

# Classification of Agroforestry System in Tunisia



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## Abstract

To mitigate the damages caused by climate change, various approaches have been implemented. Among these approaches we find conservation agriculture and carbon farming, which are based on combining arboricultural, forest, or semi-forest tree species with low-growing annual crops and/or livestock. These systems, referred to as agroforestry systems, are generally centered on olive trees, which represent a dominant crop in Tunisia. However, the wide distribution of several categories of agroforestry systems based on semi-forest tree species remains poorly documented. Therefore, through this study, we aim to classify the different agroforestry systems present in Tunisia.

**Keywords:** Climate change; Semi-forest-species; Agroforestry; Conservation

## Introduction

Agroforestry was defined by Nair et al. [1] as a land management system in which trees or shrubs are deliberately integrated with annual crops and/or livestock on the same land unit, arranged spatially or temporally to promote positive interactions between biotic and abiotic factors.

Agroforestry systems (AFS) in Tunisia have been adopted for several decades and represent an integral part of traditional farming systems. They were primarily developed to provide food for both human consumption and livestock while simultaneously contributing to the conservation of natural resources. In particular, these systems play a crucial role in soil protection and improvement, erosion control, maintenance of soil fertility, and the adaptation of agroecosystems to the often-challenging climatic conditions of the country.

From northern to southern Tunisia, a wide diversity of agroforestry systems can be observed, classified according to their uses, with each system further subdivided into sub-classes based on its structure and functions. Amatya et al. [2] classified agroforestry systems (AFS based on the criteria presented below, as well as on the spatial distribution and level of component arrangement, incorporating both ecological and socio-economic considerations.

In this study, agroforestry systems (AFS) in Tunisia were classified according to the combination of different components

and their nature. Such groupings can be used to facilitate analysis and to provide a comprehensive perspective that supports effective policy formulation and best management practices. The main agroforestry system types include agrisilvicultural, agrosilvopastoral, and silvopastoral systems, as well as trees for soil conservation, home gardens, alley cropping, and boundary plantations. How can such agroforestry systems (AFS) be identified, given that some agroforestry system classes may be very similar yet are referred to by different names? This study aims to characterize the major agroforestry systems, according to existing classification frameworks, across Tunisia and to understand the underlying drivers of their adoption.

## Agroforestry System Classification

Based on System 's structure (nature and arrangement of components), and function, a system is developed (Figure 1).

The Agroforestry system is divided in two parts; first based on the structure of the system, and the second on the function of this system:

### Structure of the agroforestry system

The first subdivision is based on nature of component:

a) **Agrisilvicultural system:** This land-use system integrates trees and crops on the same plot, enhancing the benefits arising from their biological interactions (Figure 2).

**b) Silvopastoral systems:** This land-use system integrates trees, forage crops, and livestock, with grazing animals managed under tree canopies that provide shade and protection. These commonly include trees on rangeland or pasture, protein banks, plantation crops with pasture and animals [3].

**c) Agrosilvopastoral system:** is an intensive, multi-layered approach that includes various trees, shrubs, herbs, vegetables, and livestock and commonly practiced in Djebba

**d) Horti-Agroculture system:** Horticulture system

consists of the main crop, filler crop and intercrops with different layer and production system, but in some cases the filler is absent [4]. Crops such as zucchini, fababean and seasonal vegetables were grown under the fruit trees. This agroforestry system adopted both in the terai and mid-hills, however, the species were varied. The major fruit trees planted in terai were ficus carica, olea europea, juglan regia, and Citrus limon. Whereas, in the hills, planted Ficus carriaca. The crops were generally seasonal vegetables, potato, pipper and tomato landrace (Figure 3).

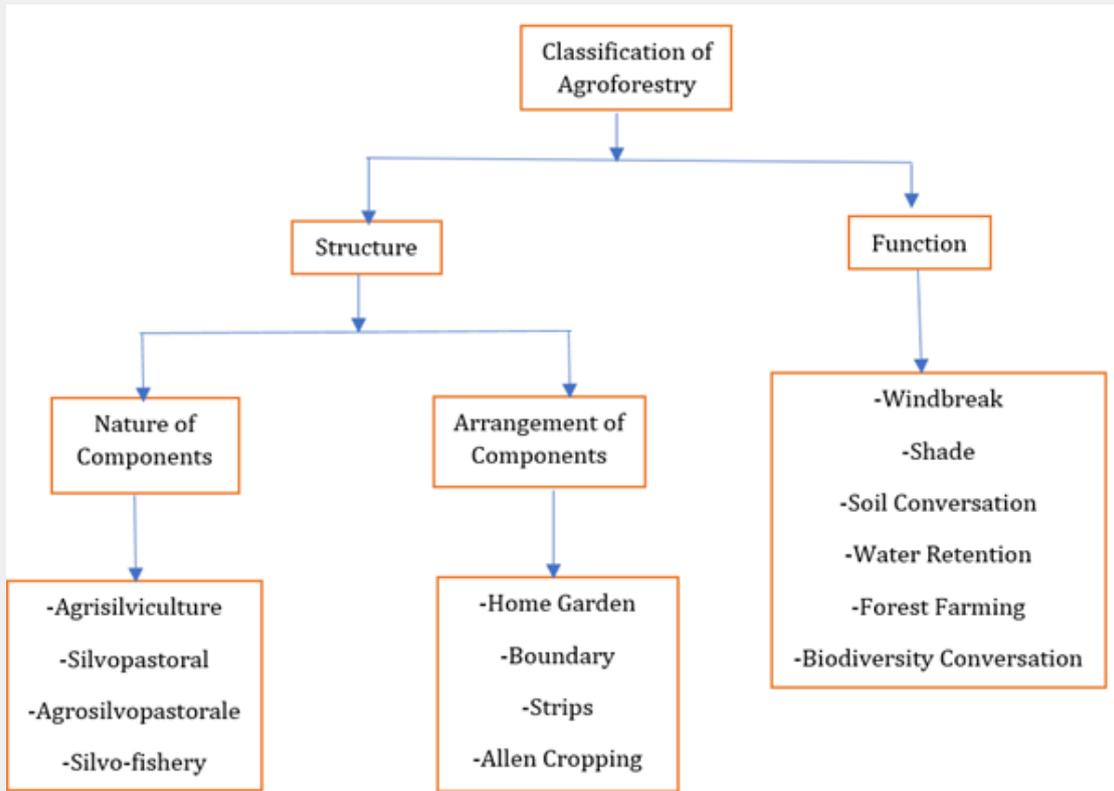


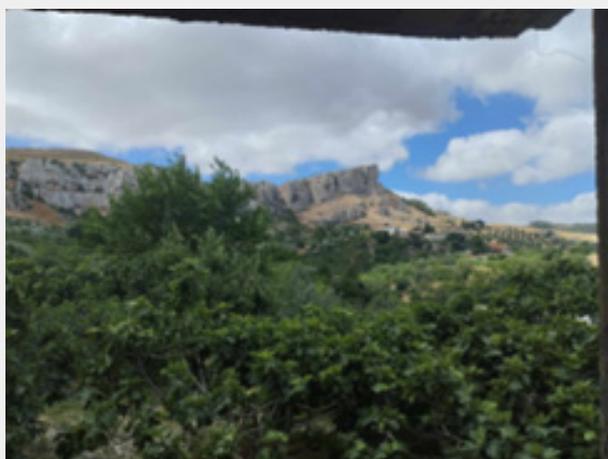
Figure 1: Classification of Agroforestry system.



Figure 1: LEED scorecard [4].



**Figure 3:** Fig tree intercropped with Zucchini.



**Figure 4:** Home Garden in Djebba.



**Figure 5:** Pecan with faba bean.



Figure 6: Tree protected with terrasse.

### Arrangement of components

**a) Homegardens:** Involving animals, and riparian buffer strips [5] and these are prominent in North Tunisia (Djebba) (Figure 4).

**b) Alley cropping** Alley cropping is a widely practiced agroforestry system in which perennial trees or shrubs are planted in widely spaced rows, allowing annual crops to be cultivated in the inter-row spaces during the early growth stages before the perennial canopy becomes fully developed. [6,7]. Under such conditions, specialty and annual crops contribute to regular cash flow essential for small farmers, while perennial crops provide fodder, fuelwood, and timber in the medium and long term (Figure 5).

**c) Boundary:** Plantation refers to the deliberate planting of trees or shrubs along farm boundaries, field margins, or property lines. This practice allows farmers to optimize land use without significantly reducing the area available for crop production. Boundary plantations provide multiple benefits, including soil conservation, windbreak effects, microclimate regulation, and enhanced biodiversity. They also supply products such as fuelwood, fodder, fruits, and timber, while contributing to carbon sequestration and climate change mitigation.

### Classification according to function

**a) Soil conservation and water retention:** A major advantage of agroforestry lies in its ability to regulate the water cycle and mitigate soil erosion. Tree roots penetrate deeply into the soil, anchoring it and limiting surface runoff that could otherwise cause erosion. Additionally, these roots improve water infiltration, reduce runoff, and enhance groundwater recharge [8] (Figure 6).

**b) Windbreak:** Tree wind breaks, are an option to reduce

water consumption in irrigated agriculture. Tree wind breaks reduce water consumption (evapotranspiration – ET) of crops, help increase crop yields, and offer additional income sources. The main effect by tree wind breaks is to reduce wind speed which is the main driver to reduce crop water consumption leeward of such tree wind breaks [9].

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