Ground truth biomass data collection protocol

The validation and control data set for the Africa Biomass Challenge 2023 consists of biomass data for 94 locations in Cote d'Ivoire. The data was collected from 2.10.2021 until 8.12.2021 in three areas of the cocoa belt of Côte d'Ivoire, around the towns of Guiglo, Abengourou and Aboisso (see map).

The aim of the data collection was to generate a reference data set of high quality for remote monitoring of agroforestry and degradation of forests due to cocoa. Therefore, different combinations of cocoa and forests were mapped – agroforestry plots of different shade levels. In Abengourou and Aboisso, cocoa farmers were visited and their plots mapped, in Guiglo and Mabi Yaya, forested areas were searched for cocoa planted in them. The collection was financed by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (through the three BMZ-financed projects Green Innovations Center for the Agriculture and Food Sector, Initiative for Sustainable Agricultural Supply Chains INA and PRO-PLANTEURS) and conducted by the consultancy ACTUM DEV.

The locations were chosen based on the objectives of the data collection (combination of cocoa and forests with different degrees of degradation), the accessibility to the site, and the anticipation of difficulties on the ground (practicable roads etc.). For each selected area, a team of consultants from ACTUM DEV mapped the farm boundaries with georeferenced polygons and flew a drone to capture high resolution aerial images. In addition an assessment of the aboveground standing biomass was made in a 30m-radius plot. Household data of the farmers (including information on the management of the cocoa plot such as whether inputs were used, yield etc) were collected using the online tool KoboToolbox. The datapoints presented for the challenge only concern the biomass data.

For the biomass data collection, a standard operating protocol for carbon stock assessment developed by University of Queensland (Wilma Blaser-Hart) was applied. This protocol was adapted from the HCSA Toolkit and is designed to quantify above-ground (living) biomass (AGB) on cocoa farms in circular plots of 30 m radius (0.28 ha). In the 30m radius, the diameter at breast height (DBH), species, height and number of all trees with a DBH above 10cm was registered and all cocoa trees were counted. In a smaller subplot of 6m the diameter at 30cm height of all cocoa trees was recoded (see schematic diagram below).

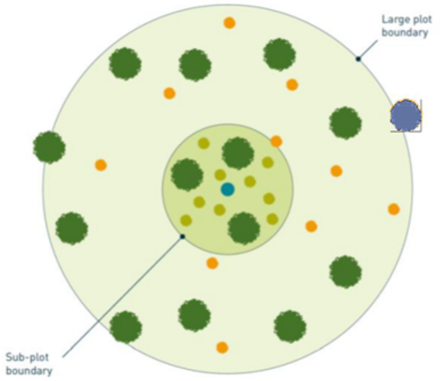

Figure 1: Aperçu des placettes de biomasse et guide de mesurément dans les grandes et sous-placettes

The center of each plot was geo-located using waypoint averaging with a handheld GPS unit.

On the basis of this data, biomass of the woody species was calculated using the open source r package BIOMASS dedicated to the estimation of aboveground biomass tropical forest inventories (Réjou-Méchain et al., 2017). The BIOMASS package assigns a wood density value to each taxon using the global wood density (GWD) database as a reference (Chave *et al*. **2009**; Zanne *et al*. **2009**). Additional wood density values can be added using the addWoodDensityData argument.

Mean wood density values in this file were extracted from the BIOMASS R package using the global wood density (GWD) database as a reference (Chave *et al*. **2009**; Zanne *et al*. **2009**). Any missing values were sourced from various databases and scientific literature and subsequently entered manually (check sources in literature list). For woody species that don't have a wood density value (i.e unknown species or species that don't have WD estimates in any of the databases) the WD average of all trees in the same plot was taken. The aboveground biomass of oil palm (Elaeis guineensis), was calculated using the species-specific equation of from Brown 1997. For Citrus sinensis, Citrus sp, we used the specific equation from Schroth et al. 2002. For cocoa we used the allometric equation from Andrade 2008.

Aboveground biomass values of all shade trees were summed per plot. The biomass of cocoa trees was estimated for the average cocoa tree in the 6m subplot and then multiplied by the number of cocoa tree in the 30m-radius plot. Shade-tree biomass and cocoa biomass was summed up to estimate total aboveground biomass per plot.

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