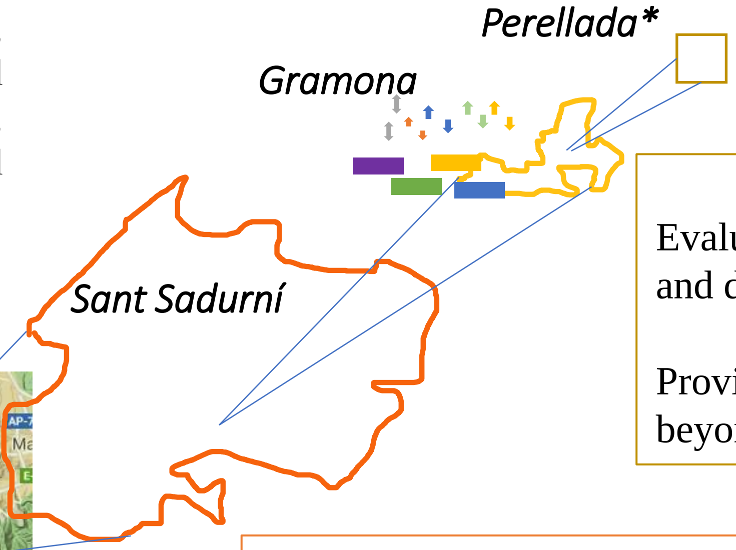
Introduction to the farm-scale analysis

Recap of the multi-scalar approach of the MA4SURE project

MA4SURE Multiscalar analytical goals

Overall objective

To characterize sustainable and profitable Agroforestry (AF) / Mixed Farming (MF) systems, resiliente and **adaptive to Climate Change (CC)**, that make efficient use of renewable resources and decrease Greenhouse Gas (GHG) emissions, evaluating their **connections** with **socioeconomic** and **policy issues.**



Plot
Test field treatments and determine best agronomic, biophysical and economic solutions

Farm
Evaluate the different practices of agricultural management and determine the best practices.

Provide benchmarks and their socio-ecological impacts beyond current and conventional averages in the region.

Landscape
Assess the influence and contribution of the implementation of best practices in a larger geographical and socio-ecological context, and vice versa (for example, the effect on GHGE, energy efficiency, biodiversity conservation, provision of ecosystem, social cohesion, system resilience and water availability)

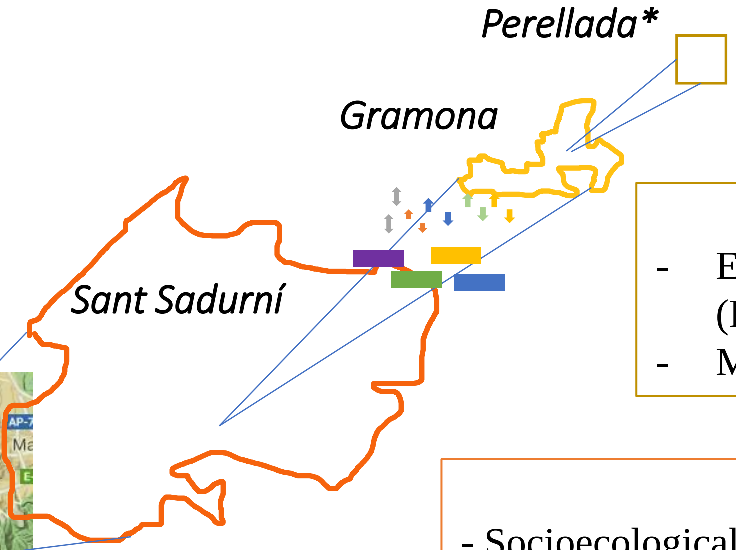
Region
Provide a representation of the current biophysical, economic and political scenarios of the Mediterranean agroecosystem and be used as a reference to the usual scenarios.

Important definitions

FARM:
An area that functionally and geographically defines a unit of Afrogorestry or Mixed Farming system conforming experimental farming sites (Living-Labs). (e.g. Gramona)

LANDSCAPE:
The greater heterogeneous area in which the experimental farm sites (Living Labs) are located.
It includes all the visible features of land, whose character is the result of the action and interaction of natural and/or human factors and between spatial patterns and ecological processes. (E.g. Alt Penédes)

Multiscalar Methods



Plot

Test field treatments (soil analyses) and determine best agronomic, biophysical and economic solutions

Farm

- Energy Efficiency Accounting of Agroecosystems (Energy Return On Investment - Erois)
- Monetary assessment (balances)

Landscape

- Socioecological Integrated Analysis (SIA)
  Landscape (territoty) and metabolism
  Ecosystem service assessment

Region

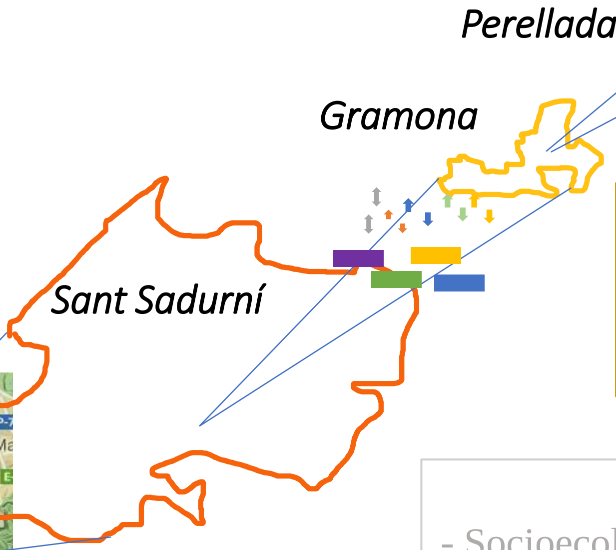
Social and political context

Assess social viability (political, cultural, economic) and feasibility.

Country (?)

Future scenarios (Climate change) and water, food, energy nexus

Multiscalar Methods



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Energy Efficency Accounting of Agroecosystems

Short introduction into Energy Return on Investment Indicators (EROIs) to assess the energy efficiency and resilience of farm systems

Agroecosystem Sustainability

Agroecosystem sustainability is defined as the system's capacity to ensuring the reproduction of fund elements (i.e., soil health, crops, forests and pastures, livestock, and associated biodiversity) that guarantee the flow of matter and energy to maintain the agroecosystem and the farmers themselves, and to provide useful goods and services to society (Tello et al., 2016).

Fund-flow model

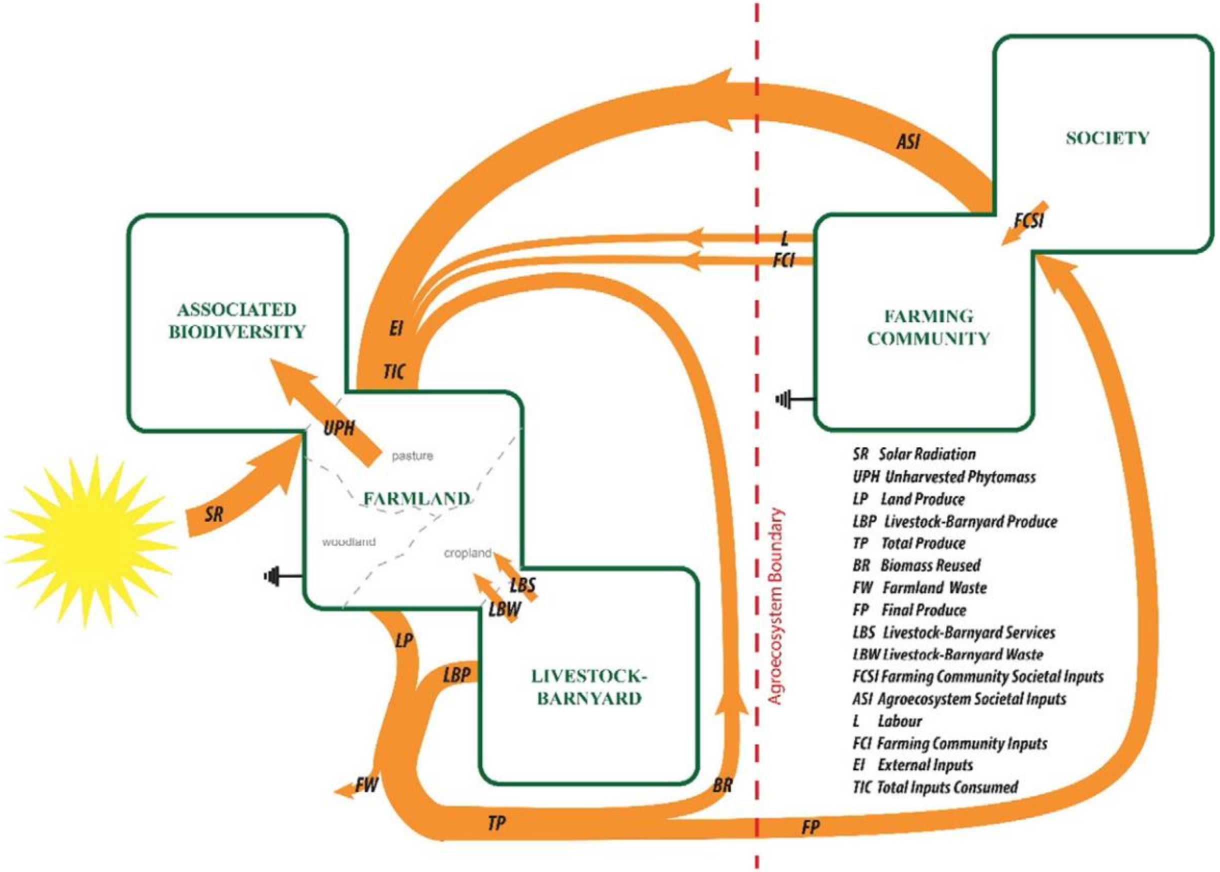
- Fund elements are elements that establish "what the system is" and provide a metric of its size. For example, biomass is a fund that is built up and maintained by solar radiation and can renew themselves and provide both ecological and economic services as long as the conditions necessary for their renewal are met. Soil fertility is also a fund, as nutrients are replenished (Gerber, EJOLT Glossary)

- Flows elements are elements that represent "what the system does", quantifying the biophysical interactions of what the fund elements do. They refer to the energy and material flows that move from one compartment of the system to another. For example, parts of the agricultural harvest obtained from the farmland flow into society in the form of food, or the inputs required by agricultural land in the form of water, energy (gasoline), or fertilizers.

Energy efficiency of agroecosystems

Epistemological basis:

- **Socio-metabolic understanding** of agroecosystems analysing the exchange of matter and energy taking place in the territory (Marull et al., 2010).
- Analysis of agroecosystems by looking at a **series of energy loops** within and between nature and society that affect agricultural activities.
- To account for the **energy throughputs of agroecosystems**, we compare the inputs invested into the farm with the final energy outputs gained to satisfy societal needs (Tello et al., 2016)



Key units of analysis:

EI = External Input
FP = Final Produce
BR = Biomass Reused

Efficiency Indicators: EROIs

- **Final EROI**: indicates the energy return on investment that farmers and society devote to get a given basket of human consumable Final Produce (FP).

E.g. Gramona Living Lab: It indicates the amount of energy required to obtain a unit of energy gained in form of must, olives, and livestock products

- **Internal Final EROI**: Internal Final EROI assesses the portion of land and livestock produce intentionally returned to the agroecosystem (i.e., as manure or animal feed), in order to obtain a unit of consumable Final Produce.

E.g. Gramona Living Lab: Indicates the amount of biomass (in energy terms) that Gramona recycles on its farm in order to produce its products and reproduce its fund elements.

- **External Final EROI**: indicates the degree of dependence of the analysed agroecosystem from the outside (external input) and thus assesses whether the agroecosystem is a net consumer or net supplier of energy for society.

E.g. Gramona Living Lab: Indicates the degree of dependence of Gramona particularly from external inputs.

Farm-level Energy Accounting

AIM:

To evaluate the different practices of agricultural management and determine the best practices from a standpoint of energy efficiency and circular economy.

What is the energy efficiency of our Living Labs at farm scale?

- Who needs to record the data and how do we manage the data recorded?
- Which flows need to be recorded?
- In which unites should the flows be recorded?
- How and over what period of time do they need to be recorded in order to carry out an EROI analysis? Where do we record the data?

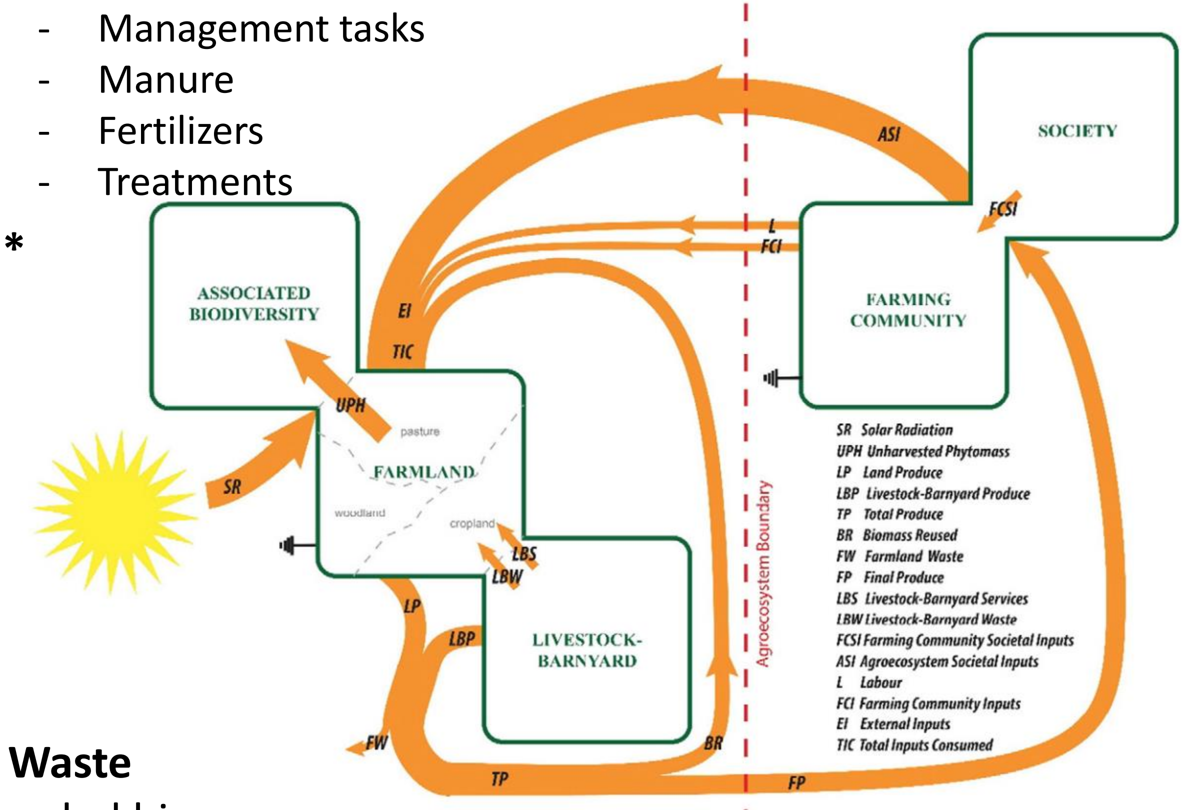
Which flows need to be recorded?

UNITS:
- ✓ Kilograms
- ✓ Hours
- ✓ Euros

Every farm **External Inputs**
- Human Labor
- Animal work (traction)
- Machinery use
- Management tasks
- Manure
- Fertilizers
- Treatments

Total farm **agricultural production***
- Final products and byproducts

Total **Biomass Reused**
- Animal feed (Produced in the farm unit)
- Animal manure (From the farm unit)
- Compost (Produced in the farm unit)



Total **Waste**
- Discarded biomass

<u>* For all the farm unit, all plots, all crops.</u>