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Farmers' and academia's views"

Deep soil nutrient alterations after implementation of agroforestry in Brazilian cropland

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Abstract

Soils in tropical environments are highly weathered and usually present limited nutrient availability. Phosphorus stocks are low due to high adsorption and potassium is easily leached to deeper layers. In addition, soil management practised by smallholder farmers is commonly based on low rates of fertiliser input, resulting in a negative nutrient balance. Agroforestry systems (AFS) are a viable alternative in such cases, due to their capacity to improve nutrient use efficiency. AFS may increase nutrient content in the top layers due to litter deposition, but what happens to the nutrients stock in deeper layers remains unclear. The objective of this work is to understand the soil nutrient dynamics in deep soil after the implementation of AFS in a Brazilian agricultural area.

We collected soil up to 3.0 m deep in an agricultural area (AG), AFS in intermediate stage (AFSi – 6yo), AFS in advanced stage (AFSa – 21yo) and a secondary forest (SF), and determined plant-available phosphorus (P) and potassium (K). All soils were red Ferralsol with high clay content.

In the long run, agroforestry reduced the plant-available P stocks in the soil. In the 0–20 cm layer, P stocks was 17.3 kg ha^{-1} in the AFSa, whereas it was 43.4 kg ha^{-1} in the AFSi and 30.4 kg ha^{-1} in AG. Different stocks were also encountered in deeper layers. In the 150–200 cm layer, AFSa had a stock of 14.7 kg ha^{-1} whereas it was 29.1 kg ha^{-1} and 27.2 kg ha^{-1} in the AF and SF, respectively.

For K, not much differences were found among the land uses up to 150 cm deep, but AFS seem to actively absorb K from deeper layers. The K stock in the 200–300 cm layer in AFSa was 130.7 kg ha^{-1}, compared to 238.9 kg ha^{-1} and 238.6 kg ha^{-1} of AG and AFSi, respectively. The stock in the SF was similar to AG and AFSi, with 283.6 kg ha^{-1}.

Agroforestry systems seem to influence nutrient stock in deeper soil layers and therefore deep soil should be taken into account in nutrient balance studies in areas of transition from agriculture to AFS.

Keywords: Phosphorus, potassium, soil fertility, tropical agriculture

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