

Horticultural Agroforestry Systems in the humid tropics: analysis of a clove tree-based system in Madagascar

Michels T.², Bisson A.¹, Ralaidovy V.¹, Rabemananjara H.¹, Jahiel M.¹, Malézieux E.³

¹CTHT, HortSys Unit, Madagascar
²CIRAD, HortSys Unit, Reunion Island
³CIRAD, HortSys Unit, Montpellier

Agroforestry systems (AFS) are cultivated systems that include several species both annual and perennial and often combine several strata. In wet tropical areas, AFS are often the only means of subsistence for poor farmers, but also potentially vector of economic and social development. Coffee and cocoa agroforests are well known in various parts of the world but agroforestry systems based on horticultural perennial crops also exist. Our objective was to analyse such horticultural AFS based on clove trees that exist on the east coast of Madagascar. A regional systemic analysis of farms and cropping systems based on clove production was undertaken in 2010 in the Fénérive-Est district of Madagascar (2,615 km²). We surveyed 48 farms (Michels et al., 2009) distributed in four municipalities, chosen in order to vary accessibility to transportation routes and situations proximity to the coastline. Three scales were considered, plot structure, cropping system and farming system, in order to identify the principal characteristics, functions, constraints and efficiency of clove-based AFS.

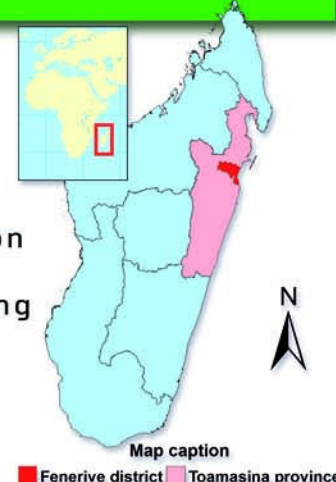


Figure 1 : Study location

1 Four distinct groups of farming systems

Taking an on-farm survey approach, and using a multivariate analysis of agro-economic data, we identified four groups of farms.

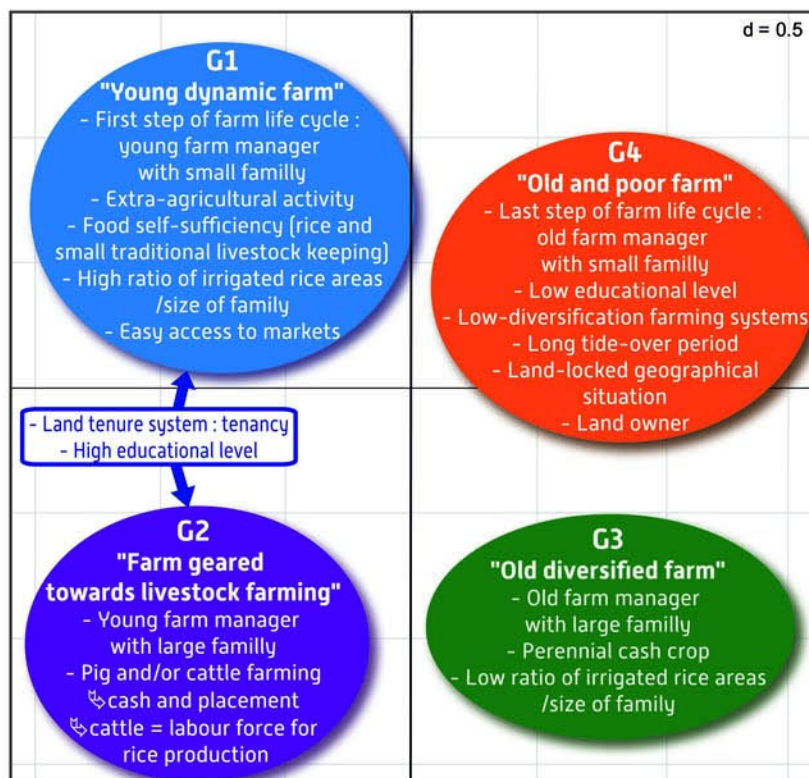


Figure 2 : Multiple Component Analysis (MCA) taking an overall farm approach.

We found four main farming systems characterized by both (i) the family situation, which was linked to the educational level, (ii) the logistics context, which was linked to the choice of crops, income levels and sources, and (iii) geographical contexts, which were linked to the land tenure system.

3 AFS structure

We analysed 16 complex ASF located on 16 different farms in three municipalities. We counted trees, identified species, and classified them according to their use (i.e. clove, coffee, fruit, and forest species for sawlog and firewood). The average percentage of clove trees (figure 4) showed the major position held by this crop in AFS. Considering clove, coffee and fruit trees as cash crops, these systems are considerable income sources for farms. Figure 5 shows the diversity of fruit species. Each plot contained an average total of 5.5 fruit species distributed over an area varying between 0.17 and 1.4 ha.

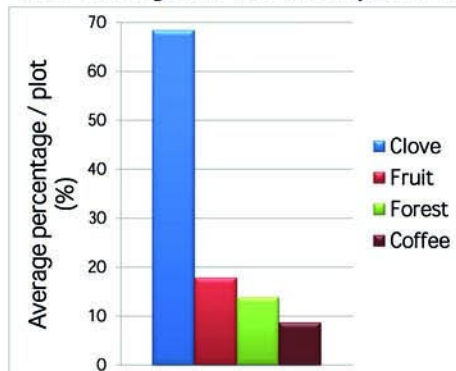


Figure 4 : Average composition of ASF calculated on 16 plots

2 Three crop management types

This second scale was intended to aimed at classifying the different clove cropping systems. These systems were characterized both by (i) spatial organization and structure and (ii) the clove production target, i.e. cloves and/or essential oil.

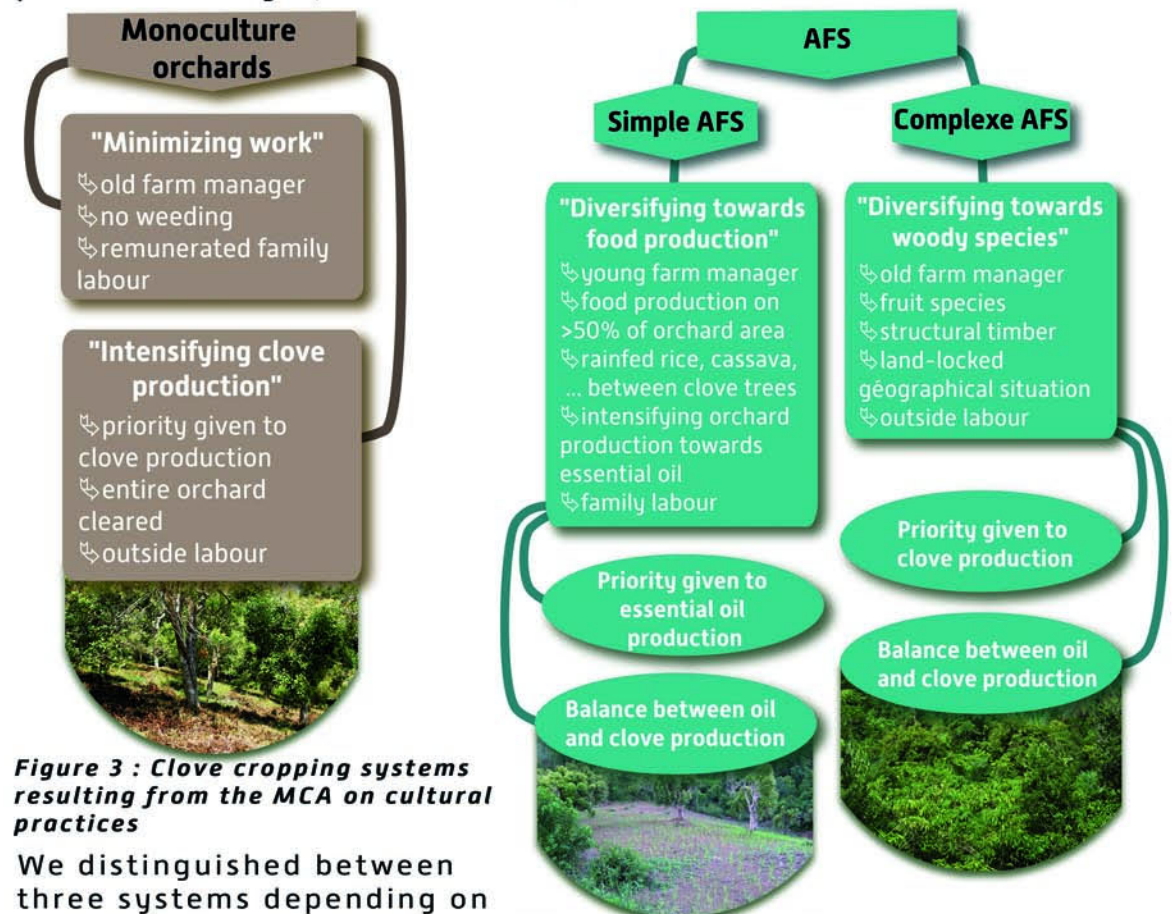


Figure 3 : Clove cropping systems resulting from the MCA on cultural practices

We distinguished between three systems depending on spatial management of the plots : monoculture orchards, simple agroforestry systems (AFS), and complex AFS. Within each system, the choices between clove and/or oil production, weed management, and some social data led to the identification of sub-groups characterized by production strategies.

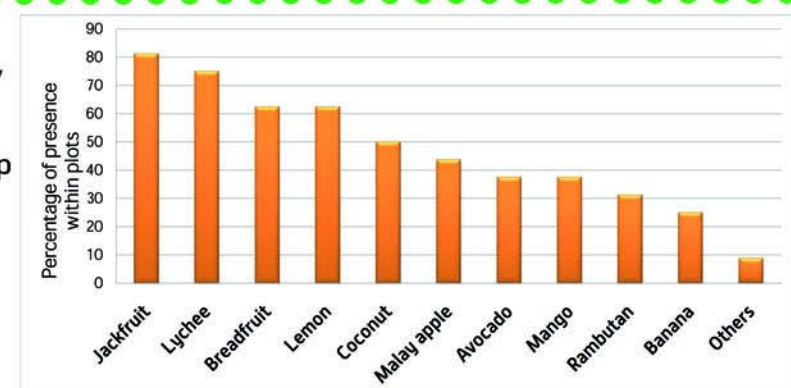


Figure 5 : Fruit species according to their frequency of appearance within the 16 surveyed plots

Conclusion

The results revealed the importance of clove-based AFS in the ecological, economic and social balance of the surveyed farms. These systems are resilient to both climatic (cyclone)

and economic fluctuations, and are likely to offer important ecological services when compared to traditional "slash and burn" systems on hillsides. The potential of these systems to store carbon remains to be studied and could be a topic of interest for a Clean Development Mechanism (CDM) project. Further studies should be undertaken to gain a better understanding of the ecological and social functioning of such systems.