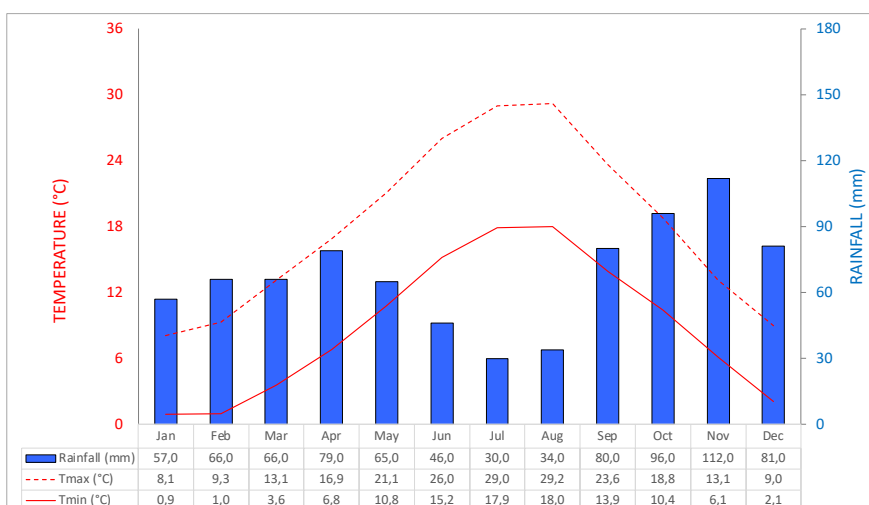# Testimonial video and associated training material

5. Agroforestry

Luigi Fabbrini is the agronomist of the public "Demo Farm" of Cesa (Arezzo), a fertile area that was traditionally characterized by the presence of mixed cropping systems with trees and herbaceous crops grown together. Luigi has started to reintroduce and revisiting those systems, and started a mixed cultivation of olive, barley and clover. In particular, he cultivates 2.5 hectares with olive trees together with clover and barley. The agroforestry system is now at the beginning but Luigi's is planning to expand the surface in the coming years.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	57,0	66,0	66,0	79,0	65,0	46,0	30,0	34,0	80,0	96,0	112,0	81,0
Tmax (°C)	8,1	9,3	13,1	16,9	21,1	26,0	29,0	29,2	23,6	18,8	13,1	9,0
Tmin (°C)	0,9	1,0	3,6	6,8	10,8	15,2	17,9	18,0	13,9	10,4	6,1	2,1

Cesa has a warm and temperate climate. The average annual rainfall is 812 mm. Usually November is the most wet month (more than 100 mm), while July is the driest (about 30 mm).
The average temperature is 13.5 °C with maximum values in June-July (about 29 °C) and minimum values in January-February (1-2 °C).

The farm is located on a plane area, characterized by soils with various textures, ranging from loamy-sandy (with 12% clay) to clay (up to 45% clay). Here, land is mostly used for herbaceous and horticultural crops.

Introduction to agroforestry

Agroforestry is defined as the "deliberate integration of woody vegetation (trees or shrubs) with crop and/or animal systems to benefit from the resulting biological, ecological and economic interactions". Agroforestry can also be defined as a dynamic, ecologically based, natural resource management system, which, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users. Agroforestry systems are multifunctional systems that can provide a wide range of economic, sociocultural, and environmental benefits.

Compared to conventional agriculture, agroforestry can reduce soil degradation, soil erosion, nitrate leaching and net greenhouse gas emissions, while it is seen as one of the most important tools to help agricultural and forest land to mitigate climate change through the sequestration of carbon into soil and (tree) biomass. Due to its long-term nature, the establishment of agroforestry systems facilitates carbon sequestration processes that have temporal variation and can result in the transfer of carbon from more easily decomposable to more durable carbon fractions.

Agroforestry: why?

Agroforestry brings numerous benefits but there are also challenges that should be addressed through a careful planning and management.

SOIL FERTILITY	● The leaf litter and pruning residues from trees provide organic matter, which improves soil structure, enhance moisture retention and increases nutrient cycling. This leads to healthier and more productive soils for agricultural crops. ● Tree species may compete with agricultural crops for nutrients, especially in the early stages of tree growth. This competition can reduce nutrient availability for crops and potentially impact their productivity. Livestock can compact the soil, reduce infiltration and increase soil erosion.
WATER	● Tree canopies protect soil from erosion, while their deep roots improve water infiltration and reduce surface runoff, helping to recharge groundwater. Additionally, shade and windbreaks provided by trees can reduce evaporation, limit soil moisture loss, and create a more favourable environment for plant growth. ● Water requirements of trees may be higher than those of some agricultural crops. This increased water demand may limit the availability of water for irrigation, potentially impacting crop yields. Increased infiltration can also cause more nutrient leaching for annual crops
CLIMATE CHANGE	● Trees play a crucial role in climate change mitigation, as they uptake CO_2 from the atmosphere and store into the wood. Agroforestry is also considered an adaptation strategy as trees provide shade, which can help regulate temperatures and give the livestock a better microclimate. ● The time required for trees in agroforestry systems to reach maturity and sequester significant amounts of carbon can be a disadvantage, as it delays the full climate change mitigation potential of the system. Also, while tree canopies provide shade and regulate microclimate, they can also create a more humid environment, which can increase the risk of certain crop diseases and pests that thrive under such conditions.

- The presence of different type of crops and trees create a diverse and complex habitat, and offers habitat for a wide range of plants, insects, birds, and other wildlife. This contributes to the conservation of biodiversity and the preservation of ecosystem services.

- Agroforestry systems that involve the introduction of non-native tree species may pose a risk of becoming invasive and negatively impacting native biodiversity. Careful species selection and monitoring are necessary to mitigate this risk

SUSTAINABILITY

- By reproducing natural ecosystems and incorporating tree cover, agroforestry can reduce the reliance on external inputs like synthetic fertilizers and pesticides, and promote the efficient use of natural resources. Furthermore, the integration of trees with crops or livestock provides additional products such as fruits, timber, fodder. This diversification can enhance the resilience of farming systems, making them less vulnerable to market fluctuations or climate-related risks.

- Maintaining and managing agroforestry systems can be labor-intensive, requiring ongoing efforts to control weed competition, prune trees, and manage potential conflicts between tree and crop growth.
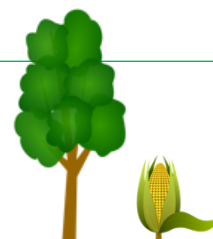
Agroforestry: how?

There are three main types of agroforestry systems:
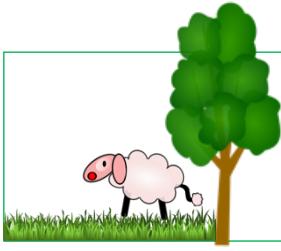
Agrisilvicultural systems
a combination of crops and trees, such as alley cropping.
Examples: olives, barley and clover; grapevine, poplar and wheat;
walnut and maize.

This agroforestry system involves cultivating crops beneath and between trees, often arranged in rows with sufficient spacing for machinery access. This practice, known as ***alley cropping***, typically employs tree rows spaced around 10 to 15 meters apart. Agrisilvicultural agroforestry can be implemented with most crops. In addition to the intercropped crops, the trees themselves provide valuable resources.

To ensure optimal growth, it is important to annually perform deep cultivation in the alley spaces, even when using techniques such as no-dig or no-till. These techniques, if employed, may result in the accumulation of tree roots within the cultivated area, even if raised beds are used.

Silvopastoral systems
which combine forestry and grazing of domesticated animals on pastures, rangelands or on-farm.

Silvopastoral systems involve the integration of grazing livestock instead of crops, as seen in agrisilvicultural agroforestry. In this approach, animals graze on the vegetation under the shelter of trees while simultaneously enriching the soil with their manure, which improves the productivity of tree crops. Trees are intentionally introduced to open fields or areas where animals already forage, and their arrangement may or may not follow evenly spaced rows.

An alternative to row planting in silvopastoral agroforestry is cluster planting. Cluster planting offers similar advantages to row spacing but provides more localized shade, which can benefit both the animals and the trees.

Another option is wide spacing, where trees are evenly spaced at greater distances from each other. However, wide spacing presents additional challenges such as potential damage from grazing animals and increased weed-related issues.

Agrosilvopastoral systems
where trees, animals and crops can be integrated.
Examples: alfalfa, barley, grazing cows; poplar, wheat and swine.
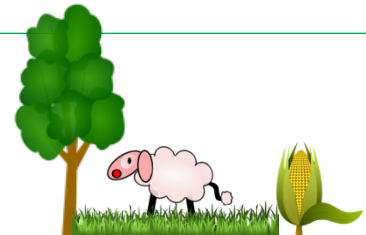
These integrated systems offer a valuable opportunity for circular food systems by effectively recycling nutrients. Through the integration of livestock, pastures, and crops, these mixed systems enhance nutrient cycling and promote sustainability. There are different forms of agrosilvopastoral systems: allowing animals to graze on previously cultivated land to consume crop stubble or fallen grain; a combination of cultivated areas and grazing areas located near or far from homesteads, where animals can be herded or tethered; cultivating land specifically for animal husbandry with zero-grazing practices, such as cut-and-carry feeding for dairy cattle, sheep, or goats.

Concluding, by combining tree cultivation with agriculture, agroforestry provides a sustainable and multi-functional approach to land use and resource management representing a valuable Nature-based Solution. However, it faces many challenges and obstacles that should be well considered before planning a new system.