

AGROFORESTRY ECOSYSTEMS, BIODIVERSITY CONSERVATION AND SUSTAINABLE AGRICULTURE: A CASE STUDY IN THE EASTERN REGION OF GHANA

Tetteh, Daniel Ako

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ABSTRACT

Cocoa and mixed food crop agroforests are common farming systems undertaken in parts of the Eastern region that ensures sustainable land-use, conserve biodiversity and stores considerable amount of carbon. The study aimed at investigating the role of cocoa and mixed food crop agroforests in the conservation of biodiversity and sustainable agriculture in the Atewa and Fanteakwa districts. A total of thirty six sampled plots of 25m x 25m were randomly demarcated. All plant species with dbh-size ≥ 10 cm at 1.3m above the ground level were identified and measured. Soil samples were collected from a depth of 0-5cm, 0-10cm and 0-15cm respectively for chemical and microbial analysis. Litter fall from the three land-use types were collected using litter traps. Litter decomposition was carried out using litter bags. Above-ground biomass of trees ≥ 10 cm DBH was estimated using allometric model. Soil Organic Carbon (SOC) was estimated from the percentage amount of carbon and bulk density of the soil. In total, 604 individuals of non-crop trees were identified during the study. Significant difference (Kruskal-Wallis test, $p < 0.001$) were recorded in stem density of non-crop trees among the three land-use types. Basal area of non-crop trees also differed significantly (ANOVA, $p < 0.05$) with the natural forest recording the highest mean value of $23.89 \text{ m}^2 \text{ ha}^{-1}$. Total mean litter produced was not significantly different (ANOVA, $p > 0.05$) among the three land use-types. The reduction in mass of cocoa leaf litter was significantly negatively correlated with number of days of decomposition ($r = -0.78$, $p < 0.001$). The rate of release of NPK was positively correlated with litter mass loss ($r =$, $p < 0.05$). Soil pH was not significantly different ($p > 0.05$) among the three land-use types. Available phosphorus content in the soil was significantly different ($p > 0.01$) among the three land-use types. Exchangeable potassium content in the natural forest was significantly (ANOVA, $p < 0.01$) higher than in the mixed food crops and cocoa agroforest. Total nitrogen and soil organic carbon content were significantly different in the three land-use types ($p < 0.001$). The natural forest recorded the highest total carbon stock per unit area of the three land use-types, with a mean of $203.26 \pm 60.41 \text{ Mg ha}^{-1}$. Tree species diversity was significantly low in the cocoa and mixed food crops agroforest than in natural forest. The rate of litter decomposition was

generally low among the land-use types. The diversity of soil microbes was higher in the natural forest than in the agroforest farmlands. Total carbon stock was high in the natural forest followed by the mixed food crops and then cocoa agroforest. Subsequent studies should focus on extending the period of decomposition in order to ensure a complete decomposition process. There should be collaboration between opinion leaders and forest guides in order to arrest and prosecute any person(s) who engages in illegal logging. The Ministry of Food and Agriculture (MOFA) in the collaborating with the Forestry Service Division should organize in-service training at least every three months for local farmers on sustainable land-use.

SUPERVISORS

Dr. Asase, Alex

Dr. Ofori-Frimpong, Kwesi

Dr. Owusu, Ebenezer