BIOMASS ESTIMATIONS AND CARBON STOCK CALCULATIONS IN THE OIL PALM PLANTATIONS OF AFRICAN DERIVED SAVANNAS USING IKONOS DATA

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ABSTRACT

The primary goal of this research was to develop biomass models and to calculate carbon stock levels of the West African oil palms (*Elaeis guineensis*) using multi-date IKONOS images. The study was conducted in two benchmark areas of derived savanna eco-region using wet and dry season IKONOS images. Allometric equations related aboveground palm biomass to their stem heights. Using field plot data, empirical regression models were established to determine wet and dry biomass (kg/m^2) of oil palms using IKONOS data. The best models (Figure 2) were non-linear exponential type, involved band 3 or indices involving bands 3 and 1 or bands 3 and 4, and explained between 63 and 72 percent of the variability in the data. Model evaluations with independent datasets showed there is 28 to 36 percent uncertainty in predictions.
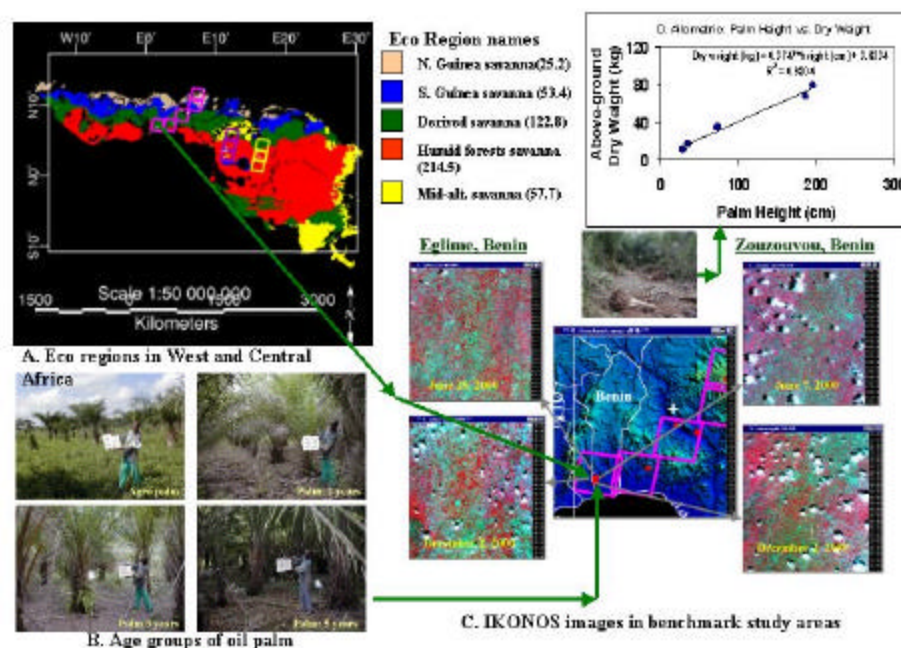
Figure 1. Study areas of Eglime and Zouzouvov in the Republic of Benin.

At the landscape level, multi-date IKONOS data mapped oil palm plantations with an overall accuracy of 88 to 92 percent. However, the ability of IKONOS data to differentiate various age groups of oil palms was limited with a high degree of intermixing of classes. The best results were obtained when delineating agro-palm (mixed with agriculture and fallows), palm of 1-3 years, and palm of 4-5 years at an overall

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accuracy of 74.5 percent when all 4 IKONOS bands were used. The results indicated the need for additional spectral bands in the IKONOS sensor.
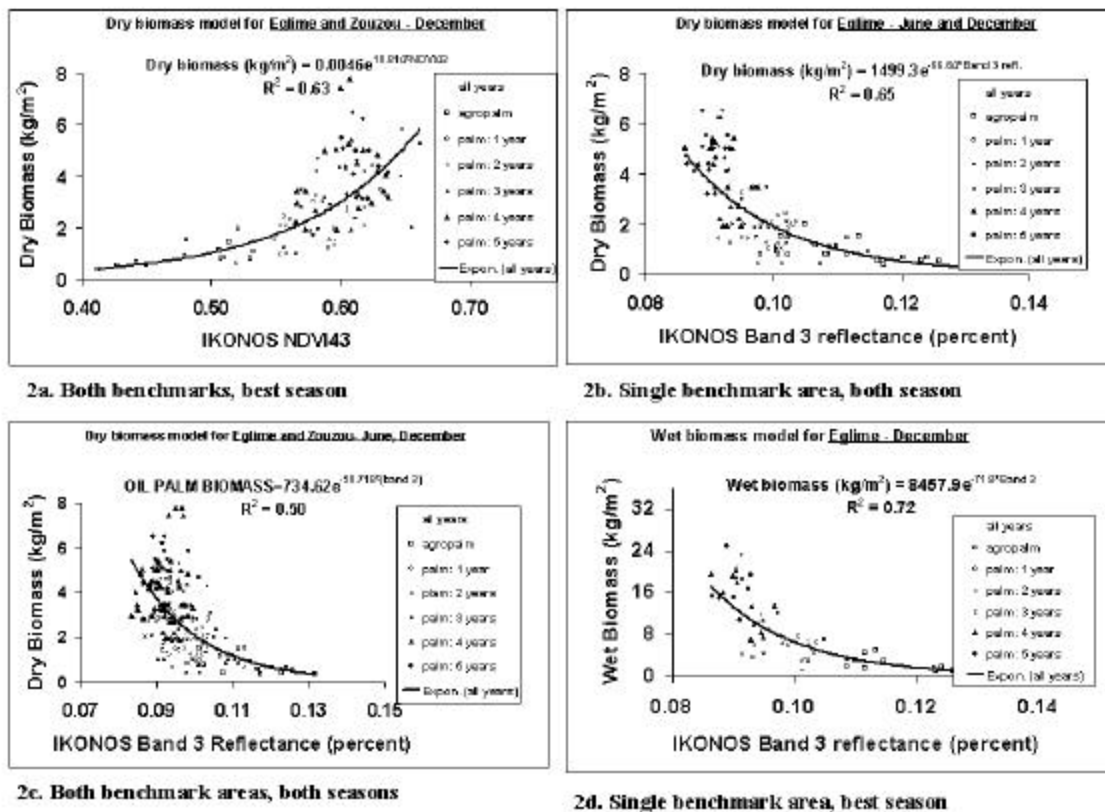

Figure 2. Empirical models to predict oil palm dry biomass (kg/m^2) using IKONOS bands and indices.

The carbon per unit area in the 1-5 year oil palms of West Africa was estimated by IKONOS data to vary between 14.75 to 14.94 tones/ha (or Mg ha^{-1}) in the two-benchmark areas (see illustration in Figure 3). The corresponding dry biomass (kg/m^2) varied between 29.5 to 29.88 tones/ha (or Mg ha^{-1}). The mean rate of accumulation of carbon varied between 2.95 to 2.99 t C ha^{-1} yr^{-1}.

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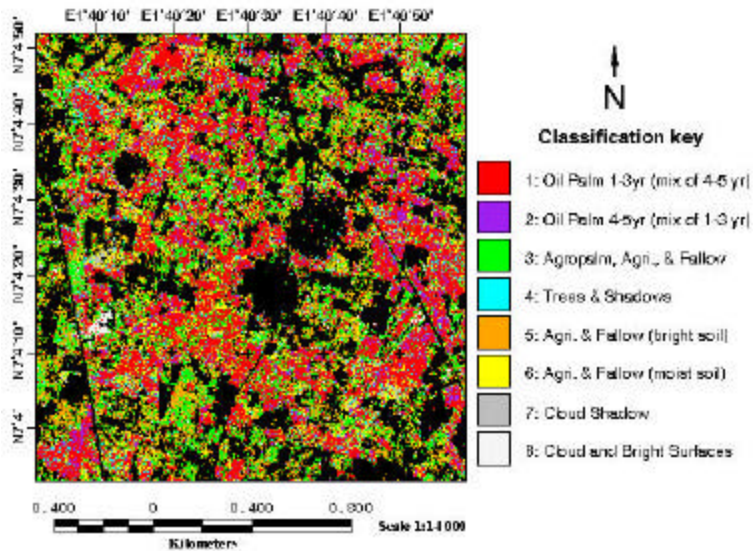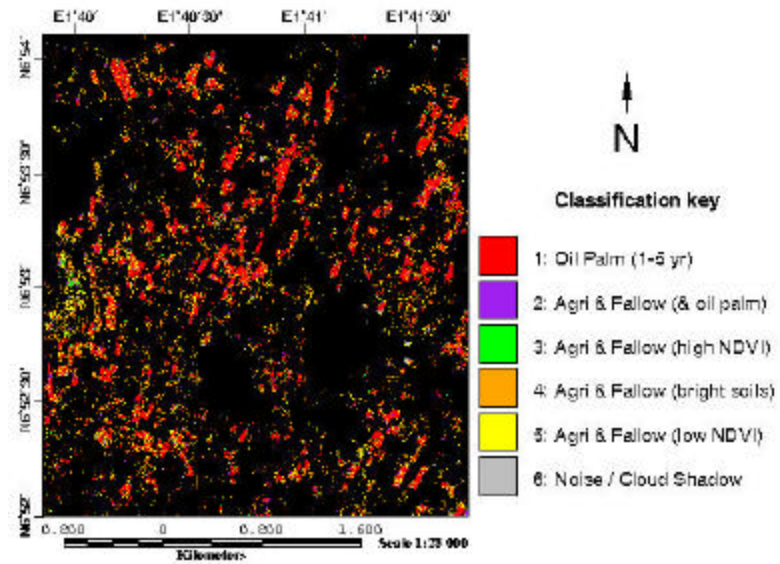
Figure 3a. Eglime oil palm and other classes.

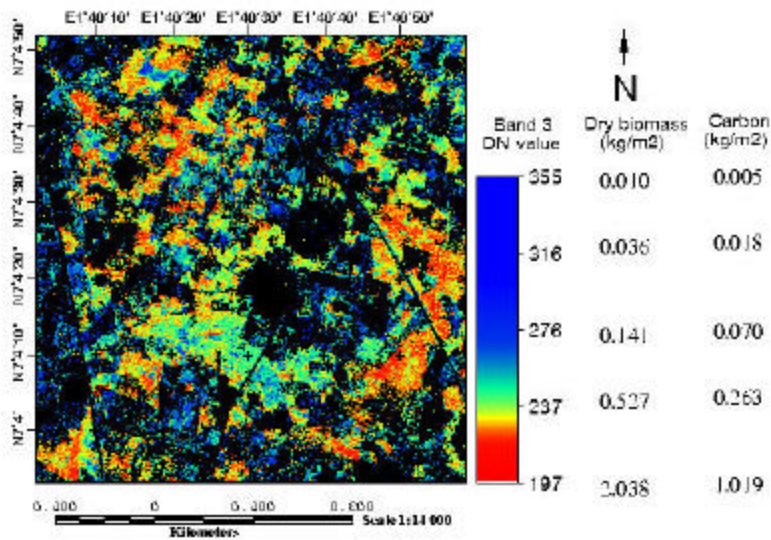Figure 3b. Zouzouvou oil palm and other classes.

Figure 3c. Carbon, dry biomass, and band 3 reflectivity in Eglime
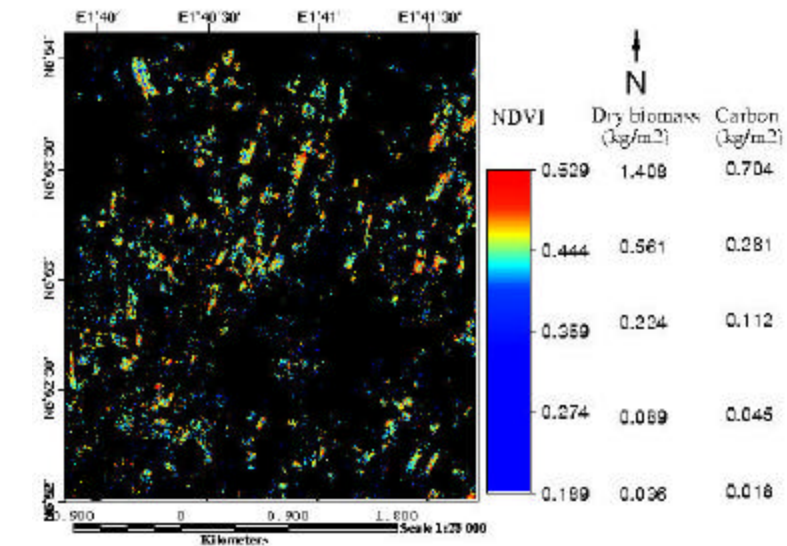(dry biomass computed using equation from Figure 2b).

Figure 3d. Carbon, dry biomass, and NDVI in Zouzouvou
(dry biomass computed using equation from Figure 2a).

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