# Synergies in Integrated Systems

Improving Resource Use Efficiency While Mitigating GHG Emissions

Through Well Informed Decisions about Circularity

## D1.2 Technical Briefs – Argentina

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**Project summary**

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| 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)<br>University of Bristol (UOB)<br>Stichting Wageningen Research (WUR)<br>University of Hohenheim (UHOH)<br>Demeter e.V. (Demeter)<br>Consiglio per la ricerca in agricoltura e l'analisi dell'economia agrarian (CREA-AA)<br>Brazilian Agricultural Research Corporation (Embrapa)<br>National Institute of Agropecuarian Technology (INTA)<br>Instituto Nacional de Investigación Agropecuaria (INIA) |

**Deliverable summary**

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|---|---|
| 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 |

# Contents

# 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 understand the current circularity status of these systems. The data we collect will drive models to determine alternative 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 studies in Argentina, which are coordinated by our partner INTA.

# 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 Argentina

There is one benchmark case study in Argentina (AR1) and several participatory case studies. Table 1 exhibits the general characterization of the case studies in Argentina.

**Table 1.** General characterization of the case studies in Argentina.

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AR1 | Buenos Aires province | INTA | ES | ILCF | 2021 | 91 | 58 | 32 | 1 | Cfb | 909 | 14.2 | Phaeozem |
| AR2 | Buenos Aires province | INTA | ES | ILF | 2012 | 360 | 0 | 260 | 110 | Cfa | 1100 | 16.5 | Phaeozem |
| AR3 | Corrientes province | INTA | CF | ILF | 2017 | 800 | 0 | 700 | 100 | Cwa | 1500 | 23 | Phaeozem |
| AR4 | Tucumán province | INTA | ES | ILF | 2017 | 1 | 0 | 12 | 416 | Cfa | 880 | 15.5 | Phaeozem |

## 3.1 AR1

The case study AR1 is an experimental station, which is located in Buenos Aires province (Fig. 1a). The local climate is classified as Cfb, which is characterized by cool summers and mild winters and frequent precipitation (Fig. 1b).

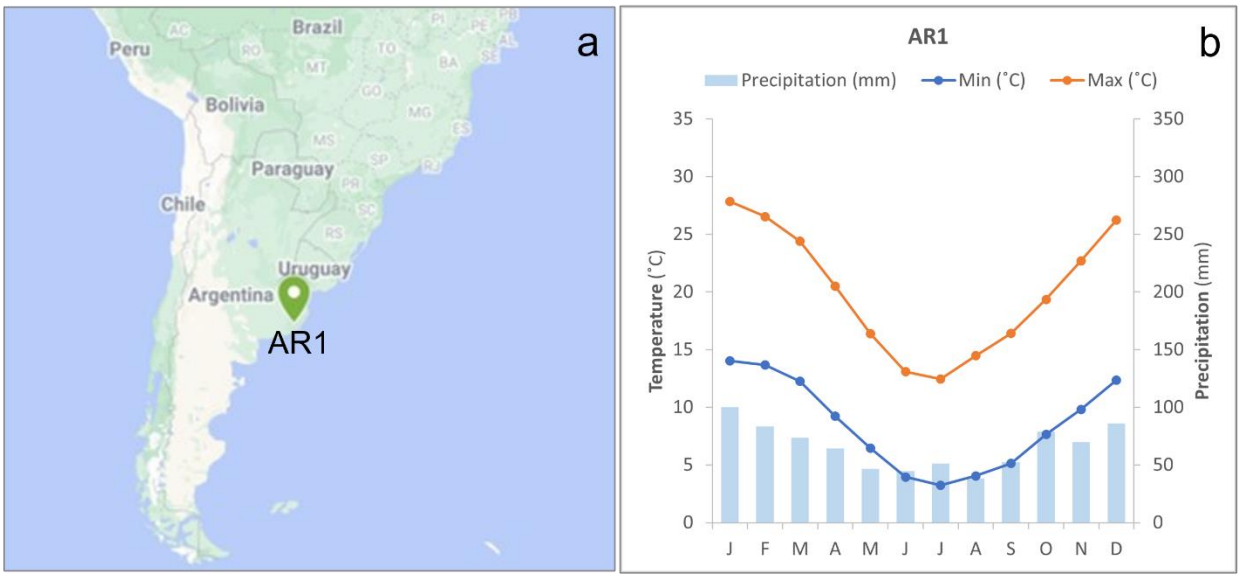


**Fig. 1.** Location of the case study AR1 (Google Maps© image) (a) and the monthly climatic data for the area (b). Climatic data is derived from a 50-year observed data series. Source: siga.gob.ar.

The area where the benchmark site is located has a topography, natural vegetation, forest and crop history that is typical in the region. Soil belongs to the *Chernozen* family, showing ca. 4 to 6 % of Organic Matter in the A horizon, while the B horizon presents 30 – 35 % clay. The landscape of the system is that following the topographic sequence hill-piedmont-upland-lowland, with the benchmark being in the uplands. Spontaneous vegetation in the site can be described as belonging to a community where species of the *Compositae* family dominates, with *Carduus* sp. and *Conyza* sp. as dominant, typical of this topographical position, but also a gramineous cover dominated by *Paspalum dilatatum*. Regarding the history of the experimental plot with pecans, it comes from an agricultural history (wheat, potato, soybeans), although during the years 2005 to 2009, birdsfoot refoil (*Lotus tenuis*) was cultivated there. A pecan orchard was planted in 2013, along with a pasture consisting of a mix between white clover (*Trifolium repens*) and tall fuescue (*Festuca arundinacea*), with the pasture being currently degraded and spaces left gained by the spontaneous species above mentioned. The site also has forests that acts as barrier against wind. The species in the barrier are Eucalyptus sp. and Pinus sp. The orchard plus the surrounding plots are being integrated to the dairy farm of the Experimental Station.


**Fig. 2.** Ground view (a) and sensor implementation (b) in the case study AR1.

Currently, circularity in AR1 involves the use of dairy manure to fertilize some pecan trees during autumn, so that trees will assimilate N and P not for the fruit but for the root reserves which will provide with energy and N to the sprouts during the next growing season. At the same time, circularity implies the incorporation more continuous of calves to graze the pasture (so far they do it eventually), which are provided with shadow during summer, improving their comfort. The site is in the first stage towards circularity (manure fertilization).

## 3.2 Participatory case studies

There are several participatory case studies in Argentina. One of them, is a Silvopastoral system (*Chloris gayana* cv Finecut and *Prosopis alba*) located at the Animal Research Institute of the Semiarid Chaco (IIACS) dependent of the National Institute of Agricultural Technology (INTA), located in Leales to the southeast of Tucumán province, Argentina (27°11' S, 65°17' W) (Fig. 3). This area corresponds to a depressed saline plain and has an altitude of 335 m above sea level. The mean annual precipitation is 880 mm and rainfalls are concentrated between November and April. The mean annual temperature reaches around 19 °C, ranging from 25 °C in January to 13 °C in July. The climate is subtropical subhumid with a dry season, matching up the latter with the relatively colder period of year spanned from April to October. The soil type subsumes into the class Fluvacuentic Haplustoll following the US Soil Taxonomy System. In this case, the study implies OC and N stock after tree planting, and GHG emission from soil, fences and urine patches.

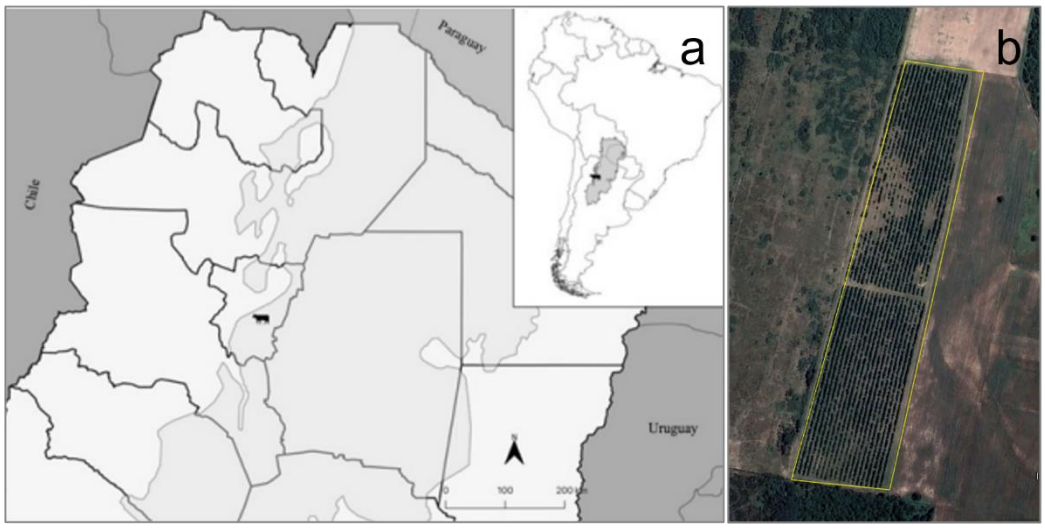


**Fig. 3.** Location of the case study (a) and Silvopastoral system with Chloris gayana cv Finecut (grass) and Prosopis alba (b). Source: Nasca et al. (2020).

# 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

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