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SUMMARY OF DOCTORAL THESIS

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Title: Evaluation of growth and carbon storage, and influence of soil physico-chemical properties on useful tree species in West Africa.
(西アフリカの有用樹種の生長量と炭素蓄積量の評価、および土壌の理化学性の影響)

Large scale industrial *Tectona grandis* (Verbenaceae) plantations are increasing in Ghana because of the quick economic returns. The primary factors affecting the growth of teak are depth, drainage, texture, moisture status and fertility of both surface and subsurface soils. There is need to select suitable sites for teak growth for an afforestation project.

Restoration efforts to establish native tree plantations have seen little success, evidenced by low yields (about 1 m^3 ha^{-1} $year^{-1}$) and the choice of species unsuitable for the growing conditions of Northern Nigeria. In order to circumvent these obstacles, fast-growing exotic tree species have been chosen to initiate forest recovery. Typically, eucalyptus and pine, two exotic tree species, are the most common components of forest plantations in Tropical Africa.

From these situations, this dissertation was selected to study the common afforestation tree species (*Tectona grandis*, *Eucalyptus camaldulensis* and *Pinus caribaea*) in West Africa.

First study was conducted to assess the growth and carbon storage of *Tectona grandis* (Verbenaceae), and to evaluate the influence of chemical properties and moisture of soils on teak (*Tectona grandis*) growth in Afrensu Brohuma Forest Reserve, Ghana. This study site was located at a 15-year-old teak plantation. A site classification in Ghana was used to evaluate the growth status of teak. Teak growth in the present study sites was classified into 50% was class 1 (good), and 50% was class 2 (medium) growth. The aboveground carbon storage and chemical properties of soils in the study sites and those of other teak plantations and different tree species were compared.

Precipitation seemed to influence height and above ground biomass of teak. The soil total N and exchangeable K in the study sites were lower than those in other teak plantation in the region. The volumetric water content in soils of the most class 1 sites was significantly higher than that in class 2 sites. Consequently, teak growth was probably affected by some chemical properties and moisture status of soils in the present study sites.

Subsequently, we describe the relationship between growth and soil physico-chemical properties in *Eucalyptus camaldulensis* (Myrtaceae) and *Pinus caribaea* (Pinaceae), two species an important in Nigerian forest recovery programs. We also estimated biomass in these species. The study site was located at a 17-year-old plantation in a Northern Nigeria forest reserve. The soils at the Nigerian study sites were nutrient poor compared with other plantations. Growth of *Eucalyptus camaldulensis* was positively correlated with exchangeable K content in soils 0- 20 cm deep, and negatively correlated with total N and exchangeable Na in soils 20- 150 cm deep. Growth of *Pinus caribaea* was positively correlated with available P in soils 0- 20 cm deep, and volumetric water content in soils 20- 150 cm deep. Soils in the top layers were very hard and plinthite layers were well developed at shallow soil depths at most sites. *Eucalyptus camaldulensis* exhibited a comparatively high survival rate, and its growth was comparable to that in other plantations. However, the survival rates of *Pinus caribaea* were low and its growth was lower than that in other plantations. The survival rate of *Eucalyptus camaldulensis* was lower at sites where plinthite layers were found within 50.8 cm of the surface. These results indicated that *Eucalyptus camaldulensis* is suitable for afforestation in Northern Nigeria. However, it is not recommended for sites where the plinthite layer occurs at shallow soil depths. In the estimation of biomass of *Eucalyptus camaldulensis* and *Pinus caribaea*, allometric equation of root biomass of *Eucalyptus camaldulensis* has not yet been established and we could not estimate root biomass of *Eucalyptus camaldulensis*. Also allometric equation of carbon storage of *Eucalyptus camaldulensis* and *Pinus caribaea* has not yet been established. The aboveground biomass of *Pinus caribaea* was lower than that in other plantation.