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**AGROECOLOGICAL AND AGROFORESTRY APPROACHES FOR A
SUSTAINABLE FUTURE**

Applying landscape connectivity approaches in agroforestry to identify priority areas for reforestation: a case study in Sicily

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Southern Italy, particularly Sicily, has undergone extensive reforestation in recent decades.

However, many areas remain degraded or underutilised, especially in fire-prone landscapes where earlier reforestation relied on rigid, top-down approaches. These often-involved dense monocultures that were poorly adapted to local ecological conditions, resulting in limited long-term success and low resilience to wildfire and climate change.

The recent Italian National Forest Strategy marks a paradigm shift towards ecological restoration. It emphasises the creation of multifunctional forests (Action A.7.2.a) and the restoration of ecological corridors (Action A.7.2.b). In this context, agroforestry, the integration of trees into agricultural or pastoral systems, emerges as a highly adaptive and multifunctional tool. Such systems enhance biodiversity and connectivity while generating ecosystem services such as carbon sequestration, erosion control and fodder production, making them particularly well-suited to Mediterranean landscapes under climate stress.

This study aims to identify priority areas for agro reforestation in Sicily using ecological connectivity models, while considering ecological suitability and operational feasibility. The research addresses three core questions:

- Where should reforestation be prioritised to improve ecological connectivity under ecological and logistical constraints?
- How can agroforestry approaches reinforce and sustain landscape connectivity?

-Which native species are best suited to local conditions?

The study focused on Monte Gradara, a Natura 2000 site (ZSC and ZPS) located approximately 25 km from Palermo. Despite its high conservation value, the area has been severely impacted by wildfires. The area includes large expanses of state-owned land, making it an ideal location for a pilot study.

We applied graph-based connectivity models using the Integral Index of Connectivity (IIC) at dispersal distances of 500 m, 1,000 m and 1,500 m to reflect species with different dispersal abilities.

These models helped us to identify fragmented habitat patches and potential corridors that would benefit most from reforestation. We then filtered the results based on operational feasibility, including proximity to roads, accessibility, and spatial continuity, to ensure practical implementation.

To inform species selection, we consulted potential natural vegetation maps and ecological homogeneity areas. Suitable native species include *Pyrus pyraster* (wild pear), *Pistacia lentiscus* (mastic), *Phillyrea latifolia* (mock privet), *Arbutus unedo* (strawberry tree), *Fraxinus ornus* (manna ash) and *Olea europaea* var. *sylvestris* (wild olive). These species offer multiple benefits: they support biodiversity, restore degraded soils, increase carbon storage and provide fodder or edible fruit — key features for agroforestry systems that integrate ecological and productive functions.

This study offers a replicable model for combining landscape connectivity planning with agroforestry design. It supports national and European restoration objectives, particularly those set out in the EU Nature Restoration Law, and shows how spatial modelling, selection of native species and field feasibility analysis can be brought together to guide sustainable, multifunctional reforestation in Mediterranean environments.

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