



## Introduction

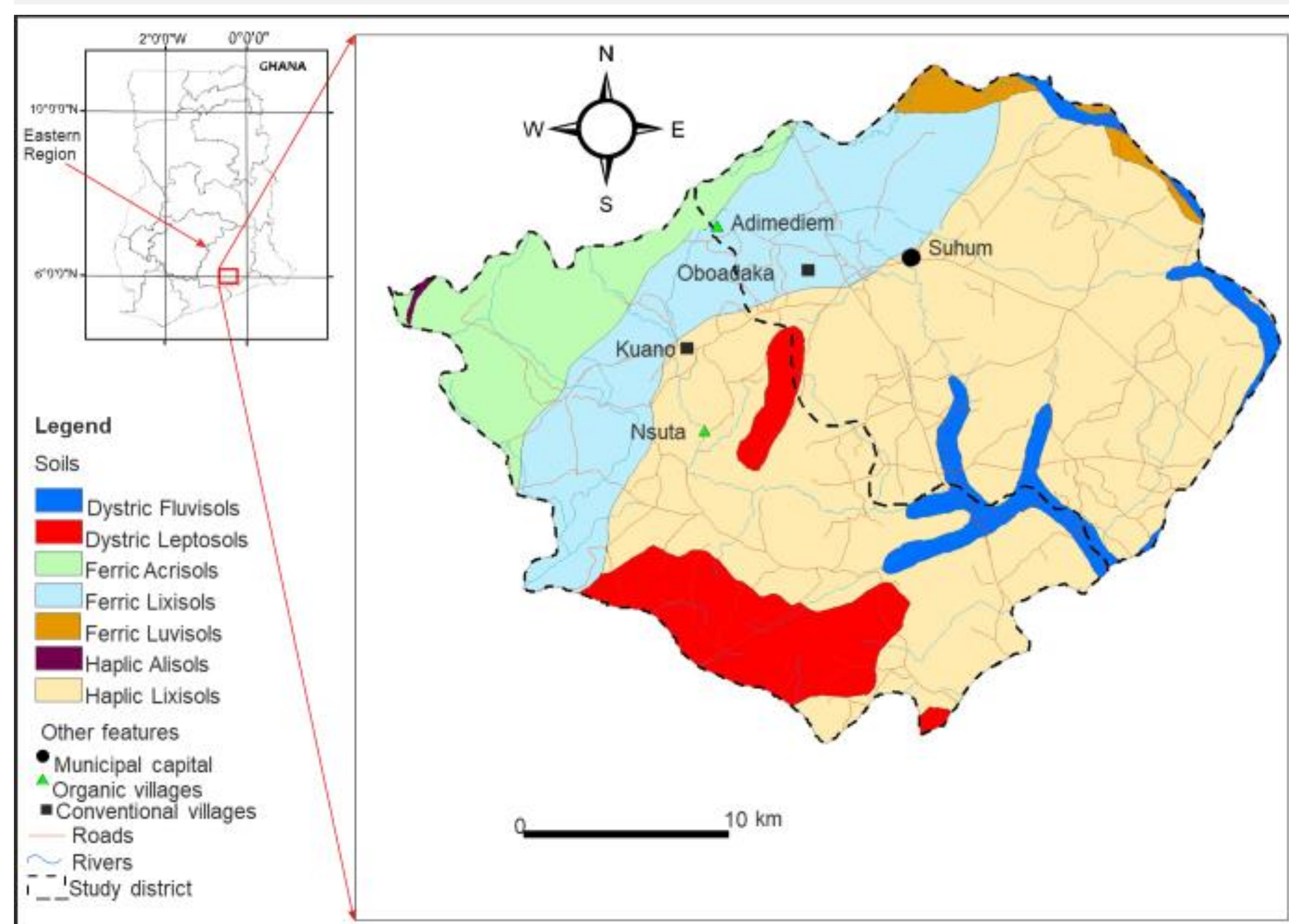
Cocoa (*Theobroma cacao* L.) production employs millions in the humid tropics. More than 70% of the world's cocoa is produced in West Africa. Based on inputs used, agroforestry systems can be classified as either organic or conventional. Studies comparing the carbon (C) and nitrogen (N) flows in traditional cocoa agroforests under conventional and organic managements are rare. **Our objective was to determine the influence of conventional and organic management on C and N flows in traditional cocoa agroforests.**



**Figure 1.** Traditional cocoa agroforest under organic (A) and conventional (B) managements

## Materials and Methods

- Study site: Suhum Municipality in the Eastern Region of Ghana
- Two villages per management were selected for the study
- Within each village, 3 farms were randomly selected



**Figure 2** Map of Ghana on the left and of the study area on the right

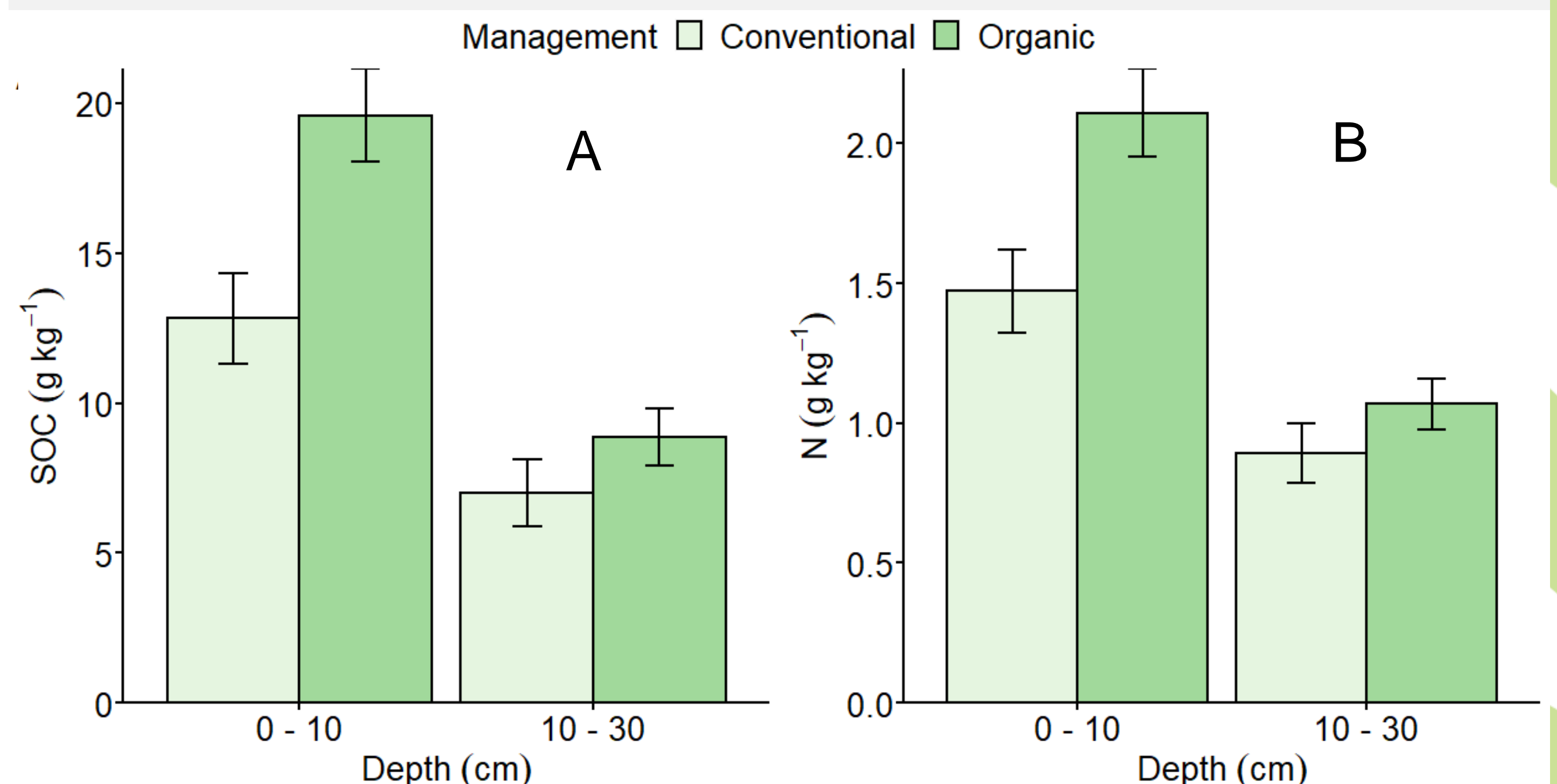
- Litterfall was collected for 6 months using 5 wooden litter boxes per farm
- Emissions of CO<sub>2</sub>-C from soil was measured using a closed chamber system connected to INNOVA 1312-5
- Soils were collected at depths 0 – 10 cm and 10 – 30 cm



**Figure 3** Wooden litterfall box (A) and photo-acoustic infra red gas analyzer (INNOVA 1312-5) (B)

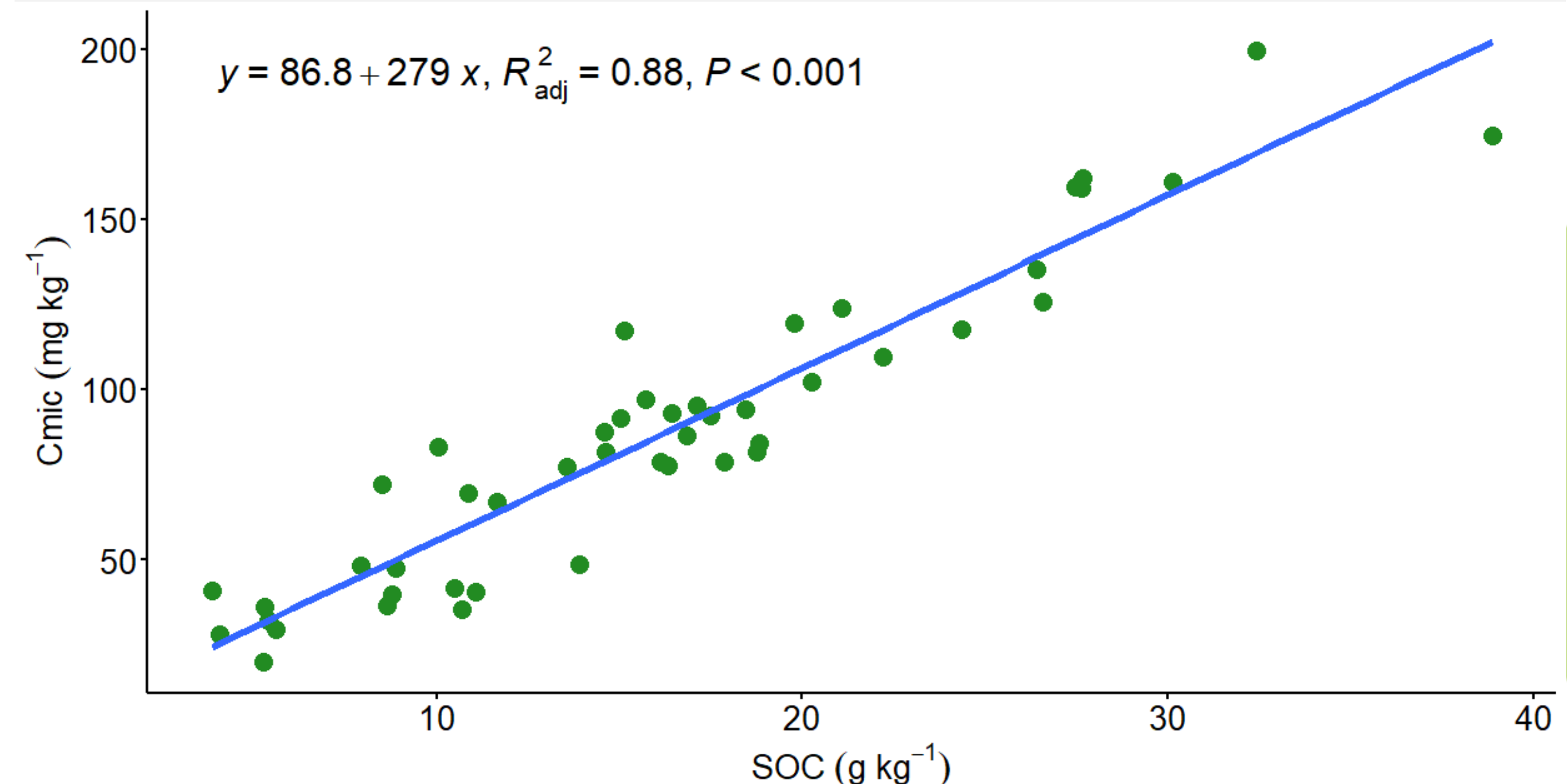
## Results

- Soil organic C and total N were by 46% and 33%, respectively, greater in topsoils under organic than conventional management
- Microbial biomass C and N followed same trend as SOC and N



**Figure 3** Soil organic C (A) and total N (B) in traditional cocoa agroforestry systems in two depths

- There was a significant ( $p < 0.001$ ) positive relationship between SOC and microbial biomass C and N (data not shown) at all soil depths



**Figure 4** Linear relationship between SOC and microbial biomass C (Cmic) in topsoil

- Carbon and N stocks in litterfall were similar across management systems
- Management had no effect on CO<sub>2</sub>-C emissions

**Table 1** Litterfall C and N stocks and CO<sub>2</sub>-C emission in cocoa agroforest

Management	Litterfall (kg ha <sup>-1</sup> month <sup>-1</sup> )		CO <sub>2</sub> -C emission (kg ha <sup>-1</sup> hr <sup>-1</sup> )	
	C	N	December	January
Conventional	319.8 ± 21.0	9.7 ± 0.6	4.2 ± 0.2	3.1 ± 0.3
Organic	335.4 ± 24.1	10.6 ± 0.8	4.1 ± 0.3	2.7 ± 0.2
p - value	0.63	0.60	0.60	0.45

## Discussion

Nitrogen, Cmic and Nmic were higher in the topsoils of organically managed farms because of their higher SOC. Across soil depths, SOC was positively correlated to all measured soil parameters. With a higher SOC we expected the C stocks of litterfall in organic to be greater than in conventional management, but this was not the case. High SOC in organically managed farms could be due to higher accumulation of dead fine roots in the topsoil which was, however, not measured in our study.

## Conclusion

Our results show that organic management increased SOC, N, Cmic and Nmic compared with conventional management only in the topsoils, whereas no difference was observed in the subsoils.