Synergies in Integrated Systems

Improving Resource Use Efficiency While Mitigating GHG Emissions

Through Well Informed Decisions about Circularity

D1.2 Technical Briefs – Italy

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Project summary

Acronym	SENSE
Title	Synergies in integrated systems: Improving resource use efficiency while mitigating GHG emissions through well-informed decisions about circularity
Call	2021 Joint Call ERA-NET Cofund ICT-AGRI-FOOD, FACCE ERA-GAS, SusCrop and SusAn: Circularity in mixed crops and livestock farming systems with emphasis on climate change mitigation and adaptation
Duration	36 months
Website	https://sense-eranet.hutton.ac.uk/
Coordinator	The James Hutton Institute (JHI)
Partners	Centre for Ecology and Hydrology (CEH) University of Bristol (UOB) Stichting Wageningen Research (WUR) University of Hohenheim (UHOH) Demeter e.V. (Demeter) Consiglio per la ricerca in agricoltura e l'analisi dell'economia agrarian (CREA-AA) Brazilian Agricultural Research Corporation (Embrapa) National Institute of Agropecuarian Technology (INTA) Instituto Nacional de Investigación Agropecuaria (INIA)

Deliverable summary

Work package	WP1: Standardized data collection: SENSE centralized database
Task	Task 1.2: Preparing the Technical Briefs
Deliverable	D1.2: Technical Briefs
Responsible partner	WUR

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1 Introduction

Specialization, intensification and spatial separation of crop, livestock and forestry production systems have contributed to climate change and biodiversity loss. Circularity in integrated crop-livestock-forestry production systems may reduce the environmental impact of agricultural production systems by increasing resource-use efficiency while simultaneously mitigating greenhouse gases (GHG) emissions. The SENSE project (2021 Joint Call on Circularity) operates in various case studies involved in integrated crop-livestock-forestry systems in four European countries (Italy, Germany, the Netherlands, and the United Kingdom) and three South American countries (Argentina, Brazil and Uruguay).

The case studies conducted by SENSE can be classified into two categories, namely benchmark and participatory, depending on the availability of historical data and the data generated during the project. These case studies may take place on either an experimental station of a project partner or a commercial farm. In benchmark case studies, sensors will be deployed to enable near real-time monitoring of soil and climate properties (i.e., soil temperature and moisture, air temperature, rainfall, etc), to model GHG emissions and carbon and nutrient cycling (WP3). Circularity and ecological indicators will be assessed (WP2) and short-term circularity measures will be implemented and tested (WP2 and WP3). Case studies will be further co-assessed with farmers/farm managers with a multidimensional sustainability assessment tool (WP4). This will allow us to assess understanding of the current circularity status of these systems. The data we collect will drive models to determine alternate scenarios for improving resource use-efficiency while simultaneously mitigating GHG emissions (WP3), thus identifying best measures that will improve circularity within these integrated systems. To test the viability of GHG mitigation, options will be co-assessed with commercial farmers and their trade-offs with other ecosystem services and their effects on economic and environmental resilience will be further explored with a multidimensional sustainability assessment tool (WP4).

SENSE case studies in Europe and South America cover different climatic and pedological zones and exhibit different levels of integration in crop-livestock-forestry systems and a diverse range of establishment dates and species integration. A particular strength of the SENSE project is the longstanding experience (> 20 years) that South American partners have with the implementation of these integrated systems.

The aim of this Technical Brief is to present the characterization of the case studies in the SENSE project. This report showcases the case study in Italy, which is coordinated by our partner CREA.

2 Task description

In the first year of the project, a data template table has been developed and shared with all case study coordinators to compile the required data for site characterization. Compiled data includes: case study categories (i.e. benchmark, participatory, experimental station, commercial farm); type of integrated system (i.e. Integrated Crop-Livestock (ICL), Integrated Crop-Forestry (ICF), Integrated Livestock-Forestry (ILF), Integrated Crop-Livestock-Forestry (ICFL)); time under integration; area; climate and soil classification; as well as a brief description of the crop, livestock and forestry components. The results are presented in this document.

3 Case studies in Italy

There is one benchmark case study in the Italy (IT1). Table 1 exhibits the general characterization of the case study in Italy.

Table 1. General characterization of the case study in Italy.

Case study	Location	Institution	Experimental Station (ES) or Commercial Farm (CF)	Type of Integrated systems	Year of implementation or start of the integration study	Total area (ha)	Crop (others) area (ha)	Livestock (grass) area (ha)	Forestry (tree) area (ha)	Climate classification (Köppen)	Mean Precipitation (mm)	Mean Temperature (˚C)	Soil classification (WRB)
IT1	Lazio region	CREA	CF	ICL	2006	205	90	70	45	Csa	780	15.3	Cambic Phaeozems, Calcaric Cambisols

3.1 IT1

The case study IT1 is a commercial farm, which is located in Lazio region (Fig. 1a). The local climate is classified as Csa, which is characterized by hot and dry summers and mild and wet winters (Fig. 2b).

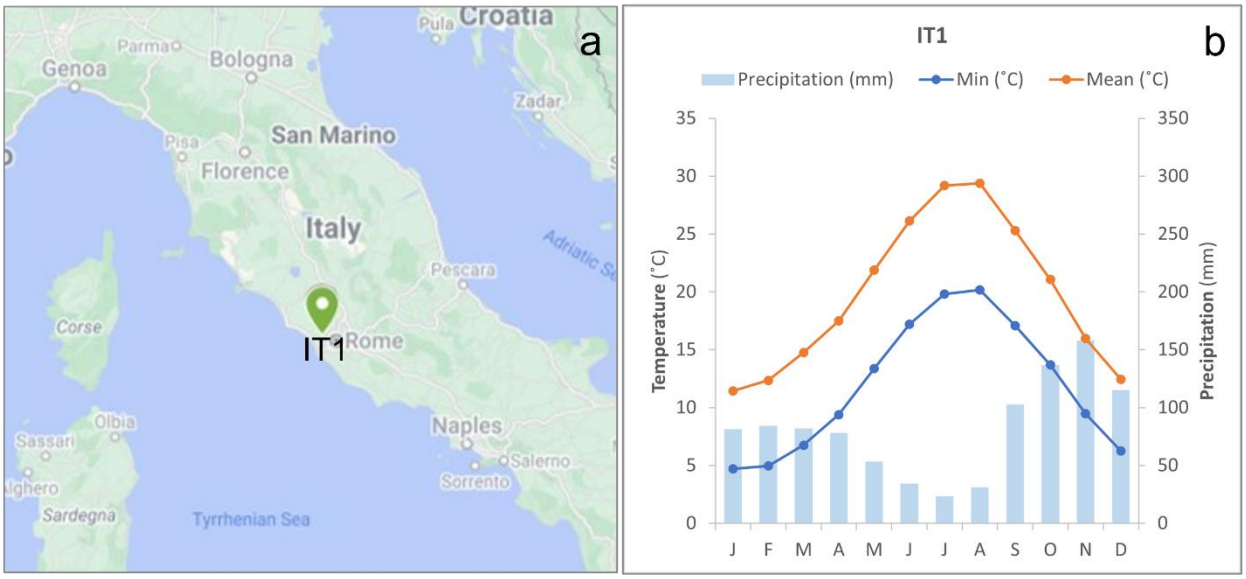

Fig. 1. Location of the case study IT1 (Google Maps© image) (a) and the monthly climatic data for the area (b). Climatic data is derived from a 40-year (1981 – 2021) observed data series. Source: Parisse et al. (2023).

The farm hosting Italian case study lies upon quaternary marine terraces, characterised by a sequence of plateau/slope/valley floor. Soil (Cambic Phaeozems and Calcaric Cambisols) granulometry therefore shift from loam to clay sandy loam and clay loam, accordingly. Bulk density ranges between 1.0 and 1.4. Average pH is 6.0. Plateau areas are since ever dedicated to agriculture and pastoralism while slopes whose grade is unfit to agriculture are left to woodlands. Agriculture in valley floor, due to an average higher soil moisture and a shallow water table in comparison to plateau areas, addresses cultivars with higher water demand. At IT1, pastures, grasslands, and olive orchards are therefore set on plateau, horticulture instead on valley floor. The farm follows biodynamic management since 2006, integrating meat and olive oil production (Fig. 2a and b). Yearly production is around 75 steers to market and 10 to growing. 2000 olive trees arranged on a 10x40 m sixth gave (2022) 4.7 tons of high-quality oil. Four hectares of vegetables and a poultry farm (500-700 chickens) integrate farm yield. Farm has also four small size photovoltaic fields and collects EU funds from common agricultural policy.

Fig. 2. Olive trees (a) and cattle grazing (b) in the case study IT1.

Since 2006, owners of IT1 set the farm management towards the recycling of by-products and wastes, aiming at an approximation to self-sufficiency for feeds and forages, thus bringing the farm management forward the current concepts of circular economy . To be pointed out also that farm took advantage of both size – 206 ha, well above the average Italian farm extension – and integration with valuable olive oil production. Besides, the management has been able to retail farm products on the high-quality market. As a result, the stress on the use of internal rainfed crops for feeding cattle, the total recycling of cattle manure, the integration with poultry and olive oil production as well as the integration of power supply though photovoltaic, let the farm to score high about circularity.

4 Outlook

The general characterization of the case studies presented here will be used in other WPs for biophysical contextualization of the case studies in the SENSE project. Results from WP2 (circularity and ecological indicators), WP3 (near real-time monitoring of GHG emissions and carbon and nutrient cycling) and WP4 (multidimensional sustainability assessments) can further enrich the information currently presented here. The Technical Briefs will be uploaded to the project's website for dissemination and communication purposes.

5 References

Barbara Parisse, Roberta Alilla, Antonio Gerardo Pepe, Flora De Natale. 2023. MADIA – Meteorological variables for agriculture: A data set for the Italian area. Data in Brief 46 (2023) 108843.