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Soil restoration in rubber and cocoa plantations in Côte d’Ivoire

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Abstract

Soil is an essential natural resource for agricultural production. In Côte d’Ivoire, extensive farming has reduced cultivable soil resources. In order to restore these soils, several initiatives have been proposed, including agroforestry. With this agricultural practice in mind, a study was carried out to assess the physico-chemical quality of soils in rubber and cocoa plantations in Central-western and Southern Côte d’Ivoire. Thus, the diversity of trees associated with the main crops (rubber and cocoa) was assessed in 7, 15 and 30 year-old plantations. Soil samples were used to determine bulk density and weight-average diameter. Finally, chemical elements such as carbon, nitrogen and exchangeable bases were measured in composite soil samples. The results revealed that rubber plantations are rich in 5 tree species divided into 5 genera and 4 families. Rubber plantations aged 15 years have the highest number of trees, with 5 stems.ha⁻¹, corresponding to a basal area of 0.79 m².ha⁻¹. Cocoa plantations contain 38 tree species divided into 33 genera and 13 families, including 4 species with special status. Old cocoa plantations (30 year-old) are the most densely wooded, with 56.84 stems.ha⁻¹, while basal area is highest in 15-year-old cocoa plantations, with 7.04 m².ha⁻¹. In terms of soil physico-chemical quality, cocoa farming has contributed to the conservation of physical soil quality. DMP does not vary between the different habitats. In contrast, rubber cultivation has contributed to the restoration of physical soil quality as the age of the rubber plantation increases. The vast root system of rubber trees could justify this result. DMP is higher in cocoa plantations, with lower bulk densities. Chemical element contents are relatively higher in cocoa plantations than in rubber plantations. Principal component analysis revealed that exchangeable base contents (Mg²⁺, K⁺) increase with the age of the rubber plantation, while Na⁺ decreases. Considering cocoa plantations, carbon and nitrogen contents are higher in 15-year-old plantations, which host the largest-diameter trees. The adoption of agroforestry in all cropping systems is a beneficial option for soil restoration.

Keywords: Agroforestry, cocoa plantation, land degradation, rubber plantation, soil quality