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Multi-criteria Assessment of the Relationship between Deforestation, Rainfall and Landuse Change from Remotely Sensed Data in Nigeria

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The objective of this paper is to undertake an in-depth evaluation of deforestation, rainfall and landuse dynamics in Nigeria using a localized hybrid TREES/FAO deforestation model. Forty seven (47) 2002 (October 2001-March, 2002) Landsat 7 scenes covering Nigeria were assembled and processed with 376 ground control points for image rectification, reprojection, conversion to reflectance and mosaicking. We also assembled 250m and 500m Moderate Resolution Imaging Spectroradiometer (MODIS) reflectance data for Nigeria for 2002. Using data from the NigerianSat1 Atlas for 2003, Nigerian Geospatial Data Infrastructure (NGSDI) 2002 and a threshold of 70% /5ha for forest cover, the Landsat and MODIS composites were classified into Rainforest, Swamp Forest, Deciduous Forest and Cropland. The overall accuracy was 88%. We developed a multi-criteria hybrid TREE/FAO model for sampling deforestation rates for 2002, 2008 and 2012 for Nigeria. For 2008 and 2012, NigerianSat1 and other satellite data sources were used to fill gaps or replace data on the scanner error of Landsat7. Accumulated patches of Rainfall Data (0.250 x 0.250) was obtained from Tropical Rainfall Measuring Mission (TRMM) for selected forest samples while land cover data from NGSDI was updated with field work data in other evaluate its relationship with the Remotely sensed data. Deforestation rates stood at 0.33% yr-1, 0.14 yr-1 and 0.17% yr-1 for the Woodland, Rainforest and Deciduous Forest respectively. Estimates for the Swamp Forest could not be effectively computed due to high cloud cover throughout the year. The relationship between forest cover change and rainfall stood at r= 0.21; p≤0.05 and r=0.42; p≤0.05 for the forest and Savannah zones respectively. Deforestation rate was higher in the Woodland than the Rainforest and Deciduous zones due to the better economic value of the species and the ease of felling these trees with minimal cost and favorable terrain features. The weak relationship between rainfall and forest cover in the Rainforest is associated with its location within the zone of maximum air mass convergence due to the concave

landscape structure of the Niger Delta to the Atlantic. Moreover, the Rainforest region is nearly always green throughout the year with a highly variable dry season when there are no clouds; hence variability in rainfall may not affect the rate forest cover change as opposed to the Savannah landscapes where forest cover change is dependent on rainfall or moisture supply. Consequently our results show that deforestation is concentrated along the Forest-Savannah boundary of Nigeria where intensive agriculture, anthropogenic forest fires and shifting cultivation dominate. Our results could not confirm hot deforestation spots (pixels) as indicated by most continental-global scale evaluation of deforestation patches. We are going to develop a multi-criteria decision support system for identifying localized deforestation hot spots for Nigeria.

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