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BOOKLET OF ABSTRACTS

Drone-based estimation of trees biophysical parameters in complex cocoa-based agroforestry systems

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ABSTRACT

In cocoa-based agroforestry systems, the biophysical parameters of upper canopy trees, such as height, crown area, crown forms and vegetation indices such as the normalized difference vegetation index (NDVI) are important tree attributes used to assess and monitor the ecosystems services provided by tree associated to cocoa tree. However, exhaustive field measurements of tree biophysical parameters with conventional field methods are laborious, time-consuming and require a significant workforce. The use of uncrewed aerial vehicle (UAV) in agriculture have proved useful in estimating crop biophysical parameters. UAV-based images provides low-cost flexible data acquisition with few weather constraints and high spatial resolution. However, to date, there has been limited application of drone surveys in cocoa-based agroforestry systems. The purpose of this study was to evaluate the use of economical high-resolution multispectral UAV images to assess tree biophysical parameters in cocoa-based agroforestry systems. The study was carried out in 12 cocoa-based agroforestry systems presenting various tree density and complexity. The studied fields are located in the centre-west of Côte d'Ivoire. The UAV flights were performed at an altitude of 80 m using a DJI multispectral Phantom 4 Pro quadcopter. The images were processed using the structure from motion technique in Pix4DMapper software and produced multispectral orthomosaic aerial images, digital surface model, and point clouds. By subtracting the digital surface model and the digital elevation models, tree heights were mapped while the crown areas were extracted from the orthomosaic. NDVI were calculated using the red and near-infrared spectral bands of orthomosaic data. To assess the accuracy of the UAV measurement, correlations and root mean square error were used to compare UAV extracted height and crown area with ground measured data. A very strong correlation was found between individual tree height derived from UAV's canopy height model and field-measured tree height ($R^2 = 0.8$).

The difference between the field measurements and the UAV measurements were dependent on the tree height and crown class. This study thus highlighted that an inexpensive UAV system can measure the biophysical and structural characteristics parameters of most trees in cocoa-based agroforestry systems with accuracy comparable to those of the expensive field inventories.

Keywords: canopy structure, UAV, Digital Surface Model