INFLUENCE OF LANDUSE ON ORGANIC MATTER DISTRIBUTION IN SOIL AGGREGATE SIZE FRACTIONS IN ILE-IFE, SOUTHWESTERN NIGERIA

By

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INTRODUCTION

- **The importance of soil organic carbon (SOC)**

- Soils of tropical and subtropical forests account for almost 30% of total global SOC (FAO, 2005)

Three proposed mechanisms for SOC stabilisation are:

(1) incorporation of SOC in soil aggregates that establishes a barrier between microbes, microbial enzymes, and organic matter substrates;

(2) preservation of SOC through inherent biochemical recalcitrance, or selective degradation into chemically resistant materials during microbial decomposition; and

(3) sorption, precipitation, or complexation of SOC with the mineral matrix via intermolecular interactions that reduce the availability of substrate through changes in conformation and binding of functional groups.

(Christensen 1996; Sollins *et al*. 1996; Jastrow and Miller 1998; Baldock and Skjemstad 2000; Six *et al*. 2002*a*; Krull *et al*. 2003).

- Carbon sequestration in soil and quantification of for C trade schemes (CDM)
- The dynamics of SOC by physical protection.

SOIL AGGREGATION

- The Heirachical model (Oades, 1993).
- This model has not been clearly confirmed by studies on aggregate fractionation (de Sa et al., 2000), maybe due to variations in methods employed for soil fractionation (Ashman et al., 2003).
- Soils with different clay mineralogy were observed to respond differently to fractionation, and aggregate hierarchy exists only in soils where aggregate stability is controlled by organic materials (Oades and Water, 1991).

JUSTIFICATION

There is currently limited knowledge of which mechanisms are most important for C storage under different soils and land-use systems, yet such knowledge is crucial for devising systems with efficient C sequestration, hence this study.

THE SPECIFIC OBJECTIVES

- **To evaluate the influence of land use type on organic carbon distribution in soil**
- **To investigate the potential of different soil aggregate fractions to protect organic carbon in soils**
- **To study the relationships between soil organic and the stability of soil aggregates**

MATERIALS AND METHOD

- The experimental area was in the Teaching and Research Farm of Obafemi Awolowo University, Ile Ife (7°25'N, 4°39'E), Nigeria.
- The soil belong to the Iwo Association and were derived from coarse gneiss and granite.
- The texture varied from sandy loam to sandy clay loam.
- Seven land use types were selected viz: Forest, Cacao, Teak, Oil palm, Pasture, No Tillage (NT) and Continuous Conventional tillage (CT).
- Sample locations were mid-slope positions in all land use types
- Composite soil samples (40 subsamples) were taken in the different land use types at depths of 0-15 cm (topsoil) and 15-30 cm (subsoil).
- They were air dried, gently crushed by hand, and carefully sieved into size fractions of 1-2, 0.5-1, 0.25-0.5, 0.125-0.25, 0.05-0.125, and <0.05 mm.
- Organic C and total N were determined in each size class using the Multiphase LECO RC-412 C analyzer and the FP-528 N analyzer respectively.
- Water stable aggregates were evaluated by a modified Yoder method

RESULTS AND DISCUSSION

Table 1: The topsoil (0-15 cm) physical properties under different land use types

Land use	0-15 cm				
	pH	Sand (0.02-2 mm)	Silt (0.002-0.02 mm)	Clay (<0.002 mm)	Texture
No tillage	6.36 a	70	20	10 ab	LS
Cont. Tillage	5.88 ab	78	14	8 b	LS
Forest	6.76 a	66	21	14 a	L
Oil palm	5.95 ab	63	22	15 a	L
Teak	6.12 a	69	20	11 ab	LS
Cocoa	6.98 a	64	22	14 a	L
Pasture	5.65 ab	64	23	13 ab	LS

Means in the same coloumn followed by alphabets are statistically not different at 95% probability

Table 2: The subsoil (15-30 cm) physical properties under different land use types

Land use	15-30 cm				
	pH	Sand (0.02-2 mm)	Silt (0.002-0.2 mm)	Clay (<0.002 mm)	Texture
No tillage	6.20 a	77 b	14 bc	9 b	LS
Cont. Tillage	5.82 a	87 a	11 c	2 c	LS
Forest	6.76 a	64c	23 a	13 a	L
Oil palm	6.00 a	64c	23 a	13 a	L
Teak	6.26 a	67c	19 ab	14 a	L
Cocoa	6.95 a	67c	20 a	13 a	L
Pasture	5.71 a	66c	24 a	10 b	LS

Means in the same coloumn followed by alphabets are statistically not different at 95% probability

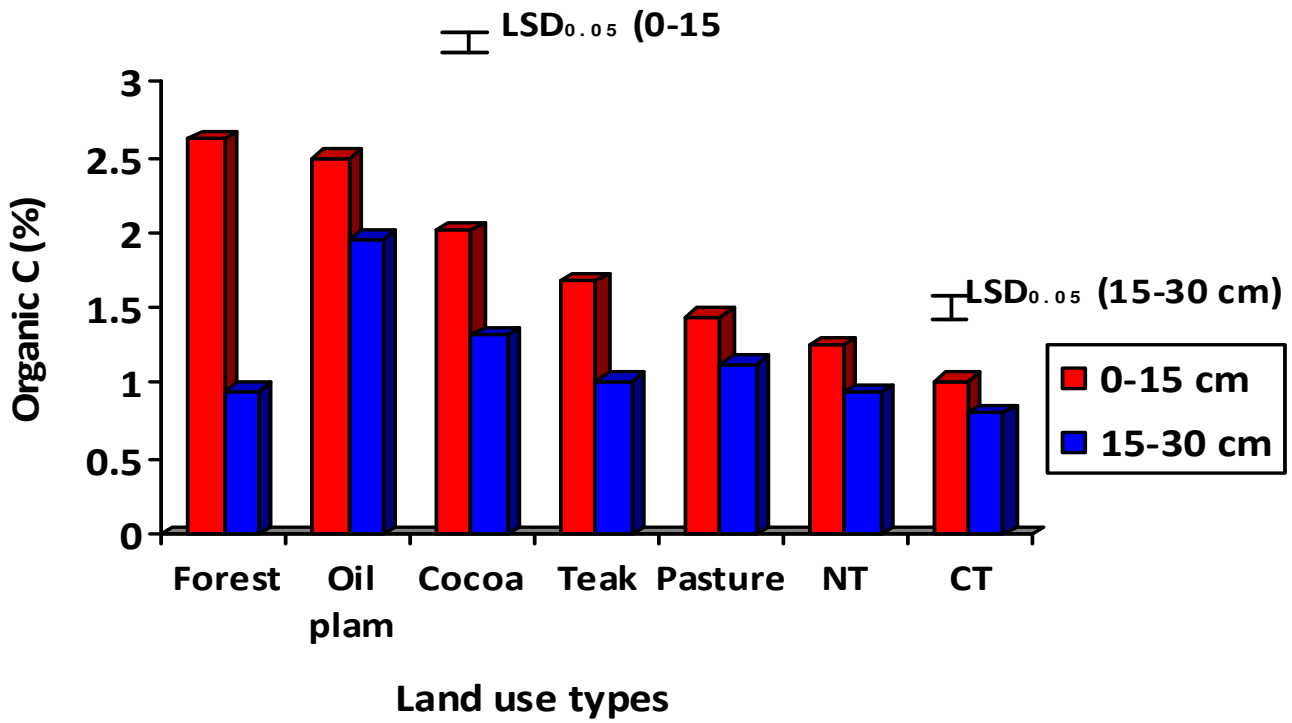


Fig. 1: Distribution of soil organic C under different landuse types.

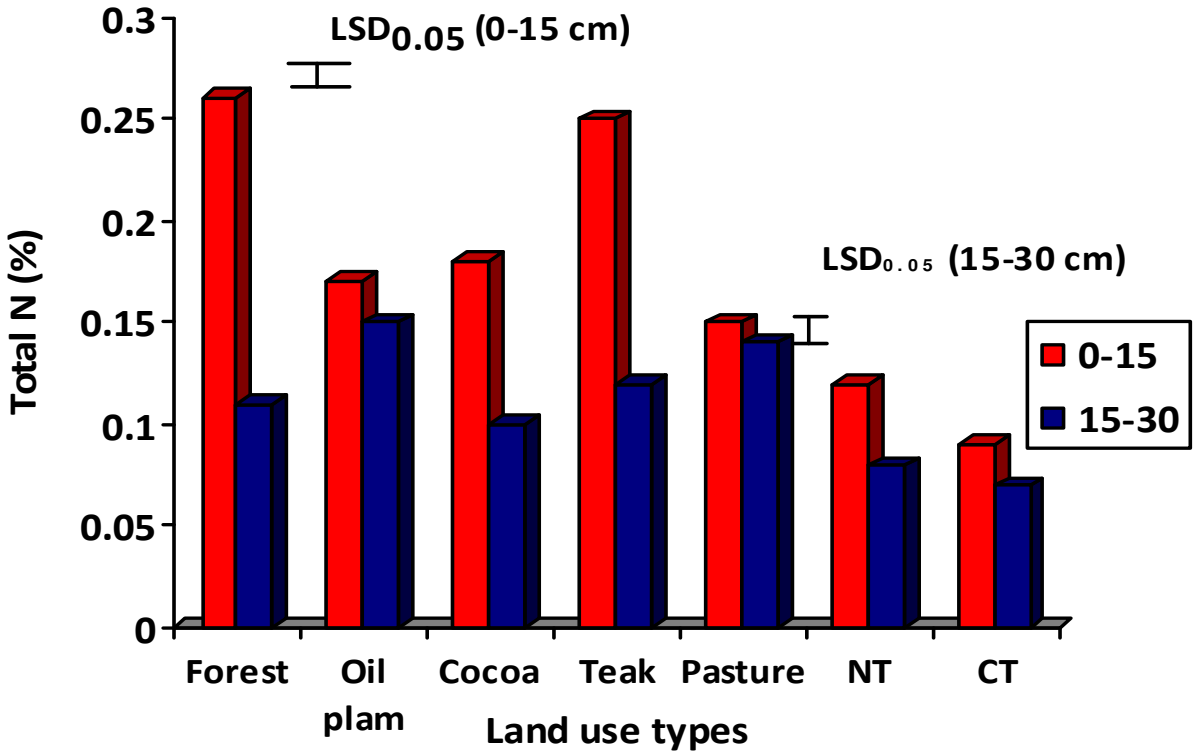


Fig. 2: Soil distribution of total N under different landuse types.

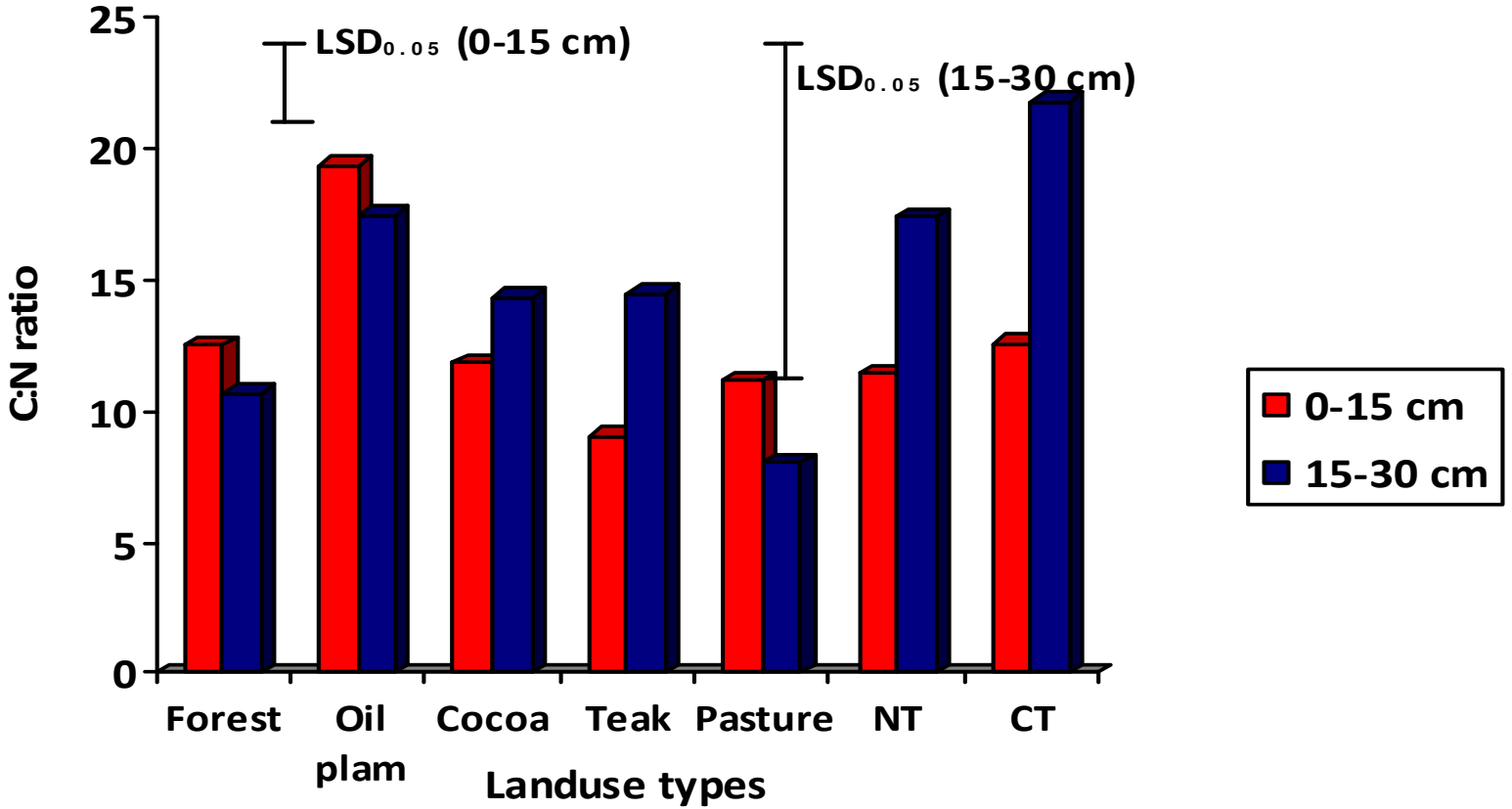


Fig. 3: Soil C:N ratio distribution as influenced by land use types.

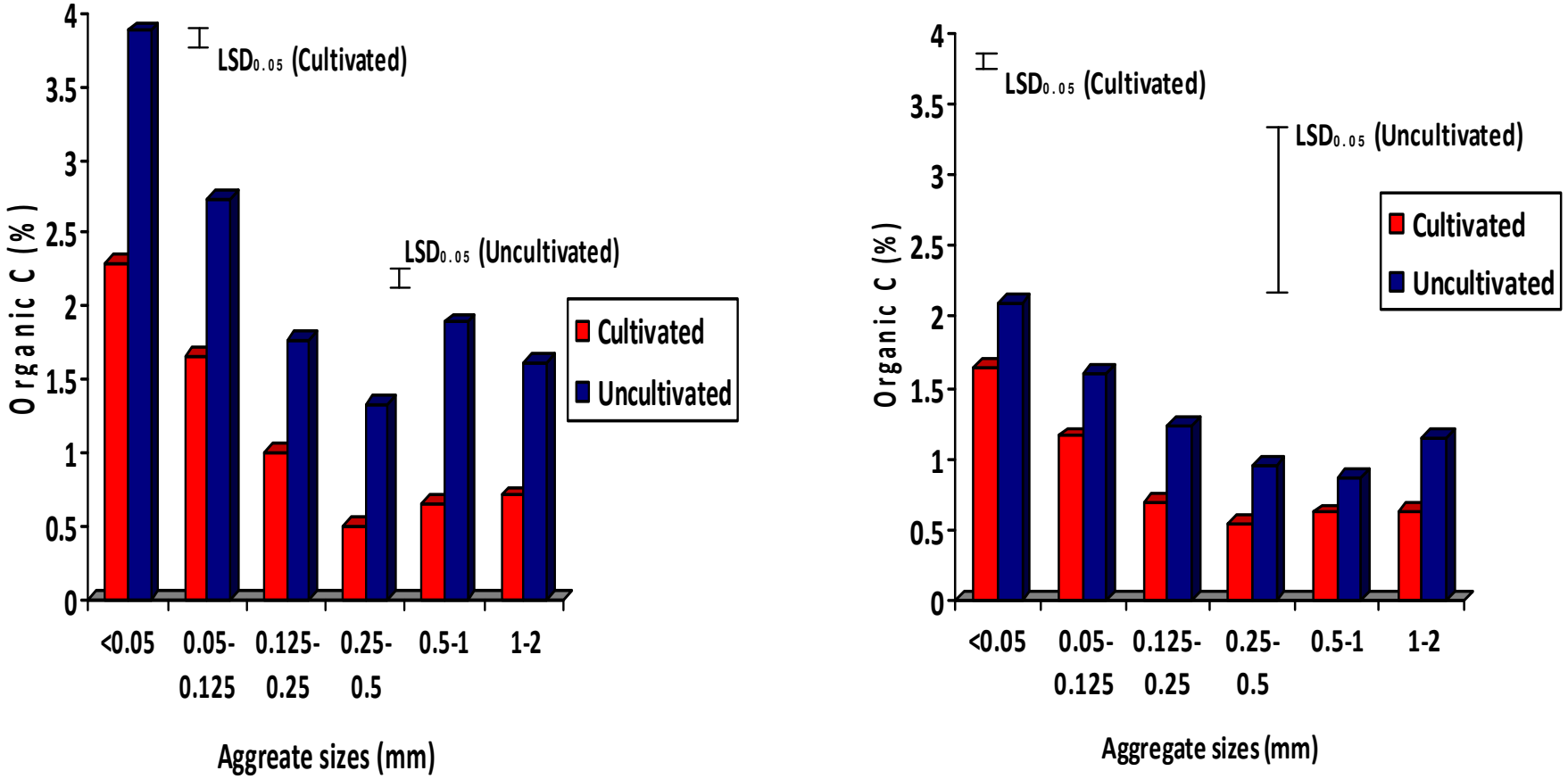
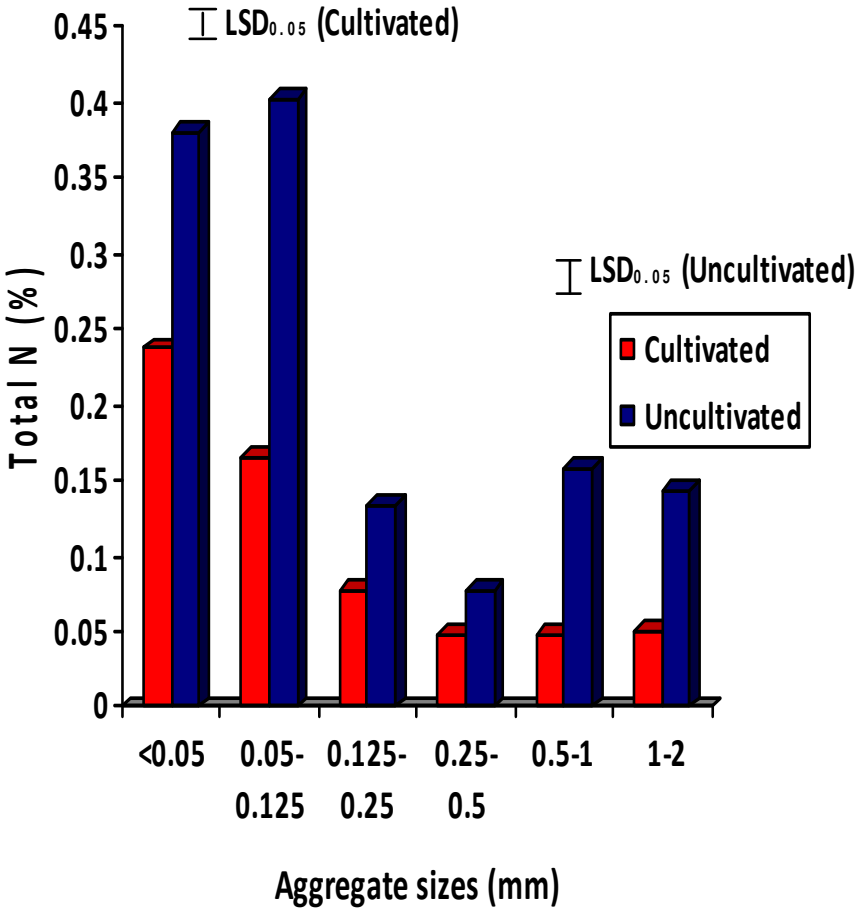


Fig 4: Organic C distribution in aggregate size fractions as influenced by cultivation in (a) topsoil (0-15 cm) and subsoil (15-30 cm)



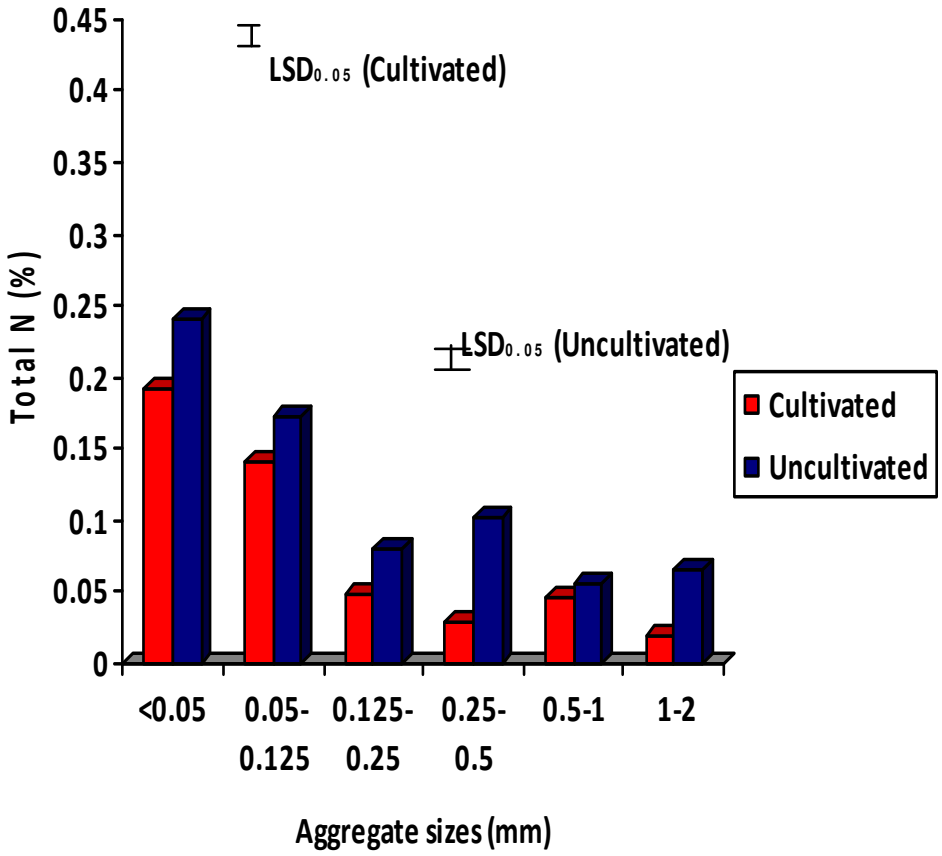


Fig 5: Total-N distribution in (a) topsoil (0-15 cm) and (b) subsoil (15-30 cm) aggregate size fractions as influenced by cultivation

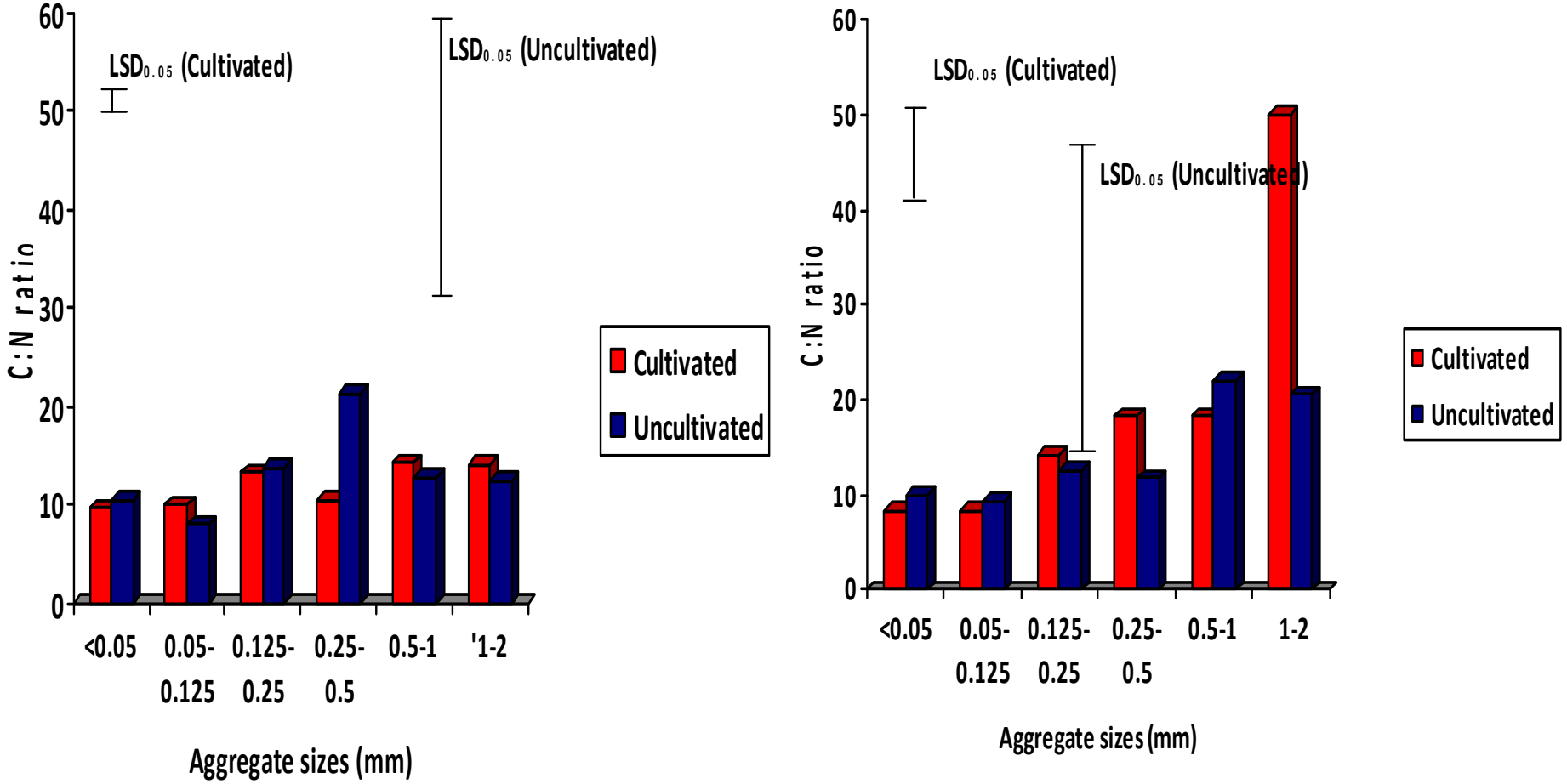


Fig 6: The distribution of C:N ratio in (a) topsoil (0-15 cm) and (b) subsoil (15-30 cm) aggregate size fractions as influenced by cultivation

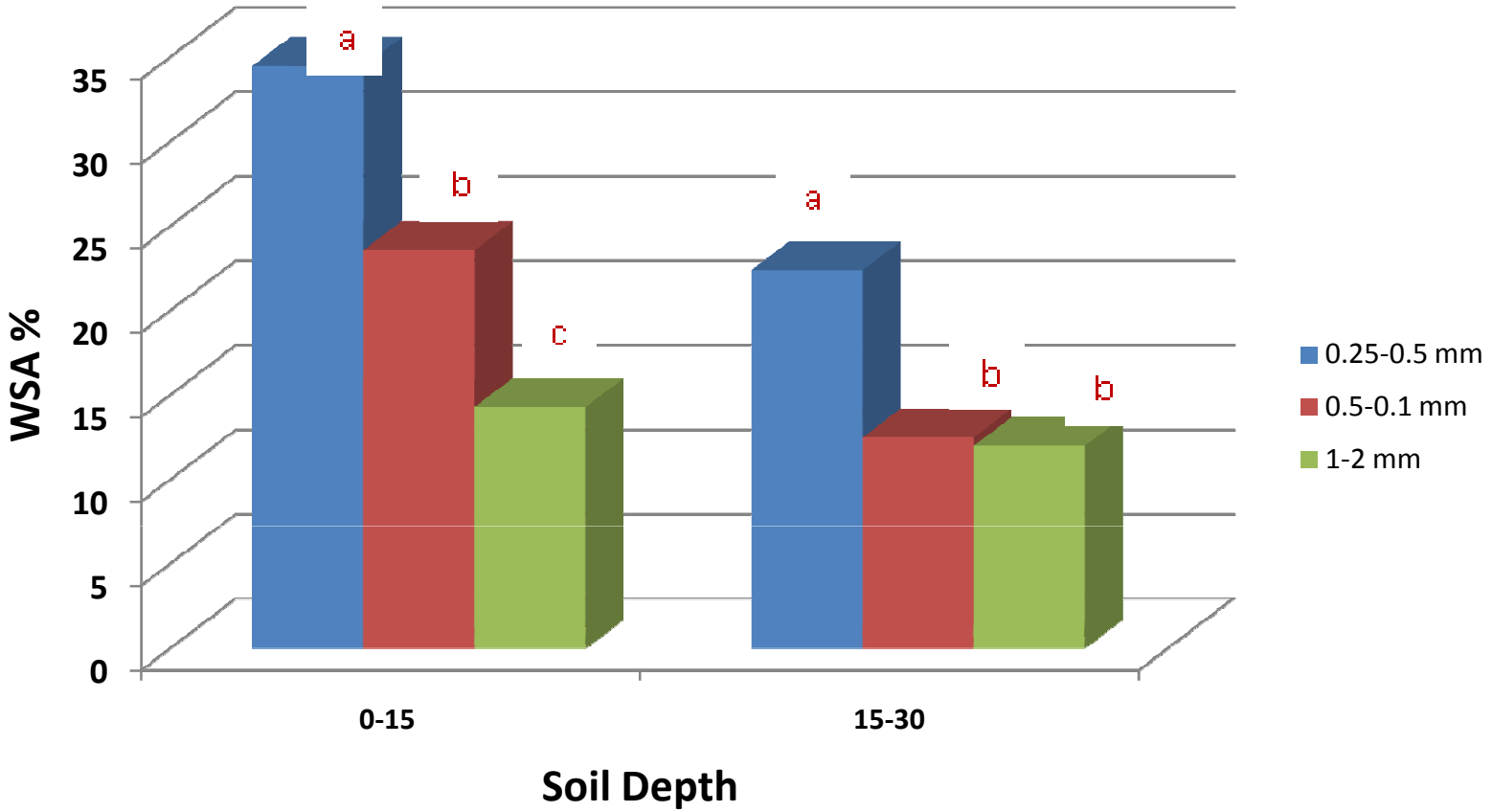


Fig 7: Stability of different aggregate size fractions

Table 3: Effects of land use on water stable aggregates of different sizes fractions in the topsoil (0-15 cm).

Land use	Aggregate Size Fractions (mm)		
	0.25-0.5	0.5-1.0	1.0-2.0
Forest	51a	48a	27a
Teak	41ab	33b	11bc
Oil Palm	39ab	19bc	27a
Cocoa	37b	28b	11bc
Pasture	35b	21bc	18ab
No Tillage	34b	13cd	03c
Continuous Tillage	05c	04d	03c

Table 4: Effects of land use on water stable aggregates of different sizes fractions in the subsoil (15-30 cm).

Land use	Aggregate Size Fractions (mm)		
	0.25-0.5	0.5-1.0	1.0-2.0
Forest	22bc	20a	08b
Teak	19bc	08a	15b
Oil Palm	38a	14a	28a
Cocoa	29ab	13a	05b
Pasture	13dc	13a	10b
No Tillage	30ab	10a	09b
Continuous Tillage	05d	10a	09b

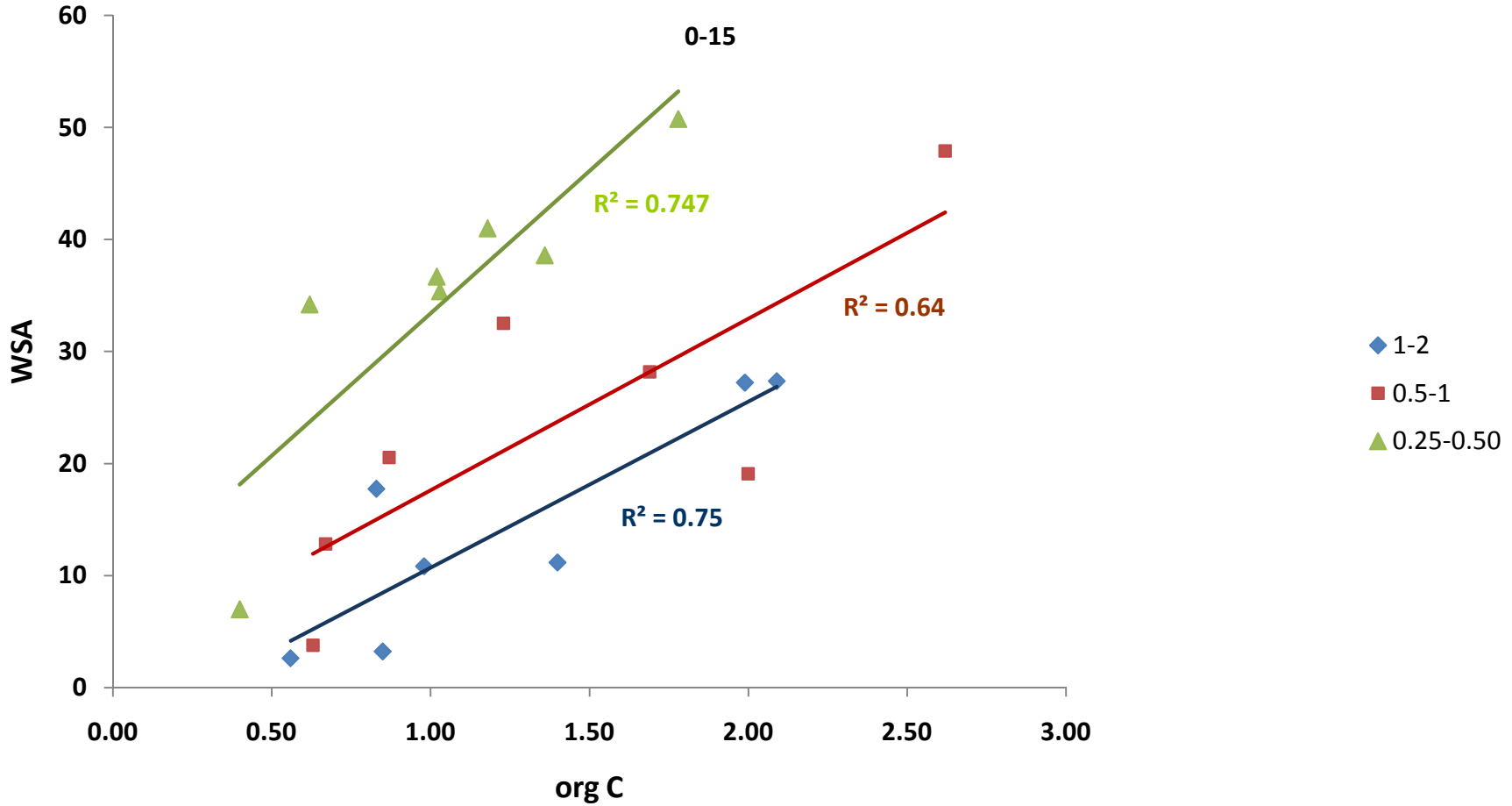


Fig 8: The relationship between SOM and water stable aggregation in topsoil (0-15 cm) as influenced by cultivation

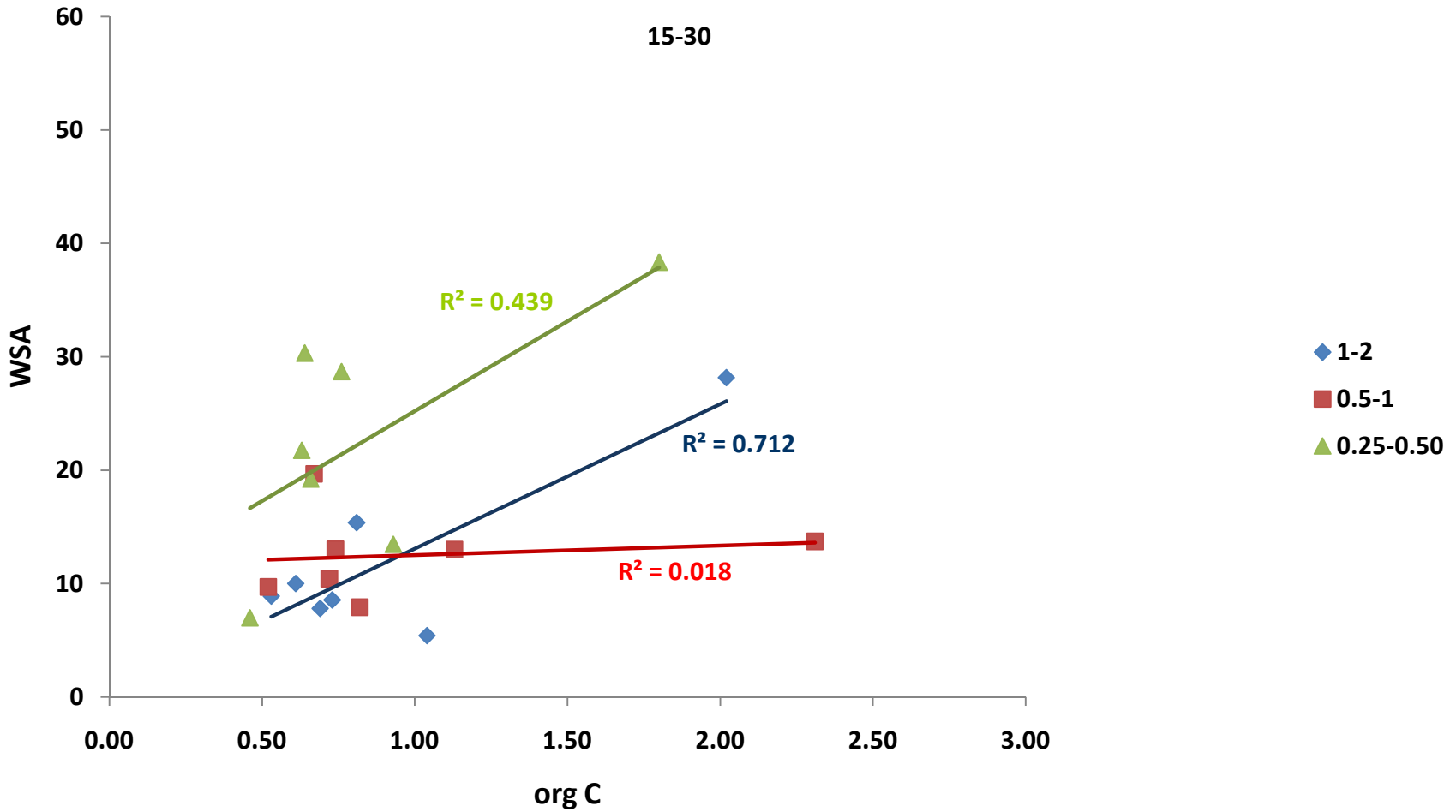


Fig 9: The relationship between SOM and water stable aggregation in subsoil (15-30 cm) as influenced by cultivation

CONCLUSIONS

- As expected, tillage and cultivation reduced the organic carbon in the soil.
- The consistently lower C:N ratio in the fine particle size fractions may indicate lower decomposition rates, thus suggesting a measure of protection of SOC by the fine sized soil particles.
- The water stability of the soil aggregates were mainly mediated by organic C.