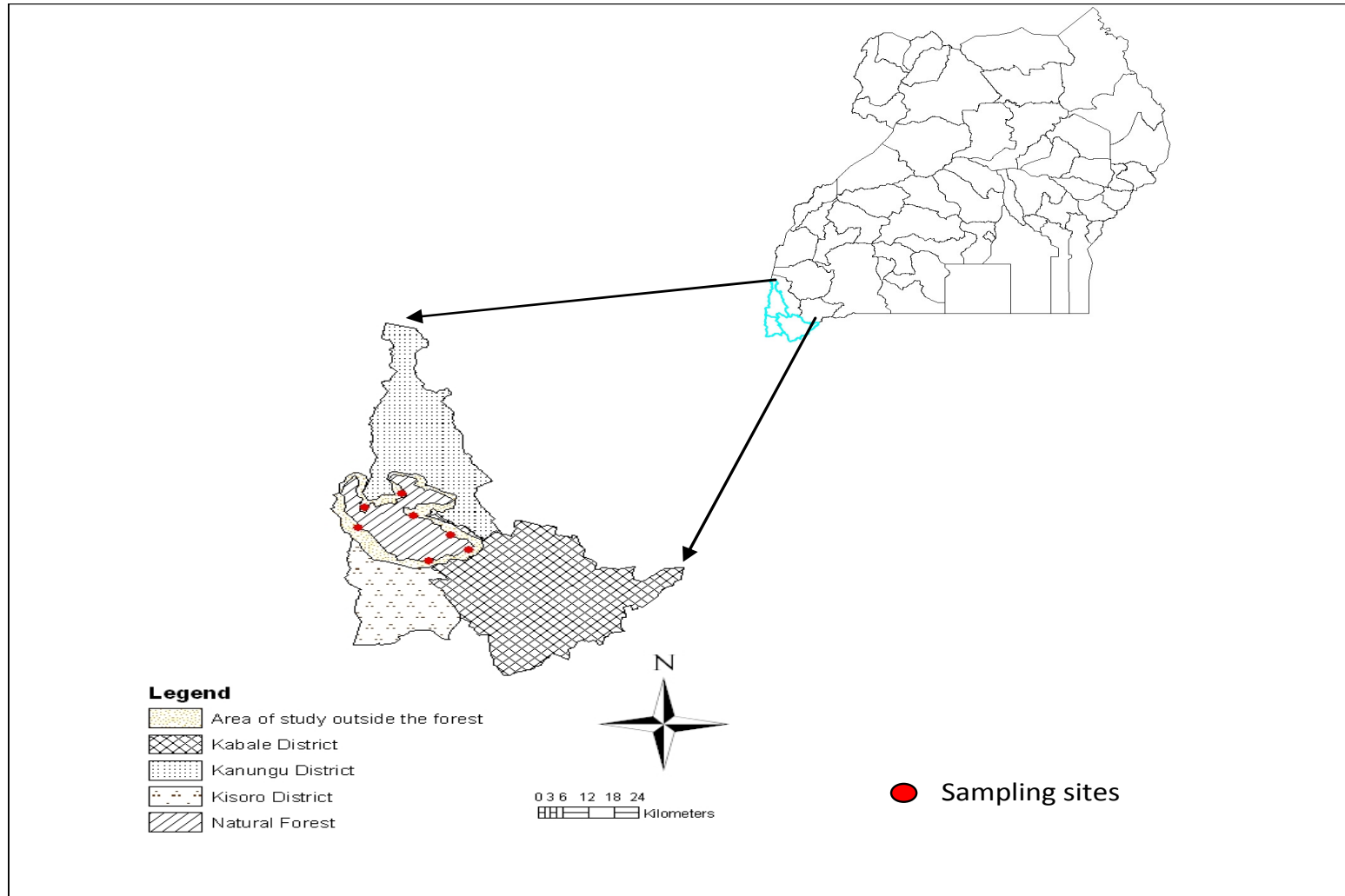
Methods
Study area

Figure 1. Map showing location and sampling areas around Bwindi Impenetrable Forest, SW Uganda
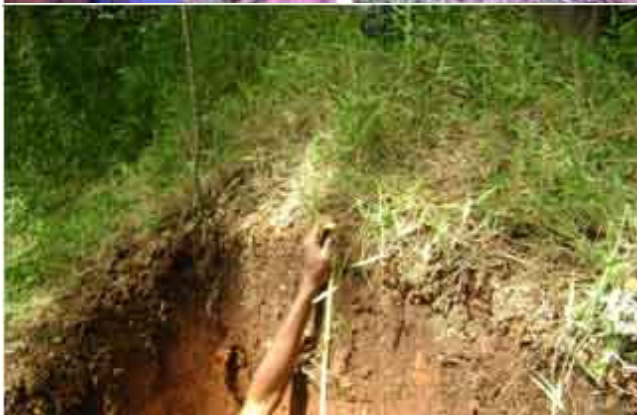
Design

- Paired sites used for sampling – for comparison
- Forest paired with; Tea, Potato, Grazing land
- 108 sites sampled
- 3 reps for each pair (F&T, F&Po, F&G)
- 4 slope faces; N, S, E, W
- 2 slope positions (Back slope and foot slope)

Soil Sampling

- Sampling plots 20m by 50m per site
- 5 samples from each plot-obtained at 0-15 and 15-30cm using-soil auger
- Samples pooled -composite sample for C content determination per depth
- 192 composite samples collected
- Profile pit in each LUT-characterise soils

Lab analysis

- Soil samples were air-dried, pound & passed through a 2mm sieve.
- Soil–bulk density- determined using the constant head method
- SOC - determined by dry combustion

Data analysis

- Data was analysed using two sample non parametric test (Wilcoxon matched pairs test) in Genstat statistical package (version 3).

- Values for $p<0.05$ were considered significant.

Results

Mean SOC and soil bulk density in each land use

Land use/cover	Mean Bulk density ±C.I (g/cm^3) at 0-15cm depth	Mean SOC±C.I (Mg/ha) at 0-15cm depth
Forest	0.85±0.12	65.9±15.9
Tea	1.04±0.13	69.7±12.6
Potato	1.01±0.16	75.5±10.1
Grazing land	1.14±0.17	87.4±26.8

Land use/cover	Mean Bulk density ±C.I (g/cm^3) at 15-30cm depth	Mean SOC±C.I (Mg/ha) at 15-30cm depth
Forest	0.86±0.12	71.1±22.9
Tea	1.05±0.12	69.5±15.3
Potato	1.02±0.16	71.7±10.8
Grazing land	1.15±0.17	75.9±17.9

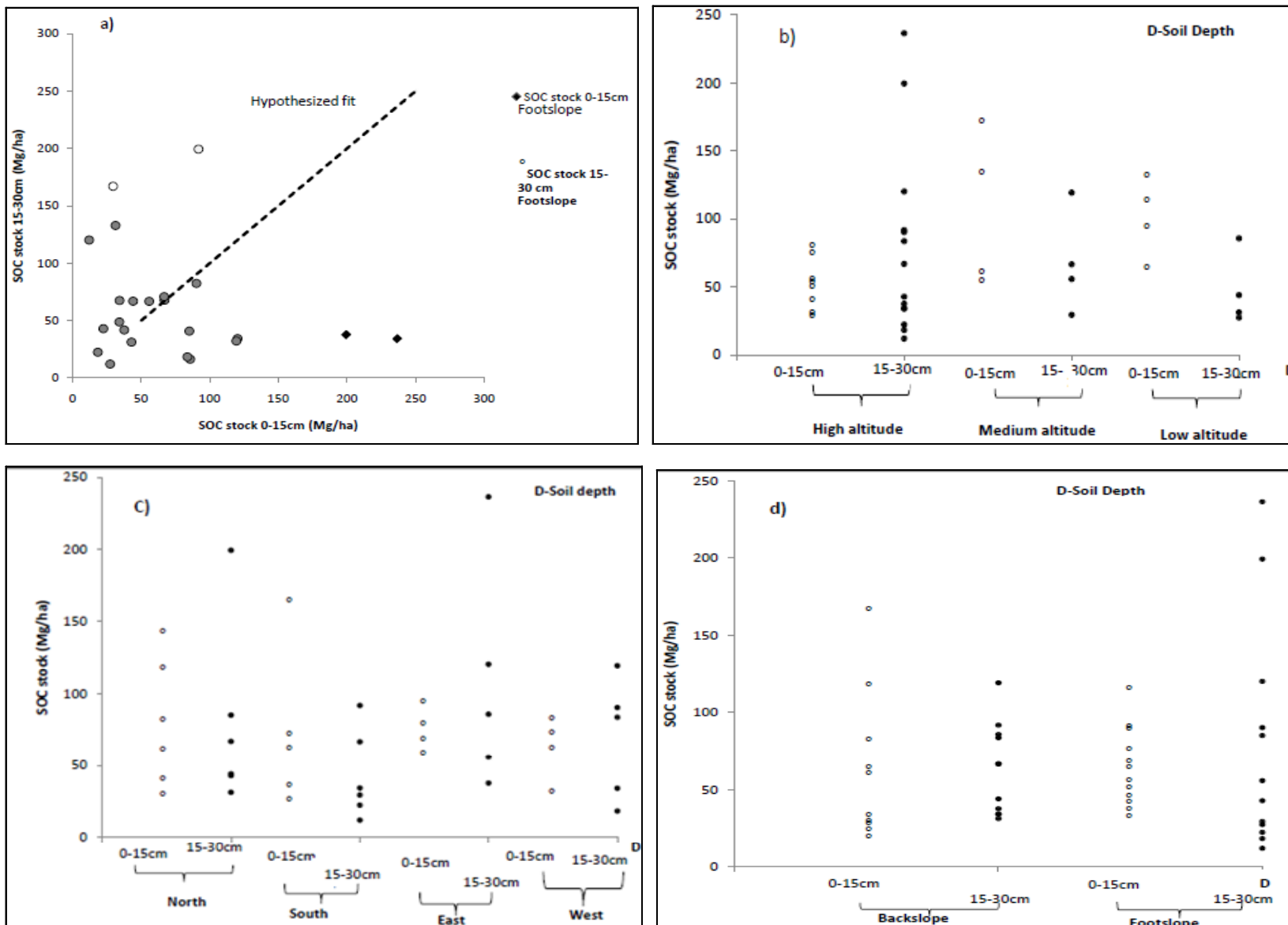| Land use/cover	Mean Bulk density ±C.I (g/cm^3) at 0-30cm depth	Mean SOC±C.I (Mg/ha) at 0-30cm depth
Forest	1.00±0.08	68.6±14.0
Tea	1.02±0.11	69.6±10.0
Potato	1.04±0.09	79.7±19.0
Grazing land	1.14±0.12	78.8±17.0

How does SOC vary within Forest landscape?

Figure 2. Variation of SOC stock in forest; a) Relationship between SOC in 0-15cm and 15-30cm (poor correlation); b) The effect of altitude; c) The effect of aspect; d) The effect of landscape position.

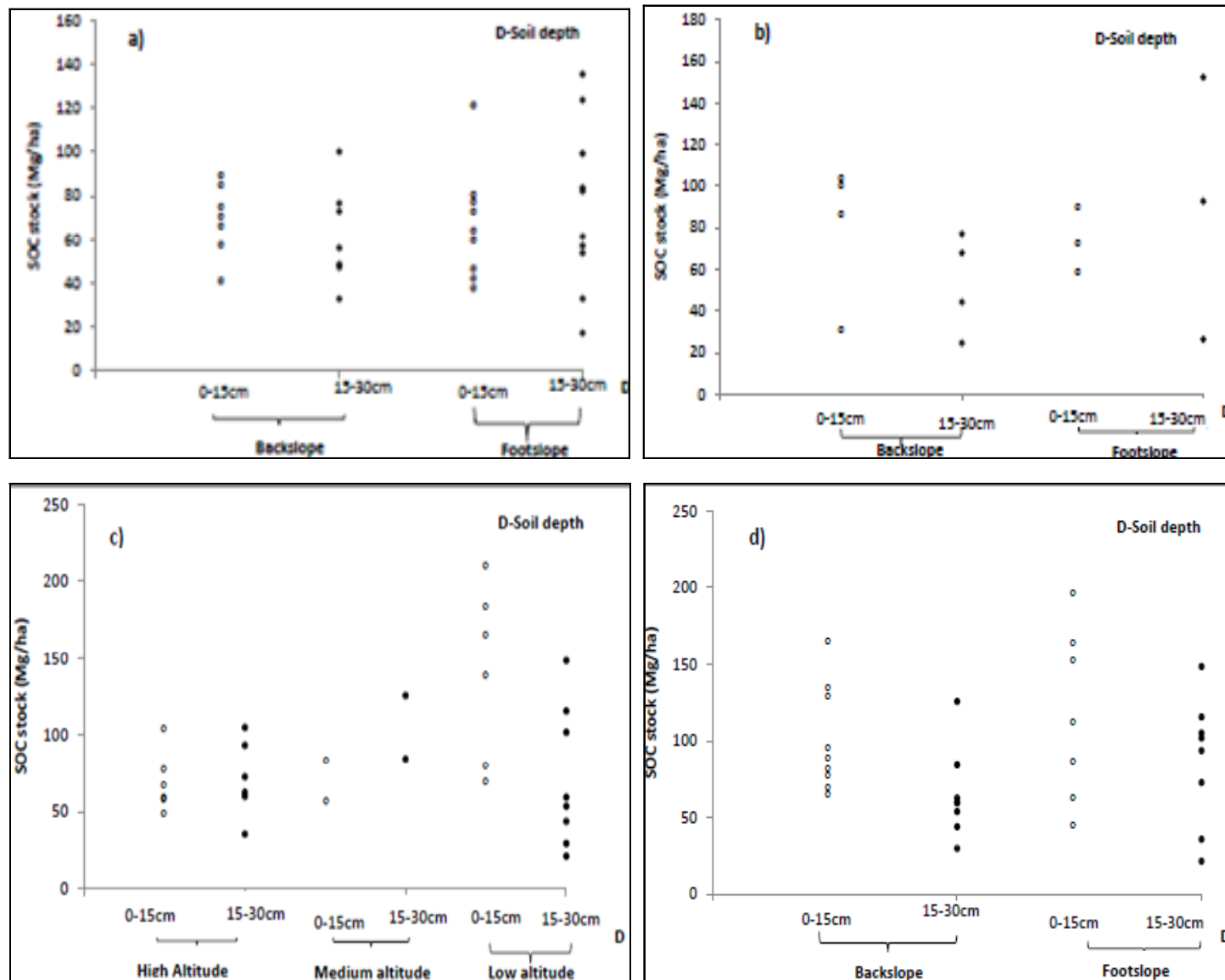# How does SOC vary in other land uses?

Figure 3. Variation of SOC stock under other land uses; a) Tea plantation; effect of landscape position; b) Potato fields; effect of landscape position; c) Grazing land; effect of altitude; d) Grazing land; effect of landscape position.

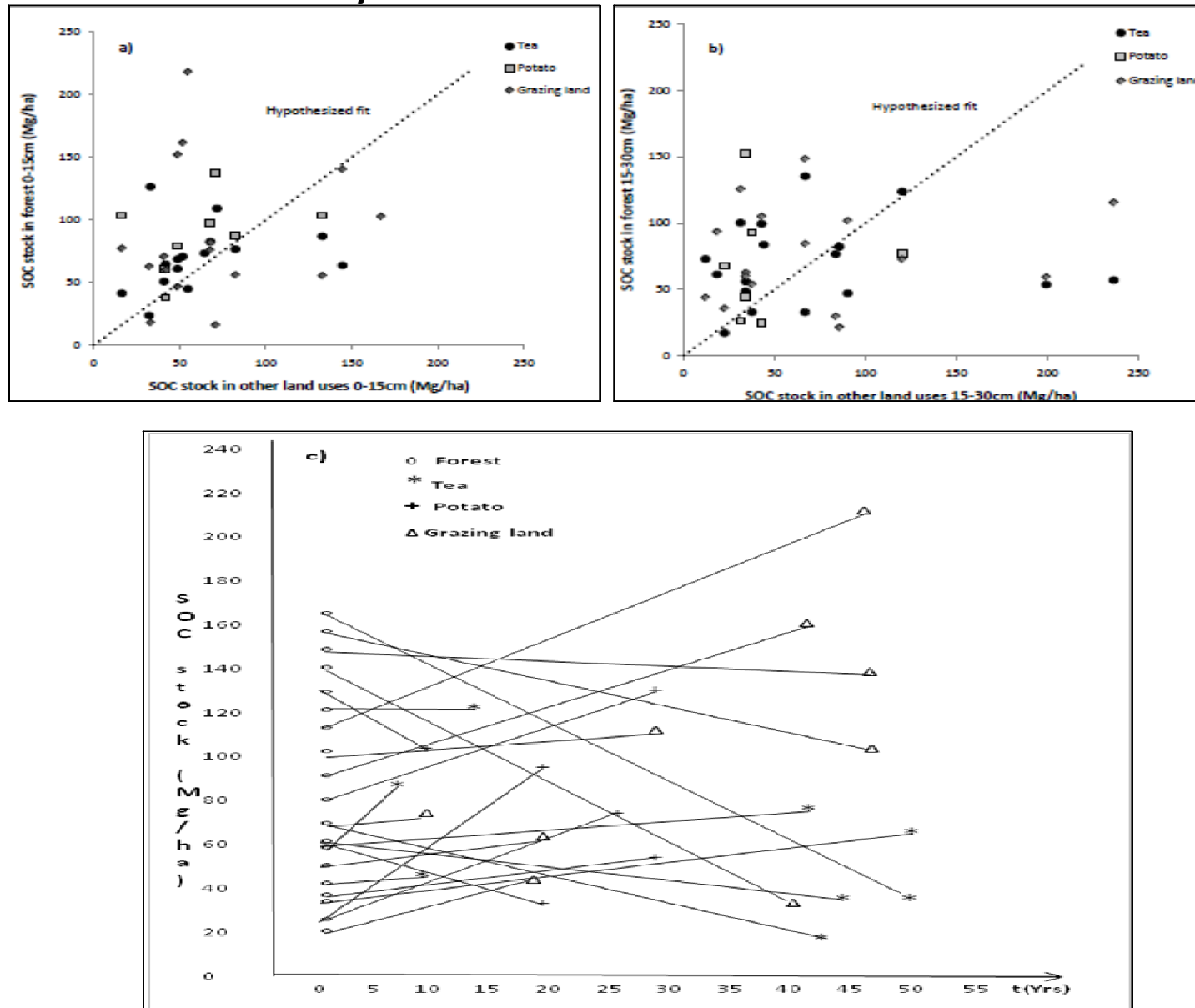# How does SOC vary as a result of forest conversion to other land uses?

Figure 4. How SOC stock changes with forest conversion; a) Forest conversion to other land uses at 0-15cm depth; b) Forest conversion to other land uses at 15-30cm depth; c) SOC stock change against time-since-conversion, in paired sites.

Discussion

- Study provides novel insights on SOC stocks of the forest and converted land uses

- SOC stocks are generally higher than those recorded in many other regions

- There is higher site to site variation compared to comparison of means of the paired plots-terrain effects

- Foot-slopes had higher SOC stocks than back-slope due to nutrient accumulation -soil erosion in the upper slopes

- Several studies showed loss in SOC following forest conversion-not so for Bwindi

- Where higher differences occurred may be due to differences in bulk density.

- Soil depth and landscape positions had significant effects on SOC stocks.

Thanks for listening