

Land use map of the Niayes Region in Senegal 2017

The land use mapping of the southern part of the Niayes area in Senegal was conducted using expert visual photointerpretation and ground control points, based on a Pleiades satellite image acquired in March 2017. The study area spans 550.46 km² (or 55 046 ha), stretching from Niaga and Sindia in the south to Mboro in the north (Fig. 1). The primary aim of this study was to identify mango and citrus orchards, categorize them into four distinct cropping systems, and determine their tree densities.

The dataset is provided in Json format and uses the UTM coordinate system (zone 28N, datum WGS84), with a file size of 34 MB. The 19 657 mapped objects are distributed into 6 classes including Orchard, Vegetable Crop, Shrub, Urban Area, Water Network, and Sandpit. Orchards are further classified into four cropping systems: Low Tree Density, Traditional, Diversified, and Intensive Export. A detailed description of each cropping system is provided below.

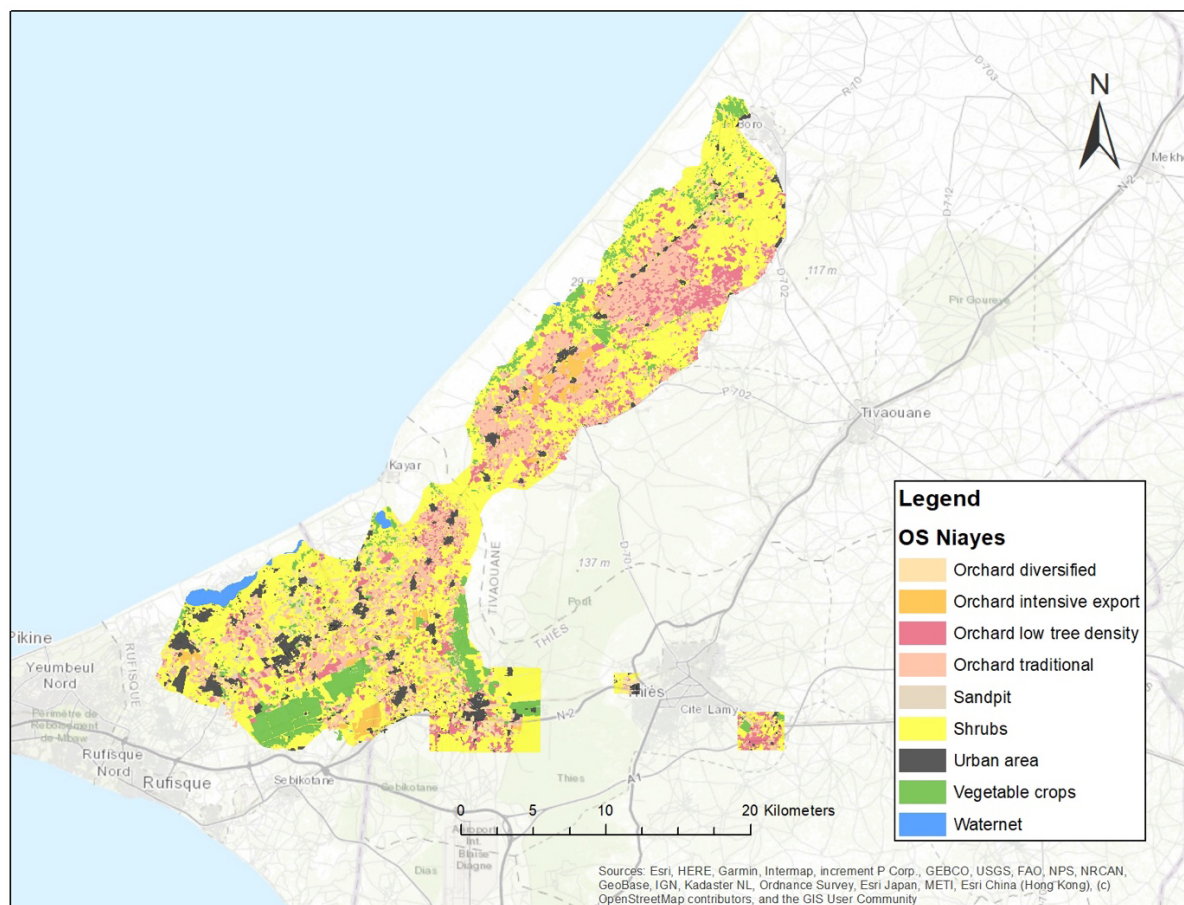


Figure 1: Land use map of the southern part of the Niayes region in Senegal, from Pleiades satellite expert photointerpretation in 2017.

The table of attributes is made of:

ID	Digit_class	Verger_type	Obj_Name	Area (Ha)	Tree count	Tree area (m2)
ID num	Class num	Type of orchards	Object name	Object area	Tree num with the object polygon	Cumulative surface area of the trees within the object

The number of trees per object polygon has been extracted from Brandt, M., Tucker, C.J., Kariyaa, A. *et al.* An unexpectedly large count of trees in the West African Sahara and Sahel. *Nature* **587**, 78–82 (2020). <https://doi.org/10.1038/s41586-020-2824-5>.

The digit class and Verger_type codes are:

Digit class		Verger_type	
Code	Name	Code	Name
1	Orchard	0	Low tree density
2	Vegetable crops	1	Traditional
3	Shrubs	2	Diversified
4	Urban area	3	Intensive export
5	Waternet		
6	Sandpit		

Here is a short descriptive table of the dataset:

Digit_class	Verger_type	Obj_Name	Frequency	SUM_Area (ha)	MEAN_Area (ha)	MEAN_Tree Count
1	0	Orchard-Low tree density	3803	5716	1,5	48,8
1	1	Orchard-Traditional	7629	10376	1,4	88,8
1	2	Orchard-Diversified	1216	2535	2,1	111,7
1	3	Orchard-Intensive export	285	1098	3,9	370,4
2	999	Vegetable crops	4277	4999	1,2	18,4
3	999	Shrubs	1251	26237	21,0	460,6
4	999	Urban area	950	3132	3,3	68,5
5	999	Waternet	72	593	8,2	7,3
6	999	Sandpit	174	359	2,1	26,3

Mango Orchard Typology in the Niayes Region (2017)

Context: The Niayes zone is Senegal's primary mango export region (Ternoy et al., 2006). Producers employ various mango tree cultivation methods, from extensive (tree planted in bare soil) to intensive (modern, single-variety, high density orchards) (Fall & Fall, 2001). Despite diverse practices and orchard structures (planting density, crop diversity, mango varieties), four main orchard types emerge (Fall & Fall, 2001; Grechi et al., 2013). To estimate the area of each orchard type, we hypothesize that spatial structure (planting density, tree arrangement, canopy surface variability) can help determine typology. Thus, satellite image processing using object-based analysis and expert photointerpretation should (1) delineate each orchard and (2) classify orchards by type.

Typology: The typology of Niayes mango orchards, inspired by Grechi et al.'s 2013 study in the adjacent Thiès region (Grechi et al., 2013), includes four types of orchards based on: mango cultivation methods, spatial configuration (tree alignment), and species composition (other tree species, vegetable cropping, mango varieties).

Type T0 orchards are characterized by very low tree density. In fact, they may be more accurately described as shrublands with scattered trees rather than true orchards, due to the sparse presence of mango trees.

Type T1 Traditional Extensive Orchards on Bare Soil, are dominated by mango trees—mainly Kent, BDH, and Keitt varieties—with a few citrus trees present. Trees are randomly spaced and vary greatly in size. These orchards receive minimal maintenance: there is no fertilization, pesticide use, irrigation, or pruning, and fallen mangoes are left on the ground. No associated crops are cultivated, and soil management is limited to a single annual clearing of dry grass after the rainy season.

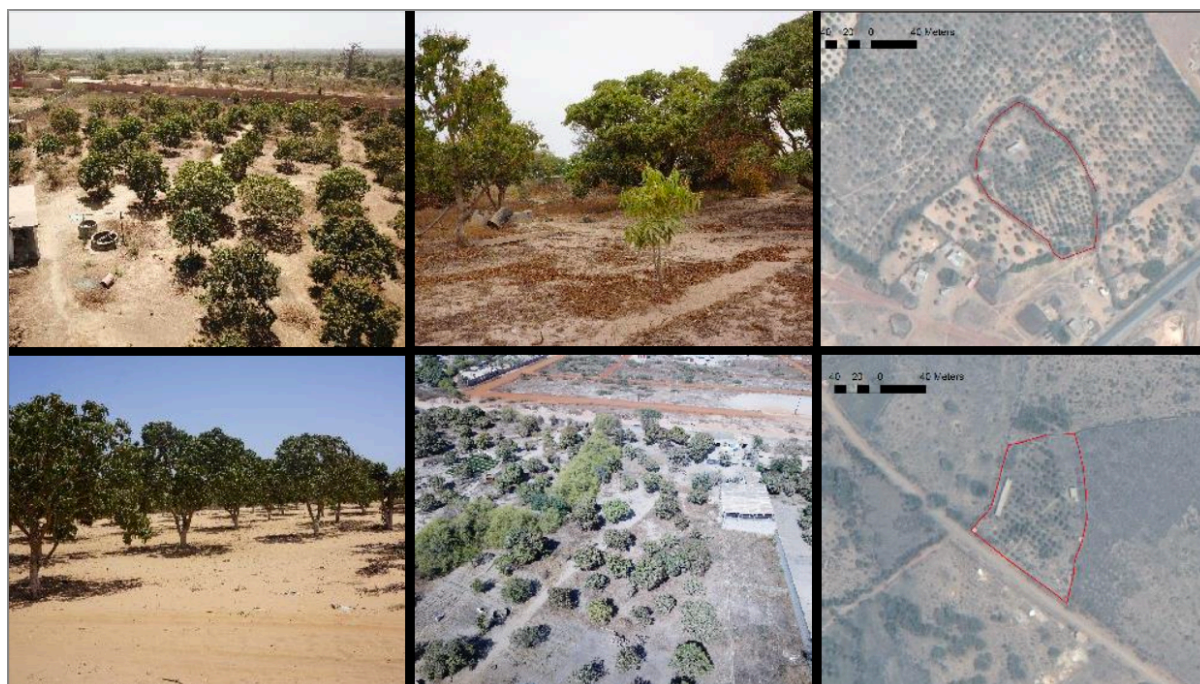


Figure 2: Images of Type 1 Traditional Extensive Orchards. Ground-level photographs are shown on the left, drone images are in the center, and satellite imagery appears in the right column.

Type 2 Intensifying and Diversified Orchards are primarily composed of mango trees along with citrus species such as lemon, mandarin, and grapefruit, and may also include guava, papaya, soursop, cashew, or sapodilla. These orchards typically feature at least two mango varieties, often three or four, with trees randomly spaced and highly variable in size. Management practices include moderate maintenance, such as pruning every one to two years, organic fertilization, occasional irrigation, and systematic collection of fallen mangoes. Vegetables like cabbage and onions, as well as peanuts during the rainy season, are commonly grown as associated crops. Soil is manually managed and generally left bare except where vegetables are cultivated.



Figure 3: Images of Type 2 Intensifying and Diversified Orchards. Ground-level photographs are shown on the left, drone images are in the center, and satellite imagery appears in the right column.

Type 3 orchards are Intensive and Monovarietal Orchards dedicated to export, planted exclusively with a single mango variety—typically Kent or Keitt. These large orchards, often divided into parcels, feature trees planted in aligned rows. Maintenance is intensive, involving regular use of mineral fertilizers, irrigation, pesticides, and annual pruning to shape the trees. There are no associated crops, and soil management is carried out manually, mechanically, and/or chemically.

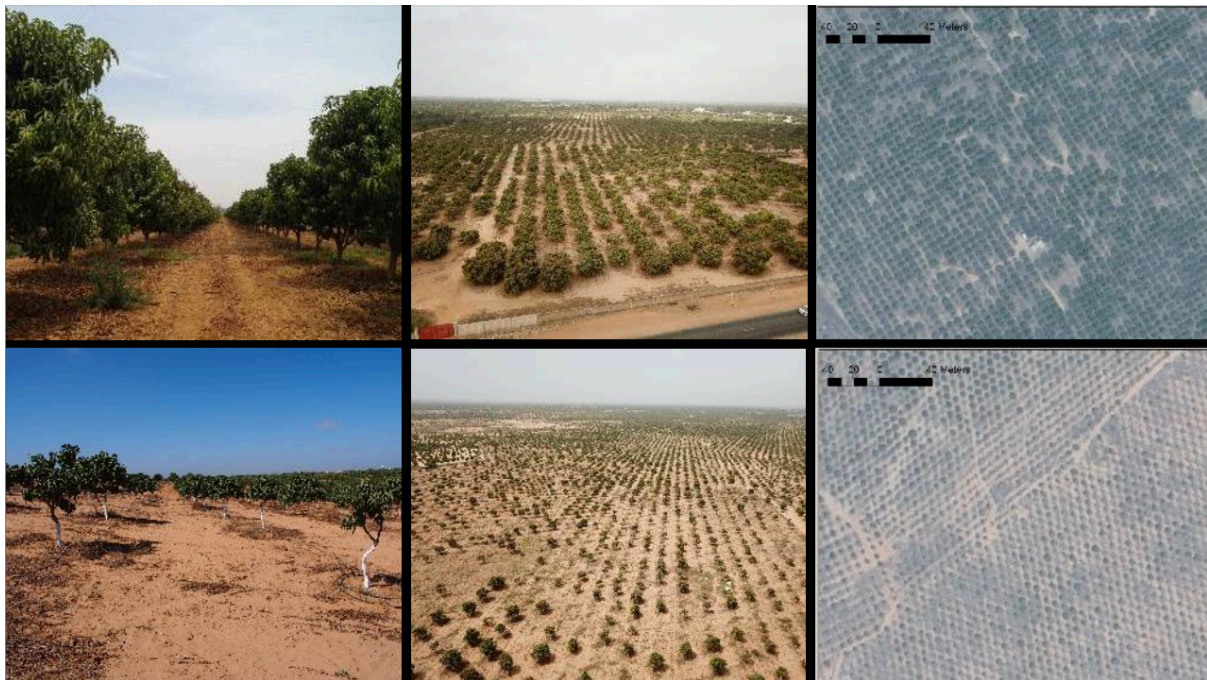


Figure 4: Images of Type 3 Intensive and Monovarietal Orchards. Ground-level photographs are shown on the left, drone images are in the center, and satellite imagery appears in the right column.

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