

The Fate of Organic Matter and Nutrients in Agroforestry Systems

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Abstract

Agroforestry systems are intermediate between forest ecosystems and agricultural systems, and exhibit some of the nutrient cycling and environmental services of natural systems and a complementarity-competition balance between trees and crops. This paper reviews how the status of nutrients and organic matter are affected by the inclusion of trees in agricultural systems and indicates some focal points for needed research. Nutrient pumping from deeper soil layers, and scavenging leached nutrients through horizontal root development, may significantly increase the overall supply and efficiency of nutrients. But nutrient pumping is limited in humid, strongly acid soils, where the contribution of P by trees usually is far below crop P requirements. Selection of trees with a deep rooting pattern and limited horizontal root development will be enhanced by more convenient methods developed recently based on fractal analysis. Fallow-rotation hedgerow systems, a variant intermediate between a simultaneous and a sequential agroforestry, hold promise to overcome some of the limitations of continuous alley cropping. Expectations of an increase in soil organic matter content in agroforestry is dependent on the amount, source, and management of the pruning biomass. Crop performance in association with N-fixing tree species often is not superior to that with non-fixing species, suggesting that N-fixation should not be over-emphasized in relation to characters that reduce competition between trees and crops. On sloping land there is a dramatic redistribution of soil fertility across the alleyways in contour hedgerow systems. This is a serious challenge to the sustainability of yields in these systems. Little effort has been expended in understanding nutrient cycling in the many farmer-developed agroforestry systems employed on millions of hectares. The fate of nutrients and soil organic matter in them is poorly quantified. Recognizing the pathways of agroforestry systems evolution in response to the availability of external nutrients may be a useful point of departure for research on the fate of nutrients in a practical context.

Introduction

Agroforestry systems deliberately combine woody perennials with crops or animals in spatial or sequential arrangements. The tree and crop components experience significant ecological and economic interactions (Nair, 1993). Because the

ACIAR. 1995. Management of Soil Organic Matter for Sustainable Agricultures in Asia. Australian Centre for International Agricultural Research, Canberra (forthcoming)