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Editorial

INIA´s Agro-Environmental Platform: A network of long-term experiments

Plataforma Agroambiental de INIA: una red de experimentos de largo plazo

Plataforma Agroambiental INIA: uma rede de experimentos de longo prazo

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1. Agricultural Long-Term Field Experiments

Long-term interdisciplinary research rooted in Agricultural Long-Term Field Experiments (LTEs) is crucial for understanding the sustainability of agroecosystems. This is particularly relevant for designing agroecosystems that prevent further land and environment degradation and support farmers to achieve long-term goals of sustainability by promoting internal ecological cycles, reducing the dependency on non-renewable and external inputs, and optimizing the use of water and energy. Also, the LTEs can provide information for policy makers to meet increasing demands for food, feed, fiber and biomass, along with guaranteed ecosystem services against a background of climate change[(1)(2)]. There are around 600 LTEs in the world, most of them in Europe. The oldest ones, with more than 100 years old, are in Europe (20) and North America (5), while the oldest in South America is the LTE “José Lavalleja Castro”, with 60 years old, located at INIA La Estanzuela in Colonia, Uruguay[(3)].

LTEs are agricultural research experiments designed for lasting several years, usually more than 30. However, their scientific and practical value increases as the experiment matures, so the challenge is to maintain neat experiments with their associated archive of samples —mainly soil and plant—, and careful data collection and curation to be used in the medium and long term[(4)]. For this, LTEs should have well-defined but flexible objectives to be able to adapt to new challenges; and present robust experimental designs and experimental plots to sustain multiple samplings over time and eventually allow divisions when faced with new questions. Basically, the aim of the LTEs is to provide information regarding the impact of agricultural management within the same pedo-climatic conditions to understand the processes behind agronomy. Therefore, a regular monitoring of soil properties and water quality, crops, pastures, animal performance and, if possible, economic results is crucial.

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The questions addressed by LTEs evolve with changing views on agricultural and ecological science and with the technology available to address those questions[4][5]. The oldest and majority of LTEs were planned to answer questions related to soil fertility and crop productivity (e.g. Broadbalk, Rothamsted, UK)[4], but also to study grazing systems within natural grasslands (e.g. Northern Great Plains Research Laboratory, NGPRL, at Mandan, North Dakota, USA)[2]. In the 21st Century LTEs are expected to address new issues related to agricultural intensification, such as the impact of climate change and its relationship with greenhouse gas emissions, plant and microbial species diversity and function, food security and water cycling and use, environmental footprints, among others. These new issues will be addressed not only through the analysis of each experiment, but also by networking with other LTEs, where questions, protocols, data, resources and facilities are shared across them.

2. INIA´s Agro-environmental Platform

INIA´s Agro-environmental Platform (INIA-AP) was created in 2018 with the aim of coordinating the five LTEs already working at INIA, managing more efficiently the resources available for their functioning, and communicating the scientific information generated. Nowadays, INIA-AP comprises a network of researchers and collaborators working on seven experiments located in four research stations within different agroecological regions of Uruguay[6]. The seven LTEs are representative of relevant productive systems, from the more intensive ones, such as vegetable systems, followed by grain crops combined with pastures with or without irrigation, agricultural-livestock systems and, finally, the more extensive ones, grazing systems on natural grasslands[6] (**Table 1**).

Table 1. Agricultural Long-Term Field Experiments (LTE) composing INIA´s Agro-environmental Platform

LTE	*Year of starting and location*	*Representative farming system*
LEELP1 – Experiment "José Lavalleja Castro"	1963 – INIA Research Station La Estanzuela, Colonia	No-till rainfed grain crops and pasture rotations
PaPELP1 – Sustainable intensification of livestock-crop production	1995 – Experimental Unit Palo a Pique, INIA Treinta y Tres	Livestock and no-till rainfed crops and pasture rotations
LEELP2 – Irrigated agricultural systems	1998 - INIA Research Station La Estanzuela, Colonia	No-till irrigated grain crops and pasture rotations
PdlLELP – Sustainable intensification of rice rotations	2012 –Experimental Unit Paso de la Laguna, INIA Treinta y Tres	Paddy rice combined with rainfed grain crops and pasture rotations (no till)
LaBELP – Recovering soil health in horticultural systems	2017 – INIA Research Station Las Brujas	Irrigated vegetable crops, cover crops and pasture rotation with different tillage systems
PaPELP2 – Extensive sheep production on natural grasslands	2021 - Experimental Unit Palo a Pique, INIA Treinta y Tres	Grazing intensity (sheep) of natural grasslands
GELP – Livestock management on natural grasslands	2023 - Experimental Unit Glencoe, INIA Tacuarembó	Grazing intensity (beef cattle and sheep) of natural grasslands

INIA-AP supports activities of various INIA research groups, often in collaboration with other national and international institutions, covering multiple disciplines and approaches. Thanks to long-term vision, the interdisciplinarity of the work and the harmonization of agreed analytical protocols between the different LTEs, it is possible to assess more precisely with systematic and robust information the impact of production activities. Since different agricultural practices imposed on LTEs had generated a gradient of conditions, it is now possible to model their impact, for example, on soil carbon stocks or to study their contribution to greenhouse gas emissions or other environmental footprints of food production systems. This information may contribute with the design of national policies, as has occurred with the national policy on sustainable soil use and management for rainfed crops (Planes de uso y manejo responsable de suelo, PUMRS) of the Ministry of Livestock, Agriculture and Fisheries of Uruguay, made with data from LTEs based on crop-pasture rotations combined with data from run-off experiments. But also, the gradients generated in these "living open-air labs" support different research approaches, from the study of cause-effect relationship on soil processes, going through studies that analyse several LTEs simultaneously to find out "national agricultural trends", up to participation in networks in which data is collected and analysed globally (e.g. the Global Farm Platform, *globalfarmplatform.org*).

In recent years, the resources and research activities of the INIA-AP increased and consolidated, revealed by the raised national and international cooperation, the scientific production and the formation of students and collaborators. Now, the main challenges are to maintain and consolidate the shared engagement in thinking and behaving as a network, maintain the infrastructure and improve harmonized protocols, and define a data management policy according to FAIR principles (FAIR stands for Findable, Accessible, Interoperable, Reusable data)[(7)].

INIA-AP is more than a research facility; it is a space for education and communication with stakeholders from the scientific, farming and governmental sectors, as well as a valuable heritage for science. Despite the relative high installation and operating costs, when the information generated is used in a coordinated an integrated manner, it constitutes an efficient and robust research strategy to evaluate environmental processes and impacts derived from agricultural activity. It aims at providing answers to specific productive systems, but also understanding the biological and environmental processes behind the production and quality of food, feed, fiber and biomass in the mid and long term, at a national and international level. Ultimately, INIA-AP aims to collaborate in achieving some of the sustainable development goals (SDG) defined by the United Nations for 2030[(8)]: reduce hunger and improve food sovereignty (SDG 2), reduce GHG emissions and mitigate the effects of climate change (SDG 13), prevent soil degradation and rehabilitate degraded soils, and stop loss of biological diversity (SDG 15).

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Author contribution statement

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