OCITAB

ACTIVITY PLAN 2025



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PRODUCTIVITY METRICS

Expected key performance indicators for 2025:

ITEM	2025
Publications	
SCOPUS Publications	320
Technical Publications	20
Books/Book Chapters	20
Communications	
Communications at international conferences	250
Communications at national conferences	150
Training	
Advanced training	10
Doctoral thesis	20
Master thesis	50
Patents	1

SUMMARY

The CITAB 2025 Activity Plan reflects our mission to promote more sustainable and competitive agrarian value chains. We aim to create added value, build capacities at both academic and non-academic levels, and transfer scientific knowledge and technological innovation to stakeholders, decision-makers, and society in general.

While CITAB's primary objective is to enhance the performance of agrarian socioeconomic sectors—particularly in rural and underprivileged areas, focusing on the valorisation of products and co(products) and circular economy principles, aiming food safety and security—we recognise that environmental protection of agroforestry ecosystems and effective responses to climate challenges are integral to achieving long-term sustainability. This dual focus will guide CITAB's research strategy by developing and improving socioeconomic and environmentally sustainable solutions. These efforts will be grounded in our core principles of internationalisation, interdisciplinarity, innovation, and industry engagement.

CITAB envisions a renewed organisational structure, centred on a circular approach, to address these pressing challenges. This approach will holistically integrate the research groups within CITAB and enhance collaboration among them, fostering scientific breakthroughs and the practical application of knowledge to develop synergetic solutions for the interconnected agriculture-environment system.

To accomplish this vision, CITAB will establish two Research & Development groups:

- R&D 1: Natural Resources, Biodiversity, and Climate Challenges
- R&D 2: Resiliency and Valorisation of Agrarian Value Chains

which will be supported by the Technology & Innovation group:

- T&I: Technological Innovation to Support Agrarian Systems,

ensuring a strong focus on scientific and technological advancements that create knowledge and drive sustainable practices and innovation in agrarian systems and surrounding natural ecosystems.

RESEARCH ACTIVITIES

R&D1 - Natural Resources, Biodiversity & Climate Challenges

GENERAL ACTIVITIES

R&D1 is devoted to the interplay between climate, water, soil, landscape management, and agroecology & biodiversity. The group aims to develop strategies for sustainable natural resources management, enhancing ecosystem services (ES) and biodiversity conservation. These aims indeed align with several SDGs, bolstering resilient agrarian value chains and ecosystem health, thereby with strong win-win links with the R&D2 and T&I. As such, the specific objectives of R&D1 can be organized into the following thematic domains:

- Climate research will address climate variability and change impacts through modelling and projections, impact assessment and risk analysis. The assessment of the implications of climate change on natural resources, agrarian value chains and ecosystems, will enable the development of adaptive strategies for promoting agroecosystem resilience and human health.
- *Water resources research* will foster ecosystem health and ES, through connectivity restoration by decreasing aquatic ecosystem fragmentation, contributing to sustainable watershed management and mitigation of anthropic and extreme event impacts, through eco-health and ecotoxicological approaches.
- Soil research will contribute to improving soil health and quality, promoting resource conservation and soil fertility using agroforestry organic materials, microorganisms (composting, biofertilizers and biopesticides) and invertebrates (vermicomposting).
- **Sustainable landscape management** will define strategies for biodiversity conservation and ES valorisation, increasing forest resilience to climate change and fire risk, and creating a portfolio of forest-based products by strengthening the circular economy and associated value chains.
- Agroecology & biodiversity will monitor agroecosystems, with robust stakeholder engagement, for functional biodiversity, ES strengthening, and restoration of degraded habitats to ensure the sustainability of agricultural practices, forestry and natural system management.

SPECIFIC ACTIVITIES

- Reinforce smart agrosystem monitorization to understand the impact of climate on agrodiversity (e.g. agrosystem, crop, genetic resources, functional biodiversity).
- Implement and evaluate climate-smart agricultural practices as an adaptation strategy to climate changes (e.g. crop diversification; living covers; agroecological strategies; smart irrigation to improve water management and use).
- Monitor field trials and cultures using thermal and multispectral images to develop prediction models and assess the impact of climate conditions and management practices on crop development and agrosystem productivity.
- Advance in the understanding of the different sources of climate variability and predictability – local and remote – including multi-hazard extremes interdependencies, causes and mechanisms.
- Develop prediction models for crop growth and phenological development under different climate conditions.
- Assess and value ecosystem services provided by natural and urban environments and their importance for sustainable development in climate change scenarios.
- Promote ecosystem restoration through Nature-based solutions (NbS), enhancing ecosystem health and the provision of ecosystem services by restoring connectivity and reducing habitat fragmentation, promoting the long-term health and resilience of natural resources.
- Develop an integrative landscape management approach, based on NbS principles, to support biodiversity conservation, ensuring critical ES and sustainable development for the Atlantic and Mediterranean regions.
- Assess the soil health and quality of organic volcanic soils, and the impacts of different management strategies and amendments (organic compost, biofertilizers, sludge) in the agri-food agrosystems to evaluate their sustainability using soil-based sensors and standard techniques.
- Assess the impact of wildfires in afforested catchments on aquatic ecosystems, and develop strategies for soil loss control and ecosystem restoration.
- Deepen the study of multi-resistant bacteria in aquatic systems through an ecohealth approach focused on a holistic understanding of environmental and public health interactions.
- Establish continuous monitoring and evaluation by tracking the progress and effectiveness of restoration projects to enable the ongoing refinement of restoration techniques and adaptive management strategies.

- Develop comprehensive analysis of key water security topics, namely flood control and innovative solutions like the payment for water services to landowners; focusing on the progress of the societal challenges of climate change adaptation and ensuring a sustainable water future.
- Implement experimental protocols to investigate the biological effects of pesticides, microplastics, other environmental contaminants and natural products in different organisms.
- Develop bottom-based approaches to tackle the impact of new pests and manage endangered populations.
- Understand the importance of crop management and intercropping strategies for promoting biodiversity.
- Contribute with technological and modelling approaches to support decisionmaking within the scope of public policies and financial instruments to the valuation of ecosystem services and the rehabilitation of traditional economic activities in low population density territories.
- Reinforce research and activities related to the impact of fires on aquatic ecosystems, soil vulnerability, reforestation, and ecosystem restoration.
- Develop green strategic plans with Municipalities to improve fire resilience and sustainable development, contribute to sustainable ecosystem management, mitigating the impacts of human activities and extreme events.
- Study crop management and agroecological strategies to improve our understanding and implement sustainable, fair, and safe weed management, under conventional, organic, and mixed farming, using phenotyping and remote sensing tools.
- Study the behaviour of red grape varieties towards understanding their profiles of resilience/tolerance to Mediterranean climate-like increasing resilience to climate change impacts.
- Develop knowledge to foster practices tailored to the specific needs of local vineyards, enhancing the resilience of Mediterranean vineyards to climate change and diseases, minimizing the use of agrochemicals, and promoting local circular agriculture.

R&D2 - Resiliency & Valorisation of Agrarian Value Chains

GENERAL ACTIVITIES

The research of the R&D2 group is aligned with the FAO's vision focusing on the resilience of people, communities, and ecosystems for sustainable food and agricultural systems. This group aims to provide short and long-term strategies, responding to current and future multi-stakeholder needs, while enhancing competitiveness and growing income across the targeted agrarian value chains, with particular emphasis on Mediterranean crops. Therefore, the main specific objectives of R&D2 for the upcoming period can be succinctly outlined as follows:

- Develop innovative and sustainable pre- and post-harvest strategies to mitigate the negative impacts of (a)biotic stresses and increase resiliency to climate change, enhancing agri-food system health, and reducing vulnerability to pests and diseases (e.g. biostimulants, biocides, beneficial insects, mycorrhization, UV-C, resistant rootstocks/varieties/clones, training-systems).
- Promote soil health, addressing topics on organic matter, nutrient cycling, efficient water absorption, soil biota, crop rotation, intercropping, cover cropping, reduced tillage, bioremediation of agroindustry wastes, biofumigation, as well as green manures to improve soil structure, health, fertility, and biodiversity.
- **Implement precision real-time monitoring tools** to increase plant water-use efficiency, reduce the use of pesticides, and increase crop yield, quality, and sustainability.
- **Reduce ammonia and GHG emissions and increase C sequestration** through manure treatment/storage/field application from animal barns using litter additives, crops, and agroforestry for N and C fixation/sequestration.
- Develop innovative, healthy, and safe foods, by enhancing their nutritional and nutraceutical properties, promoting a circular economy through innovation, either applied to local products or through the valorisation of by-products and reduction of agri-food wastes.

SPECIFIC ACTIVITIES

- Advance studies on crop phenotyping to select and use local varieties and/or drought-tolerant varieties as a strategy for cultures' adaptation to climate constraints. In these studies, will be applied different biological solutions (biostimulants, biofertilizers, bioherbicide) as a strategy for crop protection and productivity.
- Address the effect of biostimulants on crop growth under water deficit conditions, to investigate the role of biostimulants in improving the ability of crops to use available water more efficiently, thereby maintaining physiological processes and growth under drought conditions.
- Explore the impact of biostimulants and biofertilizers on promoting crop root development and architecture, including increased root length, density, and surface area, to improve water uptake from limited soil moisture.
- Evaluate the efficacy of biostimulants and biofertilizers in mitigating droughtinduced oxidative stress by enhancing antioxidant activity and preserving pigments and secondary metabolites content, which supports sustained photosynthesis and growth during water scarcity.
- Assess and identify grapevine genotypes from ancient vineyards through genotyping and evaluation of the metagenome diversity in several grapevine varieties.
- Identify defence genes differently expressed as a result of the application of new formulations of fungicides and elicitors in grapevine.
- Explore the metagenome diversity of cowpea to mitigate the abiotic stresses proposing a new inoculant formula.
- Explore root phenotyping, using legumes as a model, for identification of abiotic stress-tolerant genotypes (namely water and salt).
- Screen abiotic stresses (water, heat, and salt) resilient varieties by identifying tolerance regulatory genes.
- Evaluate the impact of different biological solutions to assess the effect on soil microbial biodiversity and functional groups and the reduction of negative impacts on the agrosystem.
- Address a biological assessment of agroindustry organic wastes and crop residues for enhancing soil health, fertility, crop productivity and biodiversity.
- Assess the role of crop residue incorporation in boosting soil organic matter, nutrient cycling, and plant productivity.
- Assess the effectiveness of various litter additives in reducing ammonia emissions,

minimizing GHG emissions, and enhancing C sequestration in manure-treated soil.

- Study the influence of abiotic factors on the phytochemical composition of aromatic plants.
- Determine the phytochemical and nutritional composition of various local products used in human nutrition, and investigate their action on biochemical processes at the cellular level to add value to these local products, by-products and waste.
- Establish a biochemical assessment to add value to local crop production, byproducts, and residues, as a strategy to improve food nutritional quality and determine the nutraceutical potential of bioresources in the agri-food chain.

T&I - Technological Innovation to Support Agrarian Systems

GENERAL ACTIVITIES

T&I group is dedicated to the application of advanced technologies to improve agricultural and forestry systems, focusing on the integration of innovative tools that enhance productivity, sustainability, and resilience. In line with CITAB's mission, T&I will collaborate closely with R&D1 and R&D2 groups, fostering synergies between environmental and agricultural research to address key challenges in agrarian value chains. This interdisciplinary approach is key to developing integrated solutions that promote sustainable agricultural practices while addressing environmental concerns.

By leveraging technologies such as IoT, remote sensing, artificial intelligence, big data, and image-based solutions, T&I will support R&D1's focus on natural resources, biodiversity, and climate challenges, and R&D2's emphasis on crop protection, soil health, and valorisation of agrarian by-products. These collaborations will facilitate the development of practical, scalable solutions with higher technology readiness levels, driving innovation and enhancing the competitiveness of the agrarian sector.

T&I's work will also align with CITAB's overarching goals of promoting knowledge transfer, building capacity, and delivering cost-effective, environmentally sustainable solutions. The group's contributions will enhance agrarian value chains, boost the resilience of farming systems, and support rural, low-density, and economically fragile territories while contributing to food security and environmental protection.

Therefore, the main specific objectives of the T&I group for the upcoming period can be succinctly outlined as follows *Development of Real-Time Monitoring Technologies:* Implement advanced sensor systems (IoT, soil and climate sensors, etc.) for monitoring environmental and agronomic variables, aimed at improving agricultural and forestry production efficiency while reducing environmental impacts.

 Innovation in Smart Irrigation Systems: Develop irrigation systems based on soil moisture sensors and weather forecasting, using machine learning techniques to optimize water consumption and reduce waste, enhancing water resource efficiency.

- Development and promotion of Precision Agriculture Solutions: Al-based solutions to agricultural-related parameter prediction; apply geolocation technologies (GPS, GIS, UAVs) to map and monitor crop performance and optimize land management, integrating data from various sources (satellite, drones, field sensors).
- Development of methods to characterize the mechanical behaviour of products of vegetable origin: Support the definition of effective treatments for plant tissues, contributing to more sustainable production and reducing food waste.
- **Development of Digital Twins:** Integrate advanced technologies to support strategic decision-making aimed at increasing productivity, efficiency in agrarian value chains, and sustainability in the agricultural sector.
- **Technology Transfer and Collaboration with the Private Sector:** Establish partnerships with companies and stakeholders to develop and implement technological solutions in the field, promoting the transfer of technologies developed at the research centre to the agricultural and forestry sectors.

SPECIFIC ACTIVITIES

- Development of AI-Based Decision Support Systems: Create and improve decision support systems for farmers, focusing on artificial intelligence applications to predict diseases and pests, and optimize agricultural practices (e.g. irrigation, fertilization).
- Environmental Impact Study of New Agricultural Technologies: Evaluate the environmental impact of emerging technologies such as drones and IoT sensors in agricultural sustainability, focusing on reducing chemical use, preserving biodiversity, and reducing the carbon footprint.
- Implementation of Bioengineering Solutions for Sustainable Resource Management: Explore and apply new bioengineering approaches (such as bioreactors and perfusion systems) for sustainable biomass cultivation and processing of agroindustry waste.
- Development of Monitoring Solutions for Forests and Natural Ecosystems: Use technologies like remote sensing and UAVs to monitor the health and biodiversity of forest ecosystems, supporting sustainable forest management and the restoration of degraded areas.
- Development of Monitoring and Assessment Solutions for Precision Agriculture: Use image-based (RGB, multi and/or hyperspectral) to monitor and/or assess crops to improve sustainability and promote more environmentally friendly solutions.

- Execution of traction and compression mechanical tests in fruits: Use this data as a reference to calibrate numerical models and identify material properties and parameters.
- Development of Digital Twins: Apply advanced modelling to replicate agrarian systems, integrating data from IoT, AI, and other technologies to enhance decision-making, increase productivity, and ensure long-term sustainability.
- Collaboration in International Technological Innovation Projects: Participate in international research projects and networks focused on technologies for agriculture and forestry management, as part of open innovation initiatives and knowledge transfer.

COOPERATION

Although CITAB's applied research plays a pivotal role in advancing national and regional agrarian value chains, the internationalization of our research remains a top priority and will continue to be actively pursued. In 2025, CITAB will intensify efforts to strengthen its international presence through the promotion of scientific collaboration with global R&D units. This will include active engagement in European projects, such as Horizon Europe and PRIMA, as well as deeper integration into or consolidation of existing international research networks.

CITAB's position as a trusted research partner for private and public stakeholders and decision-makers will be further reinforced in 2025. Several new contracts with industry will be established, focusing on innovative solutions and applied research to address pressing challenges in agrarian systems. These collaborations will leverage the capabilities of CITAB's Specialized Laboratories (CITAB Labs, <u>https://www.citab.utad.pt/the-centre/citab-labs</u>). Partnerships with industry will remain a vital source of funding, facilitating the translation of research into practical, impactful applications.

CITAB's integration into the Associated Laboratory Inov4Agro has already strengthened its collaboration with researchers from GreenUPorto (University of Porto). This established partnership has generated significant synergies, driving advancements in agrarian research and fostering innovation across critical areas. Building on this strong foundation, CITAB remains committed to broadening the scope and impact of its research, unlocking new opportunities for internationalization and interdisciplinary collaboration. Through this ongoing partnership, CITAB continues to play a pivotal role in capacity building, ensuring the effective transfer of knowledge and innovative practices to stakeholders and policymakers. Together, these efforts address pressing global challenges in sustainable agriculture and environmental management, contributing to the development of resilient and sustainable solutions tailored to the agrarian sector. By advancing these strategic initiatives, CITAB will further solidify its position as a leading centre for cutting-edge research, dedicated to promoting sustainability and resilience in agrarian systems, at both regional and global levels-

DISSEMINATION, COMMUNICATION & OUTREACH

In 2025, CITAB will continue its commitment to transferring the knowledge generated through its research to a diverse audience, including academia, stakeholders from the public and private sectors, and the general public. This ongoing dedication to excellence reinforces CITAB's role as a hub for intellectual exchange and innovation. The planned activities for the year are designed to advance knowledge in agriculture, forestry, and environmental sciences, driving solutions for contemporary challenges in sustainable development. Key initiatives include:

MAJOR EVENTS

- CITAB Stakeholders Day: CITAB will host its stakeholders, including the "Stakeholders Committee," for open discussions on challenges and opportunities in agrarian research. This event aligns CITAB's research with private sector needs by fostering direct dialogue and collaboration. It also features lab visits, showcasing CITAB's facilities and projects. Members of the External Advisory Committee will also be invited to evaluate recent developments and provide strategic feedback.
- **CITAB/Inov4Agro Open Day**: Co-organized with GreenUPorto under the framework of the Associated Laboratory Inov4Agro, this event will highlight ongoing projects, activities, and research lines. The focus will be on regionally relevant agrarian value chains, emphasizing innovation and service provision.
- "Today is the Day" Celebrations: These activities celebrate International Days (e.g., Water, Climate, Environment, Soil, and Sustainability) related to CITAB's research areas. Each event will feature a distinguished guest speaker, providing insights into critical global issues and fostering discussions among attendees.

RESEARCH AND KNOWLEDGE DISSEMINATION

- "Harvesting Knowledge" Webinar Series: A monthly series of 15-minute presentations, led by CITAB's youngest PhD Integrated Members, to disseminate their research among colleagues and foster internal collaboration.
- Sustainable Agri-food Production Seminar Cycle: This monthly seminar series will feature PhD students in their final research stages for presenting their work.

Discussions will culminate in awards for the two best presentations, supporting publication fees or conference participation.

 Scholarship Researchers' Day: An event organized by CITAB's scholarship researchers to showcase their research and facilitate future collaborations within the Unit.

OUTREACH AND INTERNATIONALIZATION

- **Participation/Organization of Thematic Sessions in "Ciência 2025"**: CITAB will actively engage in this annual event organised by FCT, contributing to thematic sessions that align with its research priorities.
- Organization of International Meetings: These events will strengthen CITAB's internationalisation, building collaborations and showcasing its contributions to global agrarian and environmental challenges.
- Engagement in "Ciência Viva" Activities: CITAB will participate in activities throughout the year, engaging with the public to promote science awareness and education.
- Participation in the European Researcher Night and Similar Events: These events will provide opportunities to engage with the public, showcasing CITAB's research and fostering science communication.

VISIBILITY AND COMMUNICATION

- **Outreach Activities in Schools**: CITAB will implement initiatives in primary and secondary schools, alongside organising visits to the **UTAD Campus**, to inspire the next generation of researchers.
- Enhancement of the CITAB Website: Updates will align the website with CITAB's new Strategic Programme, making it a more effective tool for communication and engagement.
- Social Media Strengthening: CITAB will expand its visibility on platforms like LinkedIn, leveraging these tools to engage with broader audiences.
- Media Engagement: CITAB will increase its presence in the media, including television, radio, and newspapers, to enhance public awareness of its research and impact.