2017-2018 Activities Plan

CITAB

Compiled and edited by

CITAB Executive Committee & Ana Coimbra and Tânia Martins

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

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1 Introduction

The 2017-2018 Activity Plan will continue research in the Strategic Programme's two Thematic Strands 1) Sustainability of Agri-food and Forestry Ecosystems in a changing environment and 2) Technology & innovation in Agri-food and Forestry chains for a more competitive bio economy.

Thematic Strand 1 comprises two tasks a) Integrated monitoring of climate and environmental impacts: Adaptation and mitigation strategies and b) Conservation strategies and ecological modelling: recovering and improving sustainability in agri- food and forestry ecosystems. Thematic Strand 2 comprises three tasks a) Innovative technologies and processes; b) Bio-based products and waste research and c) Towards the valorization of agro-food co-products.

This approach supports CITAB's vision to provide scientific, technological and innovative knowledge - based on multidisciplinarity and complementarity - to meet stakeholder needs and challenges in agri-food and forestry value chains.

The CITAB 2017/18 Activity Plan responds to real societal challenges:

- to better understand climate change mechanisms, how they impact plant physiology and carry out mitigation studies on crops and forest production;
- by developing technological tools for online monitoring to improve agri-forest value chains as a result of better natural resource management;
- by continuing to contribute to the circular economy by creating added value in co-products.

CITAB is halfway through its 2015 – 2020 Strategic Programme. Planned research will support two recently NORTE 2020 Regional Funding funded Projects: Integrative Research in Environment, Agro-Chains and Technology (INTERACT; NORTH – 01-0145-FEDER-000017) and Vineyard and Wine Innovation Platform (INNOVINE&WINE; NORTH – 01-0145-FEDER-000038). These projects are strongly dependent on CITAB human resources (but also involve members from other UTAD Research Centres) and shape the 2017-2018 Activity Plan.

INTERACT comprises 3 research lines: Innovation for Sustainable Agro-food Chains (ISAC), BioEconomy and Sustainability (BEST) and Sustainable Viticulture and Wine Production (VitalityWINE). These lines aim to improve agriculture by developing scientific and technological knowledge to increase important crops yields for new market segments. INTERACT also carries out research on natural resources and the integrated management and valorisation of agrarian production chains. CITAB researchers will boost regional technological and competitiveness by developing and disseminating innovation and knowhow, new methods and technologies and more environmentally friendly and efficient processes.

INNOVINE&WINE is a multidisciplinary project involving more than 110 Researchers (70 with PhD) with expertise covering areas ranging from soil science, climatology, ecology, viticulture, physiology, microbiology, chemistry, oenology and engineering to economics and management. The INNOVINE&WINE platform will integrate wine-related research

with different specific objectives and from across different disciplines into a single overarching global strategy defined by the wine sector. INNOVINE&WINE will accelerate the process of making research more relevant and accessible to the Portuguese wine sector.

Outreach activities are also an important part of 2017/18 activities. Outreach depends on CITAB researchers working together to disseminate the centre's activities and capture the interest of potential young scientists in regional secondary schools. CITAB also informs the local community, and public and private sector organizations of its research to demonstrate its relevance to different areas of society, socio-economic activities and the environment.

CITAB will continue to developing its "open laboratory" concept to engage and involve high schools students (e.g. "Ciência Viva" programme), and engage the media on "hot topics" such as how climate change and greenhouse emissions affect agriculture, water resources, forest fires, biodiversity and the sustainable management of agri-forest ecosystems.

2 Major Objectives

The 2017 and 2018 objectives will follow the 2015-2020 Strategic Programme (SP) which focuses on solving societal and private sector (e.g. small and medium enterprises or SMEs) problems in agriculture and forestry production chains and their impact on the natural environment.

CITAB will meet the following specific targets in 2017-2018:

- Participate in the Integrative Research in Environment, Agro-Chains and Technology Project (INTERACT). INTERACT comprises 3 research lines: Sustainable Agro-food Chains (ISAC), BioEconomy and Sustainability (BEST) and Sustainable Viticulture and Wine Production (VitalityWINE).
- Open new cycles of the two FCT funded International Doctoral Programmes "AgriChains – Agricultural Production Chains - From fork to farm" and "Campus Do Mar - Marine Science, Technology & Management".
- Submit new international doctoral programmes with national and international research centres, universities and stakeholders.
- Participate in current international funded projects such as EUROLEGUME, TuRBO SUDOE, EURODAIRY, BRESOV and ALICE. These projects are fundamental for CITAB R&D and for developing collaborative links with some of the best research groups in Europe.
- Develop and participate in Horizon 2020 proposals in key areas that match 2015-2020 Strategic Programme.
- Develop planned, strategic outreach activities to engage young scientists, the media and to show the relevance of applied research in various sectors.

3 Activities

CITAB has followed recommendations to streamline research activities and tasks within the Thematic Strands in the 2015-2017 CITAB External Advisory Committee Report. Thus, this Activity Plan follows the new structure, approved by the CITAB Scientific Council. The Activity Plan provides a brief description of each task followed by a list of research activities planned for 2017-2018.

3.1- TS1 - Sustainability of Agri-food and Forestry Ecosystems in a changing environment (Coordination: Rui Cortes)

3.1.1 - Task 1.1: Integrated monitoring of climate and environmental impacts: Adaptation and mitigation strategies (João Santos)

Description: To develop and apply new analytical technologies to (ii) understand climatic and environmental forcing on target ecosystems under current conditions; (iii) to assess future scenarios of climate and environmental change to develop, test and implement suitable mitigation and adaptation measures, such as riparian restoration (e.g. to assess ecosystem service provisioning of green infrastructures), bioclimatic cultivar adaptation (e.g. crop zonation) and fire (e.g. regime, risk, weather, climate and human influence).

Main activities:

- To evaluate climate variability and change effects on grapevine and olive tree phenology, growth and yield, using both statistical and dynamical crop modelling;
- Studies on climate change mitigation and adaptation strategies to increase productivity and sustainability on olive orchards and on vineyards. Different types of cover crops, biochar, zeolites, arbuscular mycorrhizal fungi, wood ash from biomass, different types of compost (manure, olive-waste cake and municipal solid waste), as mulch or incorporated into the soil, and the foliar application of various environmental stresses alleviators will be tested;
- Compare atmospheric mesoscale prognostic models to simulate the state of the atmosphere with high spatial-temporal resolution and development of a web platform to provide climate and weather services.
- To contribute to better understanding of catchment level water cycles and natural and human pressures for an environmentally sustainable use of the water resources, as well as for support conservation and recovery strategies, including to calibrate/validate rainfall-runoff models with embedded ecological tools;
- Water reuse studies in the inactivation of microorganisms both in water and in simulated or real agro-wastewaters;
- To use distinct levels of biological organization (biomarkers and bioindicators) to improve environmental quality assessment in lotic systems and investigation on cause-effect relations along multiple-disturbance gradients;
- To establish the relation of the studied communities with descriptors of land use, landscape metrics and pressure parameters as predictors and drivers of ecological quality across different river typologies using integrated biological quality elements. To obtain a validation of multiple-level indices will be the final deliverable;
- To update the Portuguese rural fire database, to improve current knowledge on the fire regime in Portugal, the relationship with human and environmental factors and the estimates of fire incidence, danger and risk for future scenarios of global change; to assess the relationships between animal grazing patterns, climate variation and fire occurrence in mountain areas; to assess the weather, climate and human influence in

extreme fire occurrence; to characterize the regional fire climates of the world and to classify and interpret fire danger rating at the regional scale;
- To assess the relationships between climate and wood features (ring with and wood density components) in wood samples.

3.1.2 -Task 1.2.: Conservation strategies and ecological modelling: recovering and improving sustainability in agri- food and forestry ecosystems (Mário Santos)

Description: Task 1.2 researchers are experts in multivariate analysis and modelling of impacts of habitat and land use change on terrestrial and aquatic environments, ecosystem services and characterization of agri-food and forestry systems. Multidisciplinary, stakeholder relevant research will develop and apply techniques for species preservation, pest control and biodiversity. Modern methods (i.e. novel hyperspectral image, computational intelligence techniques and decision spatial support systems) will be developed and implemented to test innovative technologies that increase efficiency and system resilience and facilitate interaction between service providers and consumers to protect and enhance ecosystem services. Researchers will develop, test and apply spatiotemporally dynamic predictive analytical tools to understand how natural and anthropogenic changes affect ecosystems.

Main activities:

- To study the effects of using green infrastructures for catchment management and restoring ecosystems to reduce vulnerability to climate change and anthropogenic pressures,
- To model fire behaviour and wildfire risk for diverse environmental conditions. Experimental lab-scale study of fire behaviour characteristics in live fuel complexes to model the effects of fuel moisture and fuel structure;
- To combine new statistical developments for wildlife conservation by developing, testing and using predictive and multivariate methodologies to obtain results and decision support tools concerning ecological environments for the endangered species.

3.2- TS2 - Technology and innovation in Agro-food and Forestry chains for a more competitive bioeconomy (Coordination: Eduardo Rosa)

3.2.1. Task 2.1 - Innovative technologies and processes (Pedro Melo)

Description: Task 2.1 focuses on a major CITAB objective – the optimization and development of innovative technology for more competitive agri-food and forestry production chains. TS2 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 TS2 (i) develops physiological and best management tools; (ii) produces novel technological applications, including predictive management software and spectral imaging applied to crop and forestry parameters; (iii) identifies key intervention points to optimize plant production;

(iv) characterizes vegetation and quality to optimize physiological responses to climate conditions. TS2 contributes to sustainable economic income for regional stakeholders, but findings extend to national level. Agro-forestry ecosystems are also a concern since they are affected by production efficacy and residues that have economic and environmental impacts (addressed in Task 2.2.).

Main activities:

- Increase the productivity and yield of crops and forestry resources through physiological and best management tools;
- Produce new technological applications, including management software prediction, spectral imaging applied to food crops and forestry in order to predict maturation stages, growth rates, harvest periods, water and cycle of nutrients or fertilizers management, disease or pest occurrences, among others parameters, and software for model enzymatic kinetic assessment;
- The identification of key intervention points in resources to optimize plant production and identify species, varieties and rootstocks with potential biological and nutraceutical benefits;
- To characterize vegetation and quality assessment to optimize physiological responses to climate conditions. The findings will show how to produce with innovative methods, providing optimized solutions for current and future stakeholders by boosting competitiveness and income. This will contribute to sustainable economic income for regional stakeholders which obviously extend findings to national level.

3.2.2. - Task 2.2: Valorization of Bio-based products and co-products (Rui Oliveira)

Description: Task 2.2 studies the potential of agri-food and forestry residues (AFFR), native flora, and aromatic and medicinal plants (AMP) to develop new high bio-based value products. Researchers will develop processes to create products with biological and innovative industrial value. Task 2.2 will study AFFR use for producing materials with industrial application via transformation and structural characterization studies and physical and chemical property studies. AFFR and AMP application studies will be supported by the extraction, purification and isolation of highly bioactive compounds using updated and case-to-case protocols to assess biochemical and biological activities. Extracts, fractions or compounds will be tested for toxicology and phytotherapeutic potential (e.g. antibacterial activity, anti-aging, anti-inflammatory, anti-cancer, anti-ischemic and neuroprotective properties). Finally, the safety of extracts/fractions and validate pharmacological/nutraceutical properties will be assessed.

Main activities:

- Biological treatment of waste and agro-industrial effluents (from wineries and chestnut processing) by fungi, and valorization of the process. Evaluation of the toxicity of the

residues and research of potential biological activities (e.g. anti-microbial, herbicide) before and after treatment using multi-biological level approach.
- Evaluation of winery solid by-products respecting their chemical content;
- Identification and characterization of plant extracts, namely from autochthonous species, and determination of antimicrobial, antioxidant, anti-inflammatory and anti-genotoxic properties. Design of their potential applications and valorization (e.g. natural pest control, health, cosmetics and nutrition);
- New biocomposites, based in agro-forestry wastes and fungi, will be developed, allowing a useful destination for those wastes and contributing to the replacement of many petroleum-based polymers, such as the styrofoam and plastics, in agriculture and other industries;
- Solid state fermentation of lignocellulosic residues with white-rot fungi for selective lignin degradation, for enhance carbohydrates saccharification and subsequent bioconversion into value-added compounds or bio-fuels;
- Outreach activities and meetings are planned for all tasks. Maintenance of current stakeholders' collaboration and recruitment of new ones will be will be a priority. Increase of international collaborations and internationalization of the academic staff and researches is also an aim.

3.2.3. Task 2.3: Towards the valorization of agro-food co-products (Luis Antunes)

Description: Task 2.3 deals with the challenges arising from Task 2.2 to develop new bio-applications. The research work will involve BE and SAC researchers, in order to create new products with both biological and innovative industrial value. CITAB multipurpose collaborations result in critical mass to assess target materials on biochemical composition and biological activity of whole extracts as well as their isolated compounds.

Main activities:

- Studies on the therapeutic and toxicological properties of plant extracts will be evaluated using animal models, especially laboratory rodents, via dietary trials;
- Animal trials to support the utilization of cowpea stover and discarded apple silages in ruminant feeding will be planned. Higher levels of inclusion of white-rot fungi treated co-products (e.g. cowpea stover, or others) will be tested in animal feeding trials.
- Compounds will be isolated from extracts derived during preliminary research for in vivo assessment l
- The safety of the compounds isolated from each matrix, will be assessed.
- The same compounds will be evaluated for functional, nutritional quality and toxicological/pharmacological properties, using in vitro biochemical and cellular methods, which will be further validated.

4 Cooperation

4.1 Internal

The CITAB Executive Commission (ExCo) continues to guide and support internal cooperation via meetings and day-to-day dialogue with CITAB researchers. Feedback from researchers is discussed with the Board to help shape strategy and policy development.

Regular meetings (4 per year) between working group coordinators and monthly ExCo members are held to discuss, organize and implement research, outreach and dissemination activities, solve problems and support integration.

The development and teaching of advanced courses and the international Doctoral Program AGRI-CHAINS and Campus Do Mar encourage CITAB members to work together to develop syllabi based in areas with high levels of expertise and critical mass.

4.2 National

CITAB continues to aim for increasing cooperation with national research centres via joint applications for funding, MSc and PhD thesis supervision, and FCT sponsored projects have been a good occasion to establish contacts with other organizations. CITAB will also be involved in the calls of the SAICT (FCT), Portugal2020, Norte2020, PDR2020 as well as in the specialized services for the national community.

Collaboration Protocols with INESC-TEC (Institute for Systems and Computer Engineering, Technology and Science) and CIIMAR (Interdisciplinary Centre of Marine and Environmental Research) are being prepared in scientific activities recognized as being capable of integrating the research areas of the two research units.

4.3 International

CITAB will expand cooperative research work initiatives, through funding initiatives such as the Horizon 2020 programme. At the international level these projects are also a good possibility to establish contacts with other international research centres.

CITAB researchers will continue to actively participate in international conferences, management, scientific meetings and technical visits develop contact with important foreign researchers and acquire expertise through visits to foreign (mobility).

CITAB will continue to receive incoming researchers for PhD and Post-doc (short / medium-term stays).

4.4 Anchor Institutes

CITAB will continue to collaborate with the following anchor institutes to encourage the development of researchers through mobility and cooperation:

- Dresden University of Technology (TUD), Germany
- Paraíba State University (UEPB), Brazil

- Polytechnic University of Valencia (UPV), Spain
- University of La Rioja (UR), Spain;
- University of Navarra (UPNA), Spain
- University of Reading, United Kingdom
- University of Santiago de Compostela (USC), Spain
- University of Wageningen (WUR), Holland

4.5 Stakeholders

Research activities within CITAB will continue via close cooperation with stakeholders from different sectors of the agro-food and forestry industries. Links with stakeholders include joint participation in projects, transfer of know-how, dissemination of results, development of new products and developing technological solutions.

The listed stakeholders are:

- ACUSHLA, S.A.;
- Agência Portuguesa do Ambiente (APA);
- AgroRioBom, Lda.;
- Águas do Algarve S.A.;
- Amândio Galhano Viniculture Station (EVAG);
- Associação Agro-Florestal e Ambiental da Terra Fria Transmontana;
- Associação de Agricultores para Produção Integrada de Frutos de Montanha (AAPIM)
- Associação de Produtores em Proteção Integrada de Trás-os-Montes e Alto Douro (APPITAD);
- Associação dos Olivicultores de Trás-os-Montes e Alto Douro (AOTAD);
- Associação Nacional de Criadores de Ovinos da Serra da Estrela (ANCOSE);
- Associação para o Desenvolvimento da Viticultura Duriense (ADVID);
- Associação Regional dos Agricultores das Terras de Montenegro;
- BioBaga;
- CAP-Confederação dos Agricultores de Portugal;
- Casa de Mateus;
- Casa de Santo Amaro
- Central Termoelétrica de Biomassa Terras de Santa Maria, S.A.;
- CIIMAR;
- Comissão de Viticultura da Região dos Vinhos Verdes (CVRVV);
- Companhia Geral da Agricultura das Vinhas do Alto Douro, S.A. (Real Companhia Velha);
- Cooperativa Agrícola de Alfândega da Fé;
- Cooperativa Agrícola de Penela da Beira;
- Cooperativa Agrícola de Produtores de Frutos de Casca Rija;
- Cooperativa dos Lavradores do Centro e Norte;
- Cooperativa Soutos os Cavaleiros;
- Cooperative winery of Favaios;
- Cooperative winery of Freixo de Espada à Cinta;
- Cooperative winery of Mesão Frio;
- Cooperative winery of Monção;
- Cooperative winery of Ponte de Lima;

- Ecosfera;
- EDP, Eletricidade de Portugal;
- Empreendimentos Eólicos do Douro, SA.;
- Energia Verde;
- Energiekontor – Parques Eólicos Unipessoal, Lda;
- Figueira da Foz Municipality;
- Frulact;
- Fundação Maria Rosa;
- GIFF - Gestão Integrada de Fogos Florestais, S.A.;
- Grupo Avanza;
- Herdade do Esporão;
- Iberia HealthCare Systems;
- ICETA;
- Instituto de Ciencias de la Vid y del Vino (Spain);
- Instituto dos Vinhos do Douro e do Porto, I P (IVDP, IP);
- Instituto Nacional de Saúde Doutor Ricardo Jorge;
- LABELEC - Energias de Portugal (EDP group);
- Lusiaves;
- Mallus;
- MAVA _Fondation pour la Natur;
- Mira Municipality;
- Mirtilusa - Sociedade de Produtores Horto-Frutícolas;
- National Civil Protection Authority;
- National Forest Authority (AFN);
- Navigator;
- NEIKER-Tecnalia;
- North Region Water Authority;
- Parque Eólico de Gevancas;
- Parque Eólico do Vale do Abade;
- PROFICO Ambiente;
- Prosistemas;
- Queijos Lagos e Sabores e Ambientes Serra da Estrela;
- QUERCUS (Associação Nacional Conservação Natureza);
- Quinta do Vallado;
- RefCast - Associação Portuguesa da Castanha;
- Regiefrutas;
- Resíduos do Nordeste, EIM;
- Sociedade Vinícola Terras de Valdigem, S. A.;
- Sogevinus Quintas S.A.;
- Sogrape;
- Symington Estates;
- Tekever ASDS, Lda.;
- Torres Novas Municipality;
- Trancoso Municipality;
- UAVision;
- Vila Real Municipality;

5 Dissemination & Image

CITAB will continue to promote cycles of conferences with themes that capture the range of CITAB's areas of expertise. 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.

CITAB will increase the number of outreach activities for secondary schools. A yearly programme of talks will promote science and research activities to engage the students in Unit activities early on in their curricular studies. The Centre will be promoted at

international and international level to attract more researchers to work in both thematic strands.

Other key outreach activities will include the next edition of the "UTAD Junior University", with the theme "Develop yourself" and the UNESCO International Year of Tourism for Sustainable Development which will involve several dozen CITAB researchers and 100 young students over a week. Other outreach activities will include "UTAD Open Day", "Science and Technology Week", "Portuguese Biology Olympiads", "Earth Hour", "Open weekend - A future as a Biologist / Biochemist" and the "European Researchers' Night" (NEI). The first International Summer University on Geoparks, Sustainable Regional Development and Healthy Lifestyles will be held at UTAD, as part of the UNESCO Chair "Geoparks, Sustainable Regional Development and Healthy Lifestyles" (approved this year by the United Nations Organization area for Education, Science and Culture).

CITAB has a dedicated Secretariat, which both supports and promotes the Unit and its researchers' activities on different levels and for different target audiences (e.g. the general public, partners and institutions to stakeholders and industry). CITAB expects an increasing level of awareness of its activities and how they affect society. CITAB will engage more and more different sectors of the scientific community, students and the general population.

6 Human resources

CITAB will maintain the number of MSc, PhD and postdoctoral students carrying out studies at the Centre. However, the INTERACT project will result in a large number of new fellowships (with MSc. and Ph. D. degrees) for the Unit. We will continue to actively encourage foreign students and researchers, in particular from Brazil, China and India, to carry out their studies at the Centre.

7 Summary of scientific productivity metrics for 2017 and 2018

Expected scientific production for 2017 and 2018:

Item	2017	2018
Books	6	6
ISI Publications	120	150
Publications in national journals	30	35
Oral communications in international conferences	150	170

Item	2017	2018
Oral communications in national conferences	70	80
Reports	80	80
Organisation of seminars and conferences	7	7
Doctoral theses	10	10
Masters theses	30	30
Patents	2	3

8 Budget (FCT Pluriannual funding)

Item	%	2017	%	2018
Human Resources	57	114.417,78	58	116.880€
Missions	5	10.666,67€	2	3.500€
Aquisition of Goods & Services	15	28.888,89€	16	32.120€
Dissemination		-	4	7.500€
Overheads	20	40.000€	20	40.000€
Equipment	3	6.026,66€		-
Total	**100**	**200.000€**	**100**	**200.000€**