

2022

ACTIVITIES PLAN



CITAB

Together for Excellent Science

**This Activity Plan is in strict agreement with
the 2015-2020 Strategic Programme**

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PRODUCTIVITY METRICS***Expected scientific production for 2022:***

<i>ITEM</i>	2022
<i>Publications</i>	
<i>Books/Book Chapters</i>	4
<i>ISI Publications</i>	200
<i>Publications in national journals</i>	8
<i>Communications</i>	
<i>Oral communications in international conferences</i>	70
<i>Oral communications in national conferences</i>	10
<i>Reports</i>	0
<i>Organization of seminars and conferences</i>	0
<i>Advanced training</i>	
<i>Doctoral thesis</i>	12
<i>Master thesis</i>	35
<i>Patents</i>	

ACTIVITIES

Thematic Strand 1- Sustainability of Agri-Food and Forestry Ecosystems in a changing environment

Thematic Strand 1 aims to deliver integrated frameworks to anticipate, detect and tackle ecological changes in agricultural, forestry and natural ecosystems and landscapes. Thematic Strand 1 integrates natural and social sciences concepts to develop and integrate novel analytical frameworks and tools that contribute to progress in fundamental and applied fields of environmental research (Task 1.1) and ecological sustainability in agri-food and forestry ecosystems (Task 1.2).

Task 1.1 - Integrated monitoring of climate and environmental impacts: adaptation and mitigation strategies

Task 1.1 is highly interdisciplinary, using field, laboratory and computational techniques, advanced analysis, scaling and modelling tools and testing novel potential indicators of change. This task aims to (i) develop and apply new analytical technologies to (ii) understand climatic and environmental forcing on target ecosystems under current conditions; (iii) assess future scenarios of climate and environmental change to develop, test and implement suitable mitigation and adaptation measures, such as intercrop agriculture, riparian restoration (e.g. to assess ecosystem service provisioning of green infrastructures) or bioclimatic cultivar adaptation (e.g. crop zonation).

In brief, Task 1.1 aims to:

- 🕒 Forecast and monitor the growth and development of agricultural crops under variable climate;
- 🕒 Evaluate the effect of micro and mesoclimatic conditions on water dynamics and survival strategies of grapevines using plant-based measurement techniques;
- 🕒 Assess grape potential of several *Vitis vinifera* varieties in the same edaphoclimatic conditions and definition of physiological biomarkers to identify varieties more resistant to summer stress;
- 🕒 Evaluate the toxicity induced by heavy metals intensively used in viticulture;
- 🕒 Implement sustainable agroecological practices oriented to local vineyards specificities;
- 🕒 Create a network of weather stations to collect local weather information, to support the development of a weather warning network;
- 🕒 Develop mapping and modelling tools to simulate and estimate future chestnut production;
- 🕒 Develop a manual of good chestnut cultivation practices to be adopted by producers;

- 🕒 Develop smart irrigation systems for chestnut based on tree water potential, soil humidity sensors and remote sensing;
- 🕒 Evaluate the impact of silicon nutrition on chestnut resilience against the conjugated stresses of drought and heat;
- 🕒 Evaluate the influence of meteorological conditions (fire weather) on the wildfire regime (spatial and temporal patterns of wildfire characteristics, e.g. fire incidence, seasonality, etc.);
- 🕒 Assess the relationship between land use/land cover changes and wildfires and the influence of climate on the effect of tree species-mixing, namely on tree growth-climate relationship and drought resistance;
- 🕒 Assess groundwater resources and evaluate their sustainable use;
- 🕒 Evaluate the toxicological effects of microplastics and waterborne copper, alone or combined, will be d in different fish species providing novel insights regarding the environmental impacts of microplastics in freshwater and marine biota;
- 🕒 Evaluate the effects of glyphosate-based herbicides in impact aquatic communities;
- 🕒 Study the effect of exogenous compound sprays as short-term strategy to mitigate cherry cracking;
- 🕒 Study the effect of kaolin and seaweed-based extracts as middle and long-term strategy to mitigate negative effects of climate change in physiological performance of hazelnut tree and nut quality;
- 🕒 Study the effect of deficit irrigation on physiological and biochemical performance of almond trees;
- 🕒 Study of leaf morphological features of some species of Portuguese flora as plants protection against extreme weather events.

Task 1.2 – Sustainability in agri-food and forestry ecosystems

Task 1.2 research encompasses multivariate analysis and modelling of habitat and land-use change impacts on terrestrial and aquatic environments, and ecosystem services as well as characterization of agri-food and forestry systems. Multidisciplinary research, relevant to stakeholders, will develop and apply techniques for species and biodiversity conservation, and pest control. Following this line, the compatibilization of agriculture intensification with biodiversity conservation will be tested. Modern methods (i.e. innovative hyperspectral imaging, computational intelligence techniques, and decision spatial support systems) will be developed and implemented as part of the CITAB's strategy to test innovative technologies to increase efficiency and system resilience, as well as facilitate the interaction between service providers and consumers to protect and enhance ecosystem services (water and soil quality, soil biodiversity and temperature regulation). Therefore, research to develop, test, and apply spatiotemporal

dynamic predictive analytical tools will be directed towards understanding how natural (e.g. seasonality, precipitation, energy flow) and anthropogenic (e.g. fertilizer application in agricultural systems, discharge of effluents, variations in crop type) changes affect ecosystem integrity.

In specific, Task 1.2 aims to:

- ② Conduct predictive research on the main interactions between relevant landscape features and management strategies considering the perspectives and expectations of different stakeholders and policymakers;
- ② Test of a new participatory approach to landscape management aiming to support biodiversity conservation, assuring the provision of critical ecosystem services (ES) and sustainable development for the Atlantic region;
- ② Develop of fish behavioural barriers designed to improve the efficiency of transposition of fishes in dammed rivers to mitigate connectivity loss, avoiding the fragmentation of the aquatic environment;
- ② Use hyperspectral image combined with deep learning models to assess and monitor wine grape quality, namely by developing new enhanced oenological parameters' prediction models and by improving the feature selection methodology involved;
- ② Assess of agro-systems and of the impacts of climate and anthropic changes;
- ② Evaluate cultural practices (in crops such as grapevines) that promote sustainable water use strategies under abiotic stresses. Development of cost-effective methodologies capable of identifying genotypes resilient to water deficit, suitable for plant breeding programs and a stainable agriculture;
- ② Harvest prediction of grape varieties on the basis of fruitfulness studying of buds and vegetative shoots.
- ② Contribute to species preservation, pest control, and promoting disease surveillance, toxicological studies will be carried out in animal models and in animals of zotechnical interest, in order to reduce management costs, namely pharmacological and therapeutic.

Thematic Strand 2 – Technology in Agro-food and Forestry chains for a more competitive bioeconomy

Aligned with RIS3 policy, this Thematic Strand explores innovative approaches to develop and update processes and technologies to crop and food products, biological materials and agri-food residues. The Thematic Strand 2 will bring added-value to agri-forestry ecosystems, agri-food and forestry products and co-products, boosting regional and national economic growth. This Strand directly involves sector stakeholders throughout the 2 vertically structured tasks applying multidisciplinary research.

Task 2.1 – Innovative technologies and processes

Task 2.1 focuses on a major unit objective – optimization and development of innovative technology for more competitive agri-food and forestry production chains. This task optimizes solutions for current and future stakeholders, boosting competitiveness and income by improving food and forestry crop productivity, reducing management costs and increasing profit. To meet these objectives this task research will focus in (i) development of physiological and best management tools; (ii) production of novel technological applications, including predictive management software and spectral imaging applied to crop and forestry parameters (e.g. maturation stages, growth rates, harvest periods, water and cycle nutrients, fertilizer management, disease); (iii) identification of key intervention points to optimize production and identify suitable species, varieties and rootstocks; (iv) characterization of vegetation and quality to optimize physiological responses to climate conditions. This will contribute to sustainable economic income for regional stakeholders, but findings extend to national level.

Therefore, Task 2.1 aims to:

- 👁️ Develop of a methodology to infer the higher tolerance of *Vitis vinifera* varieties from the North of Portugal to Iron and Zinc excess by integrating cellular, molecular, and morpho-anatomic traits.
- 👁️ Develop of methods for the identification of mechanical properties in vegetal tissues. The apple was chosen for this purpose, as it is a common and highly important product for the Portuguese agricultural economy.
- 👁️ Develop methodologies for the assessment of the eco-cytotoxicity of several forms of nanomaterials, such as nano-CuO, nano-TiO₂, nano-SiO₂ and nano-ZnO, on different aquatic species and on human cell lines (Caco-2, SV-80, HepG2 and HaCaT).

Task 2.2. Biological validation of by-products and natural compounds

High added value of sustainable bio-based products in the food supply chains in order to fulfil European policies targeting zero waste policies, circular economy and the green deal, a strategic approach to integrate sustainable food production systems with the consumption of safe food products and the existing links to healthy people and healthy societies is a priority to CITAB. The consumers should envisage the selection of food towards healthier and sustainable choices, taking into account sustainable local and regional food systems and the development of environmentally friendly agriculture practices. This Task aims to address these challenges throughout the isolation, identification and characterization of natural compounds and their by-products, followed by their validation in biological systems (in vitro and in vivo approaches). Reduction of wastes in animal and agricultural production systems and in the food supply chains, as well as approaches to enhance the re-utilization of such products are addressed to promote sustainable food consumption and facilitate the shift to healthy and sustainable diets.

In brief, Task 2.2 aims to:

- 👁️ Evaluate the plant functional compounds inclusion in diets for different animal species.
- 👁️ Beneficial effects of plant by-products as sources of bioactive compounds.
- 👁️ Food by-product valorisation for agro-industrial wastewater treatment.
- 👁️ Evaluate bioactive polysaccharides from medicinal mushrooms.
- 👁️ Study the impact of salt consumption in human nutrition issues.

COOPERATION

National

Strengthening the link between CITAB research and stakeholders needs, CITAB will initiate the participation in two national mobiliser projects, “cLABEL+: Innovative natural, nutritious and consumer-oriented 'clean label' foods” and “rePLANT: Implementation of collaborative strategies for integrated forest and fire management”, which joined together a total of 40 national entities (22 industrial partners, two technological interface centres and 16 research units).

In 2022 the Centre will strengthen the position as a research provider for private and public stakeholders, with the establishment of several contracts with CITAB’s Laboratories of Applied Ecology (LEA) and Fluvial Ecology (LEF). Moreover, the mobiliser projects with the industry and the Operational Group projects, funded by the Rural Development Programme, will be a source of funding for the Centre.

International

The Centre expect the approval of one or two international projects.

DISSEMINATION

To increase the dissemination at CITAB we will use communication tools such as press releases, social media and a newsletter. We will also try to establish some media partnerships. Knowing the importance of science communication, we will continue to raise awareness among our researchers so that they do not neglect this component that brings notoriety and visibility to their work. In 2022, CITAB will continue to promote conferences, seminars and workshops with themes that capture the range of CITAB's areas of expertise. Like in past years, target audiences will include the academic community, actual and potential key stakeholders from public and private sectors. Contributions and keynote talks will be given by CITAB and consortium members and invited experts. CITAB researchers will give communications at several national and international conferences.

Organization of conferences

All funded projects will apply Open Science principles, covering the organisation of stakeholder relevant themed workshops, seminars and conferences (e.g. to present project findings and deliverables to different target audiences), researcher participation in conferences, open access publishing, creation of dedicated websites and use of social media to rapidly disseminate news to a broader audience.

Outreach activities

As in the past, CITAB will increase the number of outreach activities for junior and high schools. In this context, several initiatives are planned to be taken in 2022, despite the restrictions affecting outreach and outdoor activities. CITAB will promote dissemination events oriented mainly for high school and university students, either in person or by remote communication tools. The most relevant and impact initiatives will be: the summer courses "Verão com Ciência", the "OCJ-Scientific Occupation of Young People on Vacation", and the "Science, and Technology Week".