Soil fertility changes following conversion of grassland to oil palm

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Background and aim

- Oil palm is a major crop in the tropics and the industry is expanding rapidly.
- Expansion onto grasslands can provide economic benefits while conserving forests.
- The aim of this study was to measure changes in soil fertility following conversion of grassland to oil palm, as maintenance of soil fertility is critical for sustainability.

Methods

- Nine sites in which oil palm had been planted on grassland were identified in Oro Province, Papua New Guinea, on alluvially redeposited volcanic ash soils. The oil palm had been planted by smallholder producers between 6 and 25 years prior to sampling.
- At each site, soil was sampled at 0-5 and 10-15 cm depth. In the oil palm planting, 4 holes were dug in the frond pile zone (where pruned fronds are placed), 4 in the weeded circle zone around the palm stems (kept free of weeds to facilitate harvesting) and 4 in the 'between zones' area, where ground cover grows. Samples were also taken from 4 holes in the adjacent grassland. Samples were combined, resulting in one sample per depth increment from the grassland and each of the oil palm zones. Samples were analysed for bulk density and chemical parameters.

Murom Banabas (top right) and the field sampling team

Results

GL = grassland, OP = oil palm: WC = weeded circle (12.0% of area), FP = frond pile (10.5% of area), BZ = 'between zones' (77.5% of area)

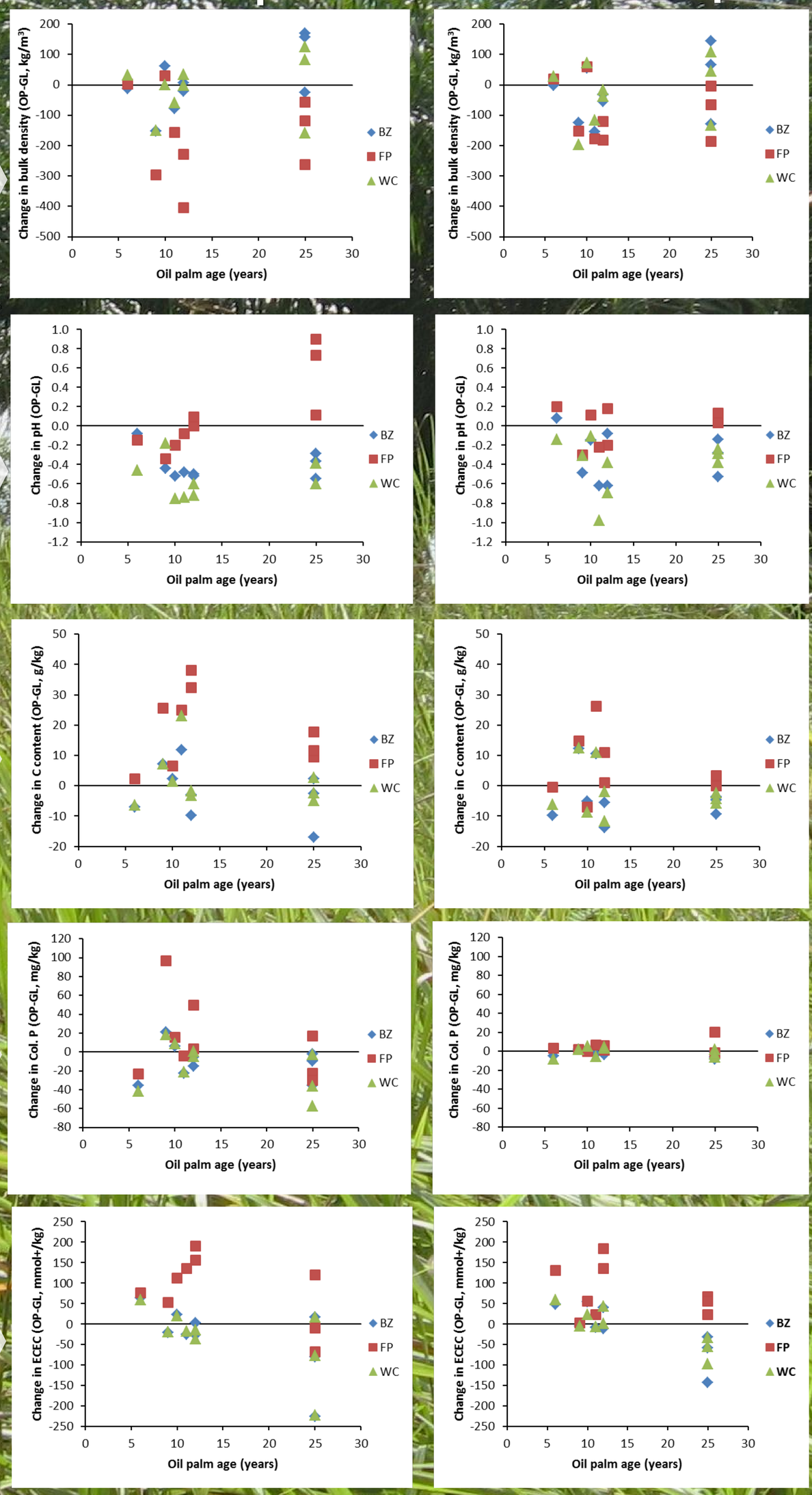
Bulk density remained similar or increased in the weeded circle and 'between zones' and remained similar or decreased in the frond pile. The grassland (reference) values were 586-1006 kg/m^3 at 0-5 cm and 656-1121 kg/m^3 at 10-15 cm.

pH tended to decrease, to a similar extent at both depths, except in the frond pile, where it remained unchanged or increased. Large amounts of organic matter, together with recycled non-acidic cations, are applied to the frond pile zone. The grassland (reference) values were 5.9-6.3 at 0-5 cm and 5.7-6.3 at 10-15 cm.

Total organic C content tended to increase in the frond pile and decrease in the other zones. Changes in total N contents followed a similar pattern. The grassland (reference) values were 23-93 g/kg at 0-5 cm and 13-79 g/kg at 10-15 cm.

Colwell P content at the surface showed no consistent change with time, and did not change at depth. The grassland (reference) values were 3-80 mg/kg at 0-5 cm and 10-32 mg/kg at 10-15 cm.

Effective cation exchange capacity (ECEC) increased in the frond pile and remained unchanged or decreased in the other zones. Exchangeable Ca content was closely related to ECEC. The grassland (reference) values were 57-314 mmol+/kg at 0-5 cm and 27-194 mmol+/kg at 10-15 cm.



Conclusions

- There was no clear trajectory of soil fertility with time under oil palm across all sites, showing that factors other than oil palm age (eg. initial fertility, depth to water table etc.) also influenced the change in soil fertility following conversion of grassland to oil palm.
- There were clear differences between oil palm zones, with the frond pile zone generally becoming more fertile than the other zones.
- Although some aspects of fertility deteriorated, the values reached were manageable and not limiting for plant productivity.