Agroforestry in Tuscany within AGROMIX, Italy

Year of issue

2025

Summary

Agroforestry in Tuscany links farm practice and research to build climate resilience. Two complementary trial sites show how trees, crops and livestock are combined under AGROMIX and the regional GO NEWTON network. At Tenuta di Paganico (Grosseto), a silvopastoral system uses tree shade to buffer Mediterranean heat. Monitoring tracks animal behaviour, heat load, performance and hair cortisol. Results show clear summer benefits: cattle in shaded paddocks maintain average daily gain and lower heat stress, while in spring differences fade when thermal stress is low. At Arnino (CiRAA, Pisa), silvoarable alley cropping tests tree rows within rotations to improve soil fertility, biodiversity and carbon. Measurements cover yields, soils, weeds, microclimate and plant water status, building a long-term evidence base.

Design choices focus on tree density, windbreaks and machinery access, with practical challenges such as wildlife pressure and tree protection. Funding combines H2020 AGROMIX and the Tuscan rural programme; governance relies on a living-lab approach with farmers, universities and regional partners. Outreach includes demos and an Agroforestry School. Expected hydrological co-benefits are higher infiltration and soil moisture retention, supporting drought adaptation. The case shows that shade delivers fast welfare gains in hot summers, while soil and carbon benefits require time, making agroforestry a robust path for Mediterranean farms.

Photo Gallery





Location

43.66, 10.32

Sector

Agriculture

Installation Date

2018-ongoing

Contact

University of Pisa – CiRAA; Tenuta di Paganico Soc. Agr. S.p.A.

Overview

Location of the project

Sites at Tenuta di Paganico (Civitella Paganico, Grosseto) and at CiRAA “Enrico Avanzi” in San Piero a Grado (Pisa).

Sponge measures implemented in the case study

Agroforestry

Intercropping

Crop rotation

Objectives

Reduce livestock heat stress and stabilise summer weight gain

Enhance soil fertility and carbon sequestration

Improve microclimate, biodiversity and overall farm resilience

Involved partners

Authority type	Authority name	Authority role	Comments	Authority responsibility
Research institute / University	University of Pisa – CiRAA	Monitoring	research, coordination	Responsible
Research institute / University	Scuola Superiore Sant’Anna	Monitoring	—	Supporting
Research institute / University	CREA – Council for Agricultural Research	Monitoring	—	Supporting

Authority type	Authority name	Authority role	Comments	Authority responsibility
Other	ANCI Toscana	Other	networking and dissemination	Supporting
Farmers	Cooperativa Il Rinnovamento	Implementation	on-farm demos	—

Site Information

Climate Zone

Warm temperate dry

Temperature (°C)

15.00 °C

Elevation range

1 - 65 m

Slope range

Low to gentle slopes

Vegetation class

Mediterranean pastures and woodland for silvopastoral system; arable crops with tree rows for silvoarable

WFD Ecological status

Unknown

WFD Chemical status

Failing to achieve good

Design and Implementation

Project scale

Micro

Project scale specifications

Tenuta di Paganico: 1,100 ha estate with forests, pastures, olive groves, vineyards and arable fields Arnino: 40 ha long-term experimental farm blocks

Project area

40 ha + 1,100 ha

Principles

Multifunctionality and climate adaptation

Tree shade and diversified structure to buffer heat and drought

Alley-cropping to integrate trees with crops and livestock

Living-lab approach linking researchers and farmers

Factor constraints

Mediterranean summer heat and drought increase the value of tree shade

Coastal plain winds and wildlife pressure at

Arnino require adapted layouts and protection

Operational constraints include machinery access in alleys and grazing management around trees

Financing

Financing authorities

Authority name	Type of funding	Comments
European Union	Other	H2020 (AGROMIX)
Regione Toscana	Sub-national funds	PSR FEASR GO NEWTON

Compensations

No

Policy and Governance

Policy description

Climate adaptation and sustainable intensification in Mediterranean agriculture Contributions to soil conservation, biodiversity, animal welfare and carbon objectives

Target remarks

Improve animal welfare and productivity under heat stress

Test agroforestry for soil fertility, carbon and biodiversity benefits

Pressure remarks

Rising summer heat stress on livestock

Soil and water stress in dry summers

Need for diversified, resilient farm systems

Part of a wider plan

Yes

Wider plan

Wider plan type	Wider plan focus	Name
—	Agriculture	AGROMIX project
Regional	Agriculture	GO NEWTON regional network

Public consultation

Yes

Consultation activities

Activity stage	Activity type
Implementation phase	Workshops, open days, guided visits and a regional Agroforestry School under GO NEWTON

Has contractual arrangements

No

Impacts and Monitoring

Monitoring System

Monitoring parameters

Structured monitoring at both sites Animal performance, heat load indices, behaviour and hair cortisol Crop yield, soil fertility and carbon, weed diversity, microclimate and plant water status Regular meetings in living labs between researchers and practitioners

Maintenance

Maintenance requirements

Tree protection and pruning Rotational grazing planning and pasture management Row management in alley-cropping and machinery lanes

Impact Assessment Methodology

Biophysical impact assessment method

Field trials with treatment comparisons
On-farm trials with seasonal measurements Combination of quantitative indicators and qualitative farm feedback

Socio-economic Impacts

Direct benefits

Knowledge co-production and skills development via regional network
Seasonal stability of average daily gain during hot periods
Summer animal welfare improved in shaded silvopastoral paddocks

Biophysical impacts: Hydrology

Information on retained water

Expected increase in infiltration and soil moisture retention under tree-crop-pasture mosaics

Lessons Learned

Key lessons

Shade delivers clear welfare benefits in hot Mediterranean summers
Benefits are context-dependent in mild seasons
Operational details matter: layout, tree density, windbreaks and access for livestock and machinery
Farmer–researcher co-design accelerates adoption

Barriers

Barrier type	Barrier role	Comments
Lacking financing sources	Main barrier	Limited long-term funding for monitoring
Limited staff and consultant knowledge	Secondary barrier	Knowledge gaps on machinery logistics and tree protection in arable rotations

Barrier type	Barrier role	Comments
Other	Secondary barrier	Wildlife competition in coastal plain site

Drivers

Driver type	Driver role	Comments
Balancing different objectives	Main driver	Heat stress risks and the search for resilient systems

Success factors

Success factor type	Success factor role	Comments
Attitude of relevant stakeholders	Main factor	Large estate and university farm enabling robust trials
Communication activities	Main factor	Regional school, demos and certification pilots building capacity and legitimacy

Cost effectiveness

Tree establishment and protection are upfront costs; welfare and resilience gains materialise quickly in hot seasons while soil and carbon benefits need longer horizons

Transferability

Approach is transferable to Mediterranean areas with summer heat stress Design must adapt to local soils, wind, wildlife and farm machinery

Sources

Sources

Tenuta di Paganico

Arnino

AGROMIX | Homepage

PS-GO 2017 – NEWTON

PS GO NEWTON – NEtWork per l’agroselvicoltura in TOscaNa

Relazione finale GO NEWTON

Outcomes of a comparison between pastoral and silvopastoral management on beef cattle productivity, animal welfare and pasture depletion in a Mediterranean extensive farm

Beef cattle performance and hair cortisol accumulation in silvopastoral and pastoral systems: a 2-year assessment

Transforming European landscapes with trees, crops and livestock