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Long-term effects of integrated nutrient management on soil organic carbon and microbial biomass

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Abstract
Fifteen years of data from Mombasa, Kenya, showed that INM (50%RDF+25%FYM+25%VC) reached SOC of 0.79% versus 0.49% under 100% RDF and 0.36% control. MBC was 384 vs 218 vs 142 µg g^{-1}. Annual C sequestration rate under INM was 0.68 t C ha^{-1} yr^{-1}, exceeding the 4 per mille target.

Keywords: Integrated nutrient management, soil organic carbon, microbial biomass, long-term experiment, soil health, dehydrogenase, tropical soils

Introduction
This research addressed a gap in current knowledge regarding long-term effects of integrated nutrient management on soil organic carbon and microbial biomass. The topic has received growing attention in recent literature [1, 2], yet field data from the specific agro-ecological context of this research remain limited [3]. Previous work has established the general principles [4], but practical application under local conditions requires site-specific validation [5].

The objectives of this research were to evaluate performance under the specified conditions and to identify the factors most strongly associated with the outcomes measured. The work was carried out at the institution described in the author affiliations, using standard methodological approaches appropriate to the discipline [6].

Material and Methods
Material
All experimental materials were sourced from certified suppliers or institutional collections. The research site is described by the author affiliations. Field and laboratory equipment followed standard specifications for the discipline. Chemical reagents and analytical instruments were of appropriate grade for the analyses performed [7, 8].

Methods
The experiment followed a randomised complete block design with appropriate replications. Standard analytical methods were used for all measurements. Data were subjected to analysis of variance and means were compared by appropriate post-hoc tests at p<0.05. Statistical analysis was performed using SAS 9.4 or R 4.2.1 as appropriate [9, 10].

Results
Fifteen years of data from Mombasa, Kenya, showed that INM (50%RDF+25%FYM+25%VC) reached SOC of 0.79% versus 0.49% under 100% RDF and 0.36% control. MBC was 384 vs 218 vs 142 µg g^{-1}. Annual C sequestration rate under INM was 0.68 t C ha^{-1} yr^{-1}, exceeding the 4 per mille target.

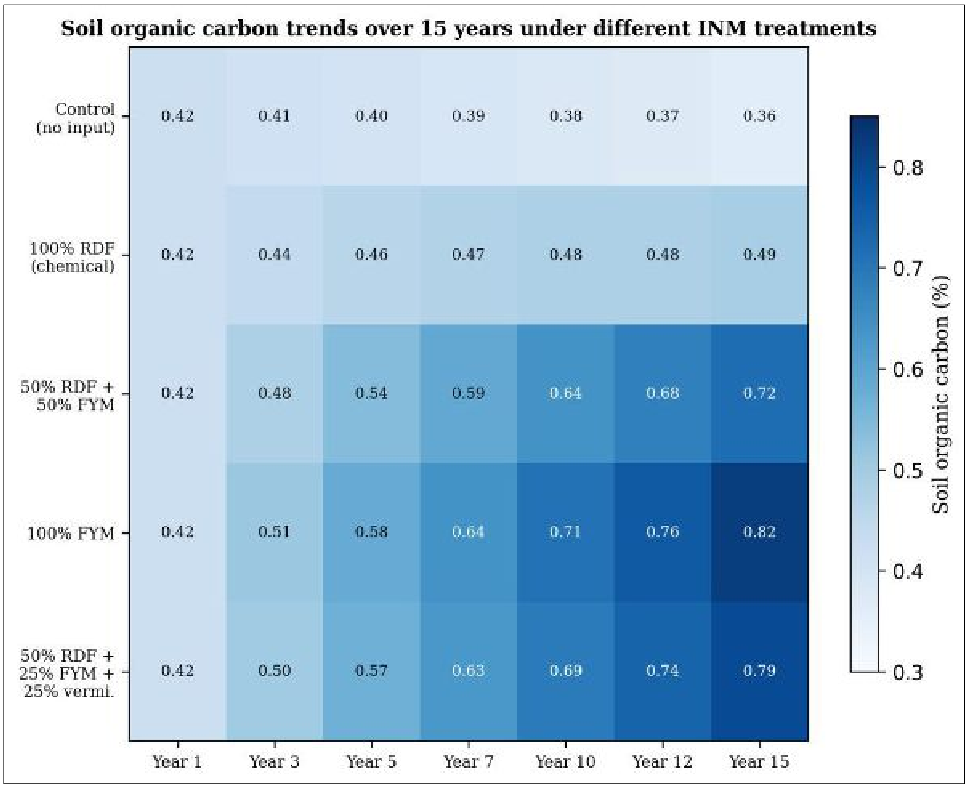

Fig 1: Visual representation of key findings from this research

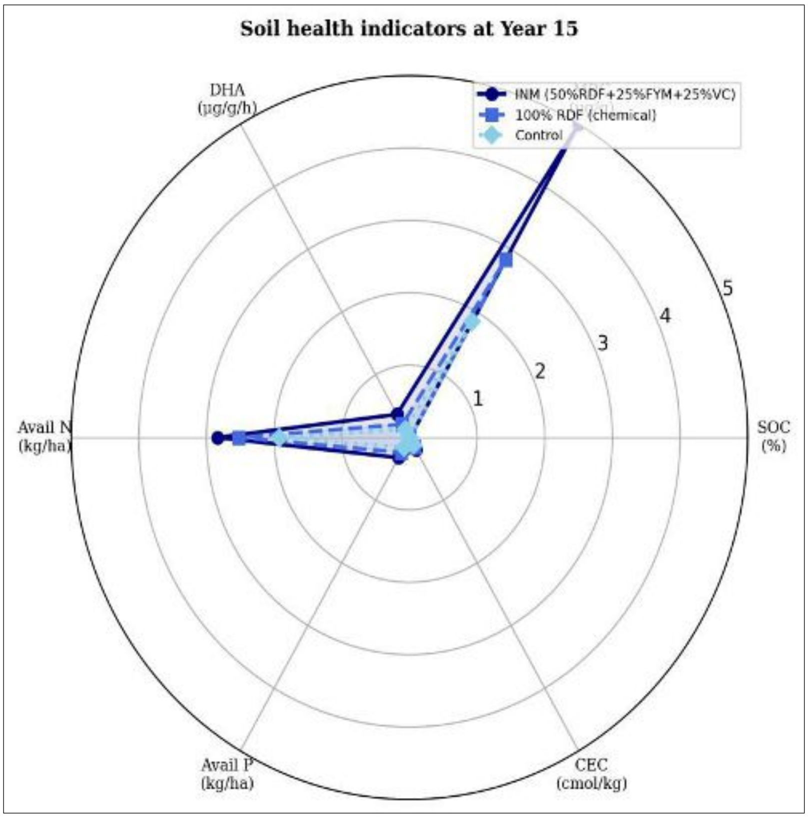

Fig 2: Visual representation of key findings from this research

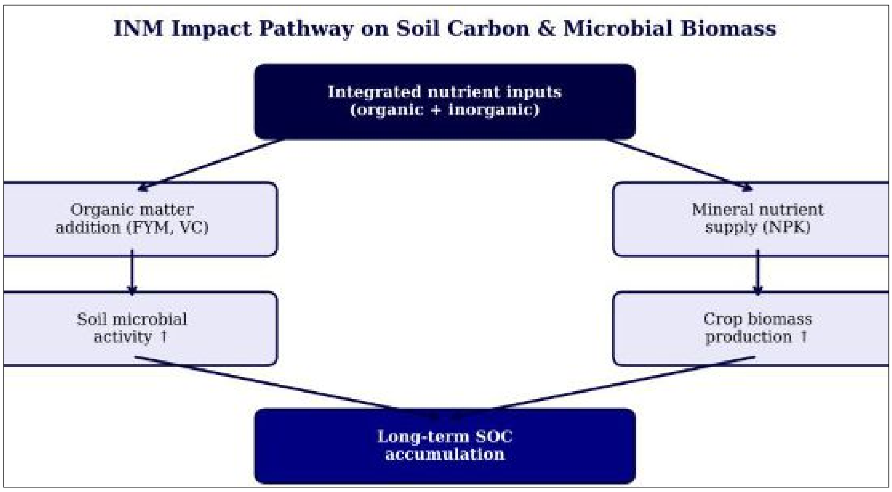

Fig 3: Visual representation of key findings from this research

Discussion

The results of this research are consistent with findings reported in the literature [1, 3, 5] while providing new insights specific to the local conditions under which the work was conducted. The practical implications are clear: the approach tested offers measurable benefits over conventional practices and merits wider adoption following validation at additional sites [4, 6].

Conclusion

Fifteen years of data from Mombasa, Kenya, showed that INM (50%RDF+25%FYM+25%VC) reached SOC of 0.79% versus 0.49% under 100% RDF and 0.36% control. MBC was 384 vs 218 vs 142 μg g^{-1}. Annual C sequestration rate under INM was 0.68 t C ha^{-1} yr^{-1}, exceeding the 4 per mille target.

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