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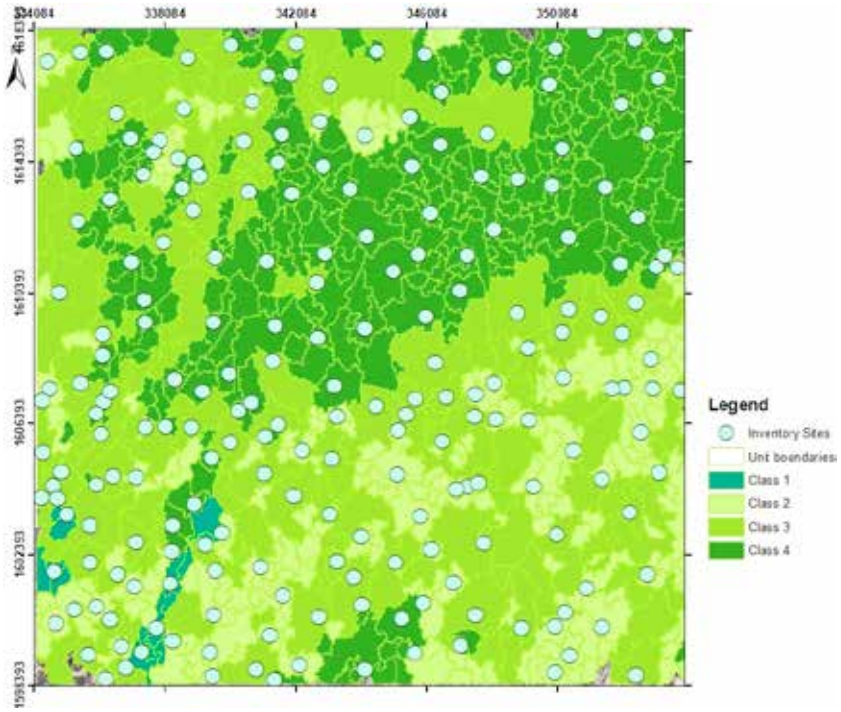
A remote sensing based approach for optimizing sampling strategies in tree monitoring and agroforestry systems mapping

Ndao B.[1] (babacar.ndao@cse.sn), Leroux L.[2], Diouf A. A.[1], Soti V.[2], Sambou B.[3]

[1] *Recherche & Développement, Centre de Suivi Ecologique, Dakar, Senegal*; [2] *UPR AIDA, Cirad, Montpellier, France*; [3] *Institut des Sciences de l'Environnement, Université Cheikh Anta Diop, Dakar, Senegal*

Characterizing agroforestry systems (AFS) at landscape scale is of a great importance for development planning at regional scale in Africa. Therefore, the major constraint to effective AFS mapping with remote sensing is the high diversity within landscapes. To have a robust and representative sample of training data, this study proposes an optimized sampling strategy guided by the AFS functioning and allowing to take into account the landscape diversity. A simple and reproducible approach based on unsupervised classification of remote sensing data and an *a priori* knowledge on the environment functioning is developed. The study is conducted on AFS of the Senegalese Peanut Basin.
Assuming that AFS landscapes with similar trees and crop cover composition will have similar phenological development, a multiresolution segmentation was performed on Sentinel-2 NDVI time series to obtain homogeneous landscape units. Then for each unit, landscape diversity proxies were derived from various geospatial data sources, namely vegetation productivity and its temporal dynamic, actual evapotranspiration, woody cover rates and soil type. Using a hierarchical clustering, four classes of typical unit of the landscape heterogeneity gradient were obtained.
On this basis an optimized sampling plan was produced and used to carry out an inventory campaign of tree biodiversity (figure). The results showed a well-defined landscape diversity gradient, confirmed by the field inventory of tree species.



Landscape heterogeneity gradient divided into four classes and the distribution of tree inventory sites. More than 8000 trees including 41 species have been inventoried covering 213 landscape units distributed accordingly to the weight of each landscape class

Keywords: remote sensing, agroforestry system, sampling strategy, landscape heterogeneity, landscape classification.