

Appendix 2: Methods of segmentation analysis for cover class assignment within local landscapes of Yoro study sites during 2018 – 2019/2019–2020.

Google Earth images were obtained for each study site to encompass an extent of 19.6 ha centered around the survey sites from the year 2020 which was the concluding year of our study (Google Inc. 2022). These images were classified using a process of segmentation based on the Simple Linear Iterative Clustering (SLIC) and Affinity Propagation (AP) algorithm which groups superpixels based on similarities in color and proximity (Zhou 2013). We conducted the segmentation process for 18 study site images (.tif format) within the R environment with packages ‘SuperpixelImageSegmentation’, ‘nmcMetIO’, ‘sp’, ‘raster’ and ‘OpenImageR’ (Pebesma and Bivand 2005; Bivand et al. 2013; R Core Team 2018; Mouselimis 2019; Hijmans 2021; Dai 2022). Segmented images were projected to the Coordinate Reference System used in the region, UTM 16 N, and subsequently transformed to vector files (.gpkg). These vectorized files were processed to extract a circular, local landscape and to assign the following land cover classes (see table 2a below): sun coffee, shade coffee, forest, advanced second growth forest, early successional cover type, pastureland/cropland and other. We assigned the land cover classes and revised the lines within the landscape’s polygons, if these were crossing over to an erroneous class assignment, in QGIS 3.14 (QGIS Development Team 2018). We determined a manual assignment process was adequate to best represent the different cover classes of the study area, in particular we were interested in determining the difference between forest and heavily shaded coffee. We based our classification on our field experience from the sites, the satellite image and georeferenced photographs we took at random points within the farm’s extent which captured different types of cover classes.

References

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Table 2a. Cover classes of 18 local landscapes in the Yoro coffee producing region 2018 – 2020. Cover classes were grouped into composite classes based on the species ecology and were subsequently used in a PCA alongside edge density to characterize the local landscapes.

Composite Class	Cover Class	Description
Open habitats	Sun coffee	Coffee farm exposed to the sun. No shade trees present to scant banana plants/single trees present. Coffee plants are either small, recently planted but forming visible rows or bushes in clear rows in satellite image.
	Early successional cover type	Lands that are recovering from agriculture, open, with shrubby vegetation cover which can be thorny. Sites with sapling growth, dense areas. If trees are present, these are not well developed (crowns are not well delineated as seen in satellite images). This site can also be known as fallow lands.
	Pastureland/cropland	Pasturelands or other crop cultivated lands that are open (i.e. corn, beans, etc.). Dirt roads are also included in this class.
	Other	Houses or other covers that are not natural.
Shade coffee	Shade coffee	Coffee farm with shade trees covering the plantation or with variable shade cover, trees have sizable crowns. In satellite images this cover is hard to tell apart without site knowledge, although at times coffee plants (dark equidistant dots) can be seen forming rows between canopy gaps.
Forest	Forest	Broad-leaf forest characterized in images by deep green color and dense-looking, large tree crowns that can be observed in satellite images.
	Advanced second growth forest	Broad-leaf forest that has trees that can be delineated but their crowns are not as large as those in the forest class, these sites have presence of tree ferns, vines, and palms as elements of a forest advancing towards maturity or old-growth.