2009 Activities Report

[beta]

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CITAB

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- Integrative Biology & Quality
- Ecointegrity
- Biosystems Engineering

1 – Unit description

CITAB is a research Unit in the area of agricultural and forestry sciences hosted by the University of Trás-os-Montes e Alto Douro (UTAD) but with a national and international scope activity. This Unit covers scientific activities, across the School of Agriculture and Veterinary and the School of Life Sciences and Environment, being a support of post-graduate courses promoted by both schools, as well as technology transfer and consulting to our stakeholders and marketing of this research area. Regarding this aspect CITAB is well involved with Clusters and the national Competitive Poles.

The Unit is organized in a straight collaborative manner of 3 Research Groups: Integrative Biology and Quality, Bio-Systems Engineering and Eco-integrity, with a respective coordinator. Despite this organization there are several activities (i.e., scientific dissemination, seminars, …) and projects which include participation of different expertise across the Groups. Thus, collaboration is a key action for our activities. Clearly, the contribution of the Engineering Group is forseen to bring an added value to the scientific development of agro-food and forestry sciences, particularly at national level, which is a distinctive feature of this Unit. Having set standards for higher competitiveness, the selection of the integrated members is done within international benchmarking criteria as well as our collaborations with national and international institutions. Indeed, internationalization is a driving force of the Unit through what we defined as anchor institutions.

The management relies in a Direction (1 Director and 2 Vice-Directors) supported by an Executive Committee (6 members- 2 from each Research Group). The ExCo has the commitment to be very pro-active at the bottom structure (individual members) being continuously asked to bring up the feelings and the results of the policy set by the Direction; the ExCo has also the responsibility of compiling the information and collaborating in all the actions to promote the visibility of the Unit. The Direction meets at least once a month and similarly for the ExCo; the Research Groups also have regular meetings to evaluate the progress of the Plan of Activities. By regulation the Scientific Council meets a minimum of 4 times a year. The Unit, regarding its dimension, has the support of a secretary that deals with all the burocratic aspects in the triangle, researchers and central services of UTAD and FCT, giving particular support to the Direction and to the Executive Committee in all the matters that require their attention.

2 – General objectives

The driving objective of CITAB is a gradually improvement of the scientific quality through a continuous application of benchmarking criteria to all the ongoing activities which have been divided in scientific and co-scientific, for a more clear approach.

In our planning for CITAB, we have centered our objectives in the improvement of the quality growth of the Unit, through the incorporation of new members of high scientific quality, in the internationalization of the Research Groups, in the development of innovative research, in the promotion of contacts with industry and in the improvement of the image and visibility of CITAB. These are the collective driving objectives of the Unit in which each of the Research Groups has been asked to act and contribute to.

2.1 – Scientific objectives

The research topics concentrate on more sustainable production chains of agri-food and forestry systems to make producers more competitive. Thus, our research objectives are concentrated in every step of the chain and their constraints, such as the improvement of the knowledge and study plant stress adaptation to climate changes- particularly the effect and overcoming of extremes- water shortage and quality and improvement of water management (for instance in grapes- Port wine region). Within the same line our objective is to develop studies on biodiversity linked to agro-forest management and protection against biotic agents, on the control of fires and recovering of ecosystems, and the identification through physical and biological metrics to quantify disturbances in terrestrial and aquatic ecosystems.

Within the sustainable production and the organic farming of the vines and other major crops, such as olives and vegetables, it is studied their quality and health benefits. Taking a novel approach, all these research lines benefit somehow from a close contribution of technology engineering to further understand the environmental changes at a scale of the ecosystem and the individual (life organism) using signal and image processing, biosensoring and remote sensing. A more specific contribution from the engineering was the study and characterization of the forestry resources to be used in the industry and as biofuels and in the exploitation of biomaterials.

Pursuing with sustainability and competitiveness of the production chains, there is a focus on the agri-food and forestry transformation units envisaging an added value of the co-products of these industries.

A special care is driven to a whole chain of interactions in agro-forested systems, from the prediction, trough ecological modeling, of the human impacts and climate changes, to the monitoring of changes on biotic assemblages (floristic and faunistics) and abiotic factors to the mitigation of those effects, providing innovative tools for restoration of disturbed ecosystems.

2.2 – Co-scientific objectives

Increase both the funding and the JCR scientific production, are key objectives. We envisaged a growth in the number of scholarships, and in the number of national and particularly international links (application of the concept of anchor institution), to increase the mobility of researchers and build projects under the FP7. The attraction of the private sector to our research is another main objective.

3 – Main achievements during 2009

During 2008 we consolidated the merging process of the 3 Units, meeting all the objectives that have been set for this process.

At the stage of the FCT evaluation and visit of the international panel (Jan. 2008) we had 42 integrated members and gradually we admitted new members to reach 56 integrated members at the end of 2008, including one Group from U. Minho and members from the Escola Superior Agrária de Ponte de Lima. Thus we grew on critical mass whilst keeping high quality standards for admission of new members.

Regarding cooperation we expanded our links to several SME's particularly in the area of Agri-Food and Environment, which lead to the opportunity of designing joint research projects, pursuing the resolution of problems during the production and transformation chain and in the reduction of the environmental impact of their effluents. Similarly we made contacts at international level to set a long lasting cooperation with our "anchor" research institutions. Each group has achieved this goal establishing at least one link. Moreover, to gain further visibility and better approach to companies, CITAB has been involved in the successful application to a National Competitiveness Pole on Agri-Food in which around 40 companies are involved. Similarly is also taking part in a Technological Platform between North Portugal and North of Spain (Galicia) in which around 150 companies are participating.

An improved image and visibility of CITAB was achieved and now an innovative site is available, where each member can input his data thus reducing the costs of updating and passing more responsibility to everyone.

At scientific level we gave specific contributions to the progress of science in the area covered by CITAB, which are addressed ahead under the description of each Research Group. For instance, in the domain of the phytochemicals and health we gain new knowledge on the effect of some compounds in the bacteria of human gut; regarding the environmental studies we can stress the achievements on new bio-indicators and monitoring of waters, on the development of stochastic-dynamic methodology and on forest ecosystems monitoring; regarding the technology application on precision agriculture we are able to gather a large quantity of in-field data for further integration and aggregation; we also developed a new method for the characterization of wood mechanical properties among others; regarding the climate we put forward a parametric

model for wine productivity, an extreme important crop for Portugal that had been submitted to climate extremes with detrimental effect on the quality of wine.

Under the co-scientific activities CITAB has increased the number of SCI papers, from 1.4 SCI/cap to 1.5 SCI/cap. Similarly the number of scholarships has increased from 21 to 29.

3 – 2009 Activities

In this part of the report we describe general activities of the Unit that are aimed at integrating the research of various groups of which multidisciplinary and/or trans-disciplinary activities are of particular relevance. The second part is aimed to describe work that the Unit does to extend beyond the scientific environment and to reach the general public, schools or other forms of engaging the public in the work of the Unit.

3.1 – Integrative/multidisciplinary activities

CITAB was built under the strategy of multidisciplinary. Although some of the activities of the 3 Research Groups were conducted individually most of the activities were the result of an active and permanent collaboration between Research Groups, often resulting in synergetic teams assembled to cope with specific tasks. Although the research is attributed to a Group, mainly for management purposes, which acts as a leader, members from other Research Groups are requested to participate according to the specific tasks building an interdisciplinarity team.

For instance, the comprehensive studies (i.e., plant stress, water request and irrigation planning, and biological pest control) on the influence of climate change and particularly the extremes on the production chains in major crops, such as grapes, chestnuts and olives was a team work between the Climate sub-group and the Integrative Biology and Quality. Similarly for the quality evaluation of the respective crops products and the respective potential health effects.

The development of data processing schemes was also a joint research between the Integrative Biology and Quality and the Biosystems Engineering. The research on the Assessment of stream condition and use of bioindicators to study the effects of environmental impacts at various spatial scales, river rehabilitation and catchment management, the biosystems engineering and the ecointegrity groups with a strong input from the climate sub-group..

Another important example of interdisciplinarity is the study of the role of microorganisms in nutrient cycling, leaf breakdown and in ecological succession; their potential use as ecological indicators and in biotechnology and treatment of agro-industrial effluents; these activities involved the Groups of Ecointegrity, Integrative Biology and Quality and the sub-group of the Climate and Atmospheric Modelling.

The Ecointegrity and Biosystems Engineering are acting together to develop a new data reduction scheme for wood fracture characterization and the development of an inverse identification procedure of fracture properties of wood.

Under the Wireless Farm concept, the input of the technologies (BE Group) in the agriculture production chain (IB&Q) was also evident in the development of multipowered small stationary data acquisition device as well as a soil-moisture laboratorial prototype sensing device.

Thus, these are only a few examples of research activities involving most of the Research Groups which reveal the added value of CITAB in designing and implementing research in the agriculture production chains.

It must be stressed that most of these activities also imply a rational use and share of equipments to keep costs at the lowest levels.

3.2 – Outreach activities

CITAB is well aware of the importance of outreach activities and has defined several major actions:

i. We have opened our Laboratories to the community and to the public schools inviting students of secondary schools and the teachers to participate in the ongoing scientific activities and in some cases managing the scientific equipments available; within the same line of action we produced very high quality scientific photos which were exhibited during the "Week of Science and Technology" in November- this was open to the society in general. Further, in 2010, these photos will take part in a road-show entitled "Science at UTAD".

ii. It was organized several conferences opened to the scientific community and to the students, with the presence of national and international experts related to forest fire management and use of remote controle and GIS for the characterization of forest ecosystems.

iii. A successful application to the POCTEP- ex-INTERREG projects, allowed a close link to several companies on the agro-food sector. Within this project were done several presentations of the ongoing activities of CITAB. Similarly was achieved with the participation on the Competitive Pole on agro-food, recently named PORTUGAL FOODS as well as in the Cluster of the Douro Wines.

iv. Within the activities of dissemination it was finalized a web page, produced 2 newsletter in Portuguese and start to produce a Newsletter in English devoted to our international partners and other scientific international institutions that operate in the same research fields.

v. Several press releases regarding "hot topics" followed interesting scientific results, such as the noninvasive methods for datation of old trees, added value for co-products from the agro-food industry.

4 – Funding

	2007	2008	2009	Subtotal
FCT Base	0,00 €	116.100,00 €	200.062,50 €	316.162,50 €
FCT Projects	0,00 €	1.629.638,00 €	2.338.892,00 €	3.968.530,00 €
Other (National)	0,00 €	3.416.743,47 €	2.487031,26€	5.903.774,73 €
Other (International)	0,00 €	1.729.444,69 €	1.797.055,00 €	3.526.499,69 €
Industry (National)	0,00 €	310.529,97 €	0,00 €	310.529,97 €
Industry (International)	0,00 €	0,00 €	0,00 €	0,00 €
Total	0,00 €	**7.202.456,13**	**6.823.040,76 €**	**14.025.496,89 €**

5 – General indicators

5.1 – Composition and training

	2006	2006	2007	2008	2009	Total
No. of Researchers Hired (Ciência Programme)	0	0	0	1	4	**5**
No. of Researchers (FTE)	78	61	41	42	55	
Training Masters (Master thesis completed)	14	22	7	26	52	**121**
Training PhDs (PhD thesis completed)	15	7	10	4	11	**47**

5.2 – Researchers hired

N/D

5.3 – Technical personnel hired

N/D

5.4 – Additional comments

N/D

6 – Research Groups

Reference	Group Title
RG-Norte-4033-134	Integrative Biology and Quality
RG-Norte-4033-135	Ecointegrity
RG-Norte-4033-136	Biosystems Engineering

6.1 – Integrative Biology and Quality

6.1.1 – Group description

Principal Investigator	Henrique Trindade
Research area	Agricultural Sciences
Home Institution	Universidade de Trás-os-Montes e Alto Douro

6.1.2 – Funding

	2009
FCT Projects	1.324.517,00 €
Other (National)	673.039,00 €
Other (International)	824.505,00 €
Industry (National)	0,00 €
Industry (International)	0,00 €
Total	**2.822.061,00 €**

6.1.3 – Objectives

This Group, formed through a rational unification of selected members from 3 research Units, set the following key objectives which, although presented separately, are closely integrated into each sub-area of this Group. Within these objectives is the common, major driving-force of the Unit - to increase associations and collaborations with agro-food companies to improve methods and solve problems relating to whole production chains (from crop and animal production, post-harvest effects, and to the final industrial processing stages with associated waste generation). This focus on agro-food chains and companies is of high relevance at both national and particularly at regional levels.

1. Contribute with research studies to the sustainable agriculture concept of the major socio-economic crops in the northern area of Portugal, such as Brassica vegetables, grapevines, olives, chestnuts, dry fruits, cherries and apples;

2. Develop focused studies on plant stress biology and biochemistry to further identify the biological and biochemical mechanisms of abiotic, biotic and climate-induced stress in the major crops identified above;

3. Plant food quality and health- under this topic it was envisaged the identification and quantification of nutrients and phytochemicals in European and non-European crop plants and to use this data to i) explain the effect of climate change in relation to plant stress and composition; ii) identify eventual influences on the taste of food; iii) identify effects on plant pathogenic bacteria, iv) identify effects on intestinal microflora of pigs and humans and ultimately the consequences for animal and human health;

4. Development of comprehensive research and experimental studies on agro-food co-products (waste) to give the companies an added economic value e.g. potential new product.

6.1.4 – Main achievements

The effective integration of activities and resources in the Integrative Biology & Quality Group has lead to an overall increase in effective research with associated achievements in the major objectives defined above.

1. Sustainable Agriculture: there have been major publications from the chestnut and hazelnut research areas (from recently completed and ongoing active projects). Especially successful, in terms of research and publications in peer-reviewed journals, is the olive biology group and the international EU hazelnut project (SAFENUT) involving many researchers from IB&Q.

2. Stress Biology: there have been major publications related with physiological and yield effects of elevated CO2 on grapevine, leaf structure and function of sweet cherry tree cultivars and physiological responses of different olive genotypes to

drought conditions. The group is taking the first steps in the main Mediterranean crop responses to mycorrization to increase water and mineral uptake efficiency.

3. Plant Food Quality and Health: There have been major achievements with associated publications, including i. identification of natural dietary compounds (isothiocyanates and other glucosinolate-derived hydrolysis products) with high antimicrobial activities against antibiotic-resistant human bacteria and against economically-important plant pathogenic bacteria, ii. identification of phytochemicals from Brassica species (isothiocyanates) with nematicidal activity against pine wood nematode; iii. extensive compositional data on nutrients and secondary metabolites in raw and processed Portuguese and Global foods.

4. Completion of initial compositional studies (total and specific phenolics; free amino acids; ergosterol and related sterols; carotenoids; tocopherols) in various commercial edible and wild mushrooms and in Agaricus mushroom residues as part of an ongoing and evolving collaboration with a major Portuguese mushroom producer.

6.1.5 – Group productivity

Publications in peer review journals

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Master and Ph.D. thesis completed

Aires, AAC Compostos bioactivos em plantas Brassicacea e o seu potencial efeito na saúde humana [PhD thesis]. PhD em Eng. Agronómica. Supervisors: EA Rosa, MJ Saavedra

Sousa S. Physiological and molecular studies on the invader Hakea sericea – a contribution for its control [PhD thesis]. PhD em Ciências. Supervisors: T. Lino-Neto, H. Gerós

Guedes, AP Essential oils from plants and in vitro shoot cultures of Hypericum androsaemum L, H. perforatum L. and H. undulatum Schousboe ex Wild [PhD thesis]. PhD em Ciências (FCT PhD grant SFRH/BD/13283/2003). Supervision: MF Ferreira

Braga, PS Production of secondary metabolites by in vivo plants and in vitro cultures of Salvia sp. [PhD thesis]. PhD em Ciências (FCT PhD grant SFRH/BD/18908/2004). Supervision: MF Ferreira

Araújo TA, Biodiesel de PAM, de espécies das famílias Apiaceae e Euphorbiaceae (PAM_ENERG) [MSc]. MSc em Biotecnologia e Bio-empreendedorismo em Plantas Aromáticas e Medicinais. Supervisors: MF Ferreira

Coelho MG. Óleos essenciais para aromaterapia [MSc]. Braga: MSc em Biotecnologia e Bio-empreendedorismo em Plantas Aromáticas e Medicinais; Supervisors: MF Ferreira

Gomes FG. Ensaio para a Acreditação de um Laboratório de Enologia [MSc]. Vila Real. 2º Ciclo em Análises Laboratoriais. Supervisors: J Ferreira Cardoso, MJ Carneiro

Gomes JM. Metodologias para caracterização fisiológica de Vitis vinifera L. Estudo de caso em três cultivares tintas da Região Demarcada do Douro [MSc]. 2º Ciclo em Eng Agronómica; Supervisors: J. Moutinho Pereira, C. Correia

Gomes, LA. Biopesticidas à base de óleos essenciais para utilização em viticultura, fruticultura e horticultura [MSc]. MSc em Biotecnologia e Bio-empreendedorismo em Plantas Aromáticas e Medicinais, Supervisors: MF Ferreira

González, DC. Modelo Bioclimático de simulação da dinâmica populacional da traça-da-oliveira, Prays oleae (Bernard) [MSc].MSc em Clima e Alterações Climáticas, Supervisors: L Torres, M Santos

Nunes, CF Distribuição espaço-temporal das PM10 em Portugal Continental [MSc]. MSc em Clima e Alterações Climáticas, UTAD; Supervisors: M.S. Leite, M.C. Marques

Rodrigues, MS. Contribuição para o estudo do impacte das alterações do clima na taxa de fixação de carbono nos ecossistemas florestais do Distrito de Vila Real [MSc]. MSc em Clima e Alterações Climáticas; Supervisors: MS Leite, D Lopes

Silva, M. Meteorologia Tropical: Previsão do Tempo nas Regiões Tropicais Utilizando o Modelo BRAMS: Uma Aplicação para a Guiné-Bissau. [MSc]. MSc em Clima e Alterações Climáticas; Supervisors: João Corte-Real

Sousa J. Modelos de previsão das concentrações de ozono troposférico em Portugal [MSc]. MSc em Clima e Alterações Climáticas; Supervisors: MS. Leite, MC. Marques

Sousa RM. Fragrâncias vegetais com actividade anti-insecto: Óleos Essenciais de Lavandula angustifolia P. Mill, Foeniculum vulgare Mill, Petroselinum crispum (Mil.) A.W. Hill e Anethum graveolens L. e suas actividades contra Anopheles atroparvus van Thiel, 1927 (Diptera, Culicidae) [MSc]. MSc em Biotecnologia e Bio-empreendedorismo em Plantas Aromáticas e Medicinais; Supervisors: MF Ferreira

Videira, CP Investigação e Produção Integrada de Artemisia annua L. e antímaláricos à base de artemisinina e seus derivados [MSc]. MSc em Biotecnologia e Bio-empreendedorismo em Plantas Aromáticas e Medicinais; Supervisors: MF. Ferreira

Patents/prototypes

Cordeiro Silva, BA, Gouveia Simões, PJ, Oliveira Malva, JJ, Pires Dias, AC, (WO/2009/087568). Compositions Comprising Antioxidant and Mitoprotective Flavonoids with Neuroprotective Properties, PCT/IB2009/000035. 2009.

Fontes N, Delrot S and Gerós H. Method to obtain intact, viable protoplasts from grape berry mesocarp cells and biotechnological applications. Patente de invenção nacional concedida: PT 103851, 2009.

Organization of conferences

28th International Horticultural Congress: Lisbon, 22-27 August 2010. Ana Paula Silva as member of Local Organising Committee and Eduardo Augusto dos Santos Rosa as member of Scientific and Programme Committee.

2nd Annual meeting of SAFENUT Project: Vila Real, UTAD, 16-18 March 2009, Ana Paula Silva as member of Organising Committee.

XXX Reunião de Primavera da Sociedade Portuguesa de Pastagens e Forragens, As pastagens e forragens na qualidade dos produtos animais: ambiente e competitividade no sotavento algarvio: Centro Multiusos do Azinhal, Castro Marim, 22-24 April 2009, Henrique Manuel da Fonseca Trindade as a member of Scientific Committee.

Semana da Ciência e Tecnologia. UTAD, Vila Real, 23- 26 November 2009. Organized by Eduardo Augusto dos Santos Rosa.

International Conference on Ecohydrology and Climate Change (EcoHCC\'09). Tomar, 10-12 September 2009. João Carlos Andrade dos Santos as member of Organization and part of the Scientific Committee.

3as Jornadas de Biologia na UTAD: Evolução. UTAD, Vila Real, 21-22 October 2009. Amélia Dias da Silva, Dario Santo and José Moutinho Pereira as members of Organization and Scientific Committee.

Industry contract research

N/D

Internationalization

Among others, IB&Q researchers have active and effective collaborations in several activities:

Co-author of several papers in collaboration with foreign researchers (Stanley Misler, WUSTL, MO, USA; David Barnett, SLU, MO, USA). CITAB member: Amélia Silva.

Co-supervisor of a M.Sc. student in collaboration with a Belgian University. CITAB member: Amélia Silva.

International Course "Hort chains under climate change", UTAD, 30 March -11 April 2009. Collaboration with national Universities of Belgium, France, Sweden, Denmark, Finland; Poland, Germany and Netherland. Supervisor Eduardo Augusto dos Santos Rosa (CITAB), Coordinator Wim van Leperen, Wageningen University, Netherland. 30 international students from Europe, Brazil, Africa and Asia.

COST action 858 – European Cooperation in the field of Science and Technical Research - "Viticulture: Biotic and abiotic Stress, Grapevine defense mechanisms and grape development" (2004-2009). Hernâni Gerós (CITAB) as Member of the management committee.

Comité Nacional para o IGBP (International Geosphere-Biosphere Program)/Mudança Global. João Carlos Santos (CITAB) as member of the Committee.

European Geosciences Union (EGU). João Carlos Santos (CITAB) as member.

Collaborative Research and Papers (Ongoing). Prof. Dr. Markus Schneider-Mmary (Swiss Federal Institute of Technology in Lausanne, Switzerland). Insecticidal Effects of Moringa oleifera Extracts. Evaluation of Glucosinolates in Geographically Distinct Tanzanian Moringa oleifera. Richard Neil Bennett responsible researcher at CITAB.

Collaborative Research (Ongoing). Dr. Joris Michiels & Prof. Dr. Stefaan de Smet (Hogeschool, Belgium). Pig Gastrointestinal Microbiology. Pig Models for Evaluating Beneficial Bioactives from Agro-Food Residues. Richard Neil Bennett responsible researcher at CITAB.

Other publications National

Afonso T, Borges A, Santos S, Santos D, Dias I, Chaves R, Silva, A, 2009. Imuno-localização de filamentos de actina na linha celular HEPG2 em várias fases do desenvolvimento da cultura celular. In: Biojornadas, 2009 Out.21-22, Vila Real, Portugal. p.70.

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Government/Organization contract research

N/D

6.1.6 – Future research

Objectives

For the future the Integrative Biology & Quality Group will be further rationalized into 3 major sub-groups with individual and common foci. This change will occur because of the integration of two new areas - i. Climate and Atmospheric Modelling (originally a separate CITAB Group) and ii. plant biochemistry/plant molecular biology researchers from the University of Minho.

The new sub-groups will be called:

1. Identification and Uses of Secondary Metabolites in the Food Chain

2. Climate, Stress and Sustainable Crop Production

3. Biotechnology & Bioproducts

The new sub-groups will pursue the following common objectives at both national and international levels:

1. Development and application of practical agronomic and biotechnological strategies for sustainable food production (animal and plant foods)

2. Identification of effective plant-derived biopesticides and medicinal compounds and studies of their application

3. The development of practical methods for generating value-added co-products from agro-food wastes as part of our sustainable production strategies

There will also be the following specific objectives:

1. Identification and Uses of Secondary Metabolites in the Food Chain will focus on i. Bioactives in foods and residues from plants and mushrooms (providing fundamental data for stress, quality and health effects); Phytochemical biopesticides (identification of effective natural products to control economically important pathogens and pests of foods and in animals and humans); iii. Agro-food wastes and co-products (developing low cost processing methods to generate valuable co-products for the agro-food and health industries).

2. Climate, Stress and Sustainable Crop Production will focus on i. applications of climate and atmospheric modelling (predictive models for agro-forestry systems) to improve sustainable production; ii. Physiological and biochemical responses to stress in model crops (plant biochemistry, productivity and quality composition); iii. Sustainable food production (overlapping and coordinated studies in agronomy, plant biochemistry, stress biology, and plant pathology of chestnuts, olives, grapes and cherries); iv. Climate change effects on greenhouse gases emissions from farmland (rice).

3. Biotechnology & Bioproducts will focus on i. Medicinal & aromatic plants (phytochemistry, bioactivities and biotechnology of medicinal and aromatic plants); ii. Plant functional metabolites and plant genetic engineering (role of plant metabolites related to biotic stress and their potential health benefits for humans); iii. Physiology and biochemistry of plant cell cultures (development of in vitro-based bioplatforms); iv. Transport of photoassimilates and plant productivity (phloem transport of photoassimilates in herbaceous plants and trees; mechanisms and regulations of transport into sink tissues); v. Ecology and biological activity on constructed wetlands (low technology systems to treat wastewater - “FitoETARs”).

Pending and expected funding

Not available

6.2 – Ecointegrity

6.2.1 – Group description

Principal Investigator	Rui Manuel Vitor Cortes
Research area	Environment
Home Institution	Universidade de Trás-os-Montes e Alto Douro

6.2.2 – Funding

	2009
FCT Projects	166.288,00 €
Other (National)	1.042.492,26 €
Other (International)	503.550,00 €
Industry (National)	0,00 €
Industry (International)	0,00 €
Total	**1.712.330,26 €**

6.2.3 – Objectives

During 2009 the group tried shift the research in order to contribute more significantly to determine the influence of different impacts on the dynamics of terrestrial and aquatic ecosystems and their biodiversity, but with the goal of defining the rules leading towards a sustainable management as well as the rehabilitation of disturbed areas. The target ecosystems where rivers impacted by dams or by point (including toxic effects) and non-point pollution, natural areas affected by wind farms and afforested areas devastated by wild fires or by pathogenic effects, such as defoliator insects. Such objectives implicated a strategy of a multidisciplinary approach in order to consider the different biotic and environmental components of the studied areas. To attain such goals we set different research projects integrating a large number of indicators of the environmental stress (including climate change), at different spatial scales (from the habitat to the catchment)

and considering the different levels of the biological organization (from cell to the whole community). These variables were also used for the prediction of the different scenarios related to the changes on soil cover and human activities. Besides, the group directed also the efforts to the appropriate forest management to reduce the fire risk ant to restoration of ecosystems, particularly burned areas and river habitats, with a special attention on the riparian layers.

These works were conducted in strict cooperation with the national and regional governmental organizations, like the Forest Services and the National Water Institute or the River District Authorities and municipalities. Moreover, the defined priorities were also set in cooperation with private organizations, like the ones gathering forest land owners associations, the enterprises exploiting the renewable sources of energy (hydropower, wind power and biodiesel production).

6.2.4 – Main achievements

The main advancements were related to the determination and quantification of the ecological stress based on bio-indicators of inland waters as well as on biochemical and physiological indicators of stress and ecotoxicological assessment of xenobiotic compounds. Such achievements. allowed to produce an important number of biological and physical metrics and assessment tools for the river districts in North Portugal, which will be used for the catchment authorities for monitoring these ecosystems under the principles of the Water Framework Directive. Such metrics are appropriate to detect and quantify point and non-point effects of disturbance at different spatial scales, for each river typology. The preparation of this program was defined along 2009 for lotic ecosystems and lentic ones (reservoirs _considered as highly modified systems) in order take place along the current year.

The development of stochastic-dynamic methodology (StDM) as a new sequential modelling process was developed in order to predict the ecological status of changed ecosystems, taking into account stochastic/random phenomena that characterize the real ecological processes. This model was successfully tested in several types of ecosystems, such as in changing traditional agricultural scenarios and in some of the environments commonly encountered in water-quality modeling: streams/watersheds, estuaries and reservoirs. In this last case it allowed to define the reference situation which is the base to assess the ecological status of highly modified systems under the Water Framework Directive (all the systems will be compared to the reference situation and the relative deviations define the disturbance level, this is, the EQR _ecological quality ratio).

The research on fire ecology during 2009 contributed to improve the characterisation of the vegetation as a fuel at different scales (particle, complex, and stand) in order to test and validate fire behaviour models and simulators. These models will provide decision-support tools to plan, implement and evaluate prescribed burning operations. As a consequence of our research it is now possible to assess the effectiveness of fuel treatments and fuel management at the stand and landscape levels and the effects of forest type on fire severity

The research on microbial diversity, physiology and ecology in unspoiled and polluted environments had clear applied purposes. Thus, it contributed to the knowledge of the degradation of environmental pollutants, either from natural or xenobiotic origins, for potential use to bioremediation technologies.

6.2.5 – Group productivity

Publications in peer review Journals

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Organization of conferences

3ªs Jornadas de Biologia – Evolução. UTAD, Vila Real, 21 - 22 de Outubro 2009. Ana Coimbra.

III Jornadas de Ecologia Aplicada: Impactes nos Ecossistemas Aquáticos. UTAD, Vila Real, Portugal, 18 de Novembro. João Cabral.

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Wildfires, Weather and Climate session, Natural Hazards Programme of the European Geosciences Union General Assembly (EGU 2009), Vienna, Austria, 19-24 April. Mário Pereira.

III International Plankton Symposium, Instituto do Mar (IMAR), University of Coimbra and University of Aveiro. Samantha Hughes.

Industry contract research

Agreement with Grupo Portucel-Soporcel for research initiatives towards improved fire management in industrial forest plantations.

Internationalization

Fire-related short-term scientific exchanges and international training activities have been carried out in the frame of COST Actions FP071 and ES0601, and have contributed to the research networks 'European Forest Institute Project Center on Fire Ecology and Post-Fire Management' and 'Eurasian Fire in Nature Conservation Network (EFNCN)'.

Active cooperation in the form of collaborative publication and preparation of funding proposals has involved researchers from: CEAM, Universitat Autònoma de Barcelona, Universidad de Cádiz, Universidad de Castilla-La Mancha, CTFC, Universitat Autònoma de Barcelona and Universidad de Salamanca (Spain); Istituto di Metodologie per l'Analisi Ambientale CNR (Italy); CNRS, INRA and CEMAGREF (France); University of Athens (Greece); University of Kastamonu and Hacettepe University (Turkey); University of Trier and Potsdam Institute for Climate Impact Research (Germany); Kings College, Macaulay Institute and University of Edimburgh (UK); Swiss Federal Research Institute and Swiss Federal Institute of Technology (Switzerland); BOKU (Austria); Lund University (Sweden); Czech University of Life Sciences (Czech Repulic); FORIM (Slovakia); Wageningen University (Netherlands); Oregon State University (US); CSIRO Sustainable Ecosystems and University of New South Wales (Australia).

Other publications National

Almeida, L., Aranha, J., Bento, J., Fernandes, P., Fonseca, T., Lopes, D., Marques, C., Rodrigues., R. 2009. Regeneração natural pós-fogo em pinhal bravo no vale do Tâmega: respostas após 5 anos. In: Actas do 6º Congresso Florestal Nacional. Lisboa: SPCF. p. 235-243.

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Viana, H., Fernandes, P., Rocha, R., Lopes, D., Aranha, J. 2009. Alometria, dinâmicas de biomassa e do carbono fixado em algumas espécies arbustivas de Portugal. In: Actas do 6º Congresso Florestal Nacional. Lisboa: SPCF. p. 244-252.

Government/Organization contract research

Preliminary assessment of surface water bodies (rivers and reservoirs) for the Northern River Basin Districts (Minho, Leça and Douro), as part of the Water Framework Directive monitoring programme.

River Habitat Survey of the Rivers of the Algarve Region as part of the Water Framework Directive monitoring programme. Contracted by the Algarve River Basin District.

6.3.6 – Future research

Objectives

This group includes 5 research areas: Fire ecology, Ecological modelling, Microbiology and biotechnology; Aquatic Ecology and Wildlife.

The group has been discussing this dispersion through this relative high number of areas, encouraged by the report of the evaluation panel, and will reduce dramatically these sub-groups to only 2 or 3 in order to attain a more multidisciplinary research increasing the ties among the eco-integrity members.

The priority will be to following items:

1. Incorporation of thermodynamics and climate changes on the ecology and fire management in forest stands.

2. Modellation of biodiversity using stochastic models from in relation to environmental impacts in terrestrial and aquatic ecosystems.

3. Sewage treatment of agro-industries for bio-ethanol production and contribution of microbiological degradation for bioremediation.

4. Development of new ceological assessment tools in aquatic ecosystems by coupling bio-indicators (fishes, macroinvertebrates, diatoms and macrophytres) and bio-markers (oxidative stress, hystopathological, genotoxic).

5. Use of satellite imagery to characterize the ecological status of forest stands;

6. Evolutive analysis of Mediterranean flora (neogenic floristic corridors).

7. Plague control in forest stands (particularly in maritime pine afforestations) and their relation to environmental factors.

Pending and expected funding

The funding can be split in 3 sources: a) international research projects; b) national research projects, and c) contributions from stakeholders.

The international projects are associated to the sustainable management of forestry, particularly wild fire control. We must mention an extension of a FP6_ FIRE PARADOX: an Innovative Approach of Integrated Wildland Fire Management Regulating the Wildfire Problem by the Wise Use of Fire: Solving the Fire Paradox and a FP7-ENV-243888-2009 - Forest fires under climate, social and economical changes in Europe, the Mediterranean and other fire-affected areas of the world (FUME). Duration: 48 months (2010-2013). 2006-2010. Besides, there is a COST Action FP0701 - Post-fire Forest Management in Southern Europe. 2008-2012

Related to national research projects financed by FCT there is a total of 9 projects funded, spread by fire ecology (3), aquatic systems (3), ecological modeling (2) and microbiology (2).

The support from stake holders is special significant in the areas of the impacts of renewable sources of energy (including also restoration) with a total of 19 projects.

We mention following the projects financed by FCT (or recommended for funding):

- PTDC/AGR-CFL/099420/2008 - FIREREG: Factors affecting the post-fire natural regeneration variability in Pinus pinaster and Eucalyptus globulus in Portugal: implications for biodiversity and post-fire management. Recommended for funding.

- PTDC/AAC-CLI/103567/2008 - Evolution of North Atlantic Climate; the role of Blocking and Storm-tracks in the Past, Present and Future climate of Southern Europe
(ENAC). Duration: 36 months (2010-2012).

- PTDC/AGR-CFL/114418/2009 - FIREGLOBUS: Developing the scientifical basis for prescribed burning as a wildfire mitigation tool in Eucalyptus globules

- FCT project PTDC/ECM/73069/2006 "Avaliação multi-cenário de sistemas urbanos e de infraestruturas para um desenvolvimento territorial integrado
- FCT project PTDC/AGR-AAM/098326/2008 "Cover cropping: the decisive strategy for the sustainable management of the rainfed olive orchards"
- PTDC/ECM/73069/2006 "Avaliação multi-cenário de sistemas urbanos e de infraestruturas FCT
- PTDC/AGR-AAM/098326/2008 "Cover cropping: the decisive strategy for the sustainable management of the rainfed olive orchards"
- Ecological and population studies on the freshwater bivalve Anodonta cygnea for the establishment of conservation measures
- An Integrative Study on the Toxipathic Lesions in Portuguese Estuarine Fishes – Assessing Injury Impact and Toxicogenomic Implications in Experimental Modes FCT (PTDC/MAR/70436/2006)
- An Integrative Study on the Toxipathic Lesions in Portuguese Estuarine Fishes – Assessing Injury Impact and Toxicogenomic Implications in Experimental Modes FCT (PTDC/MAR/70436/2006)
- Ovary apoptosis in zebrafish (Danio rerio): pathways characterization, role in sexual differentiation and as endocrine disruptors (PTDC/CVT/102453/2008)
- Modelação das vias de sinalização do ácido retinóico por contaminantes ambientais em teleósteos. (Com CIIMAR). (PTDC/MAR/68106/2006).

6.3 – Biosystem Engineering

6.3.1 – Group description

Principal Investigator	Pedro José de Melo Teixeira Pinto
Research area	Electrical and Computer Engineering
Home Institution	Universidade de Trás-os-Montes e Alto Douro

6.3.2 – Funding

	2009
FCT Projects	848.087,00 €
Other (National)	771.500,00 €
Other (International)	469.000,00 €
Industry (National)	0,00 €
Industry (International)	0,00 €
Total	**2.088.587,00 €**

6.3.3 – Objectives

The research activities of this Group are directed to the development of engineering technologies applied to agri-forestry systems, environment and life towards a more sustainable development and better quality of life.

After an initial period of adaptation after the fusion of the previous research R&D units, one of the objectives is to consolidate the scientific core areas of this Group, and to strength and develop the connections with the other subprojects from CITAB, and with other national and international R&D units and groups. Supporting this goal, we'll try to maintain an active and focused research agenda. This agenda has to be such that a balance between fundamental and applied research should be accomplished.

Also, on the efforts on identifying partners, on increasing of scientific outcomes such as papers in indexed journals, and the recruitment of researchers, an additional effort of focusing on the main scientific areas of the Group has to be made.

To accomplish the development of these activities 3 main themes were created with specific objectives each:

1. Characterization and Exploitation of Biomaterials which purpose is the experimental identification and analytical modelling of mechanical and fracture behaviour of biological materials, in order to improve the value of agri-forestry resources; the evaluation of the quality and technological applications of wood; and the characterization and exploitation of agro-forestry biomass as primary energy source.

2. Digital Image Processing within agri-forestry, environmental and biological contexts aims to the use of computer vision techniques focused on biological images and precision viticulture, including novel ones using fuzzy logic and to perform movement analysis in animal models, to study functional assessment after spinal cord injury (SCI) and in dogs with hip dysplasia.

3. Signal Processing and Biotelemetry. In this area the objectives are related with the development of embedded systems for remote sensing, environmental and physiological parameters monitoring and data processing with the purpose to take management decisions in the crops with less and more economical inputs, including to perform comprehensive studies about remote sensing needs in precision farming of viticulture in order to develop specific sensing devices and to develop high flexible acquisition devices within a wireless sensor network deployed in vineyards.

6.3.4 – Main achievements

Concerning the characterization of wood mechanical properties, new data reduction schemes for mode II and mixed mode I/II wood fracture characterization were developed. Moreover, advanced numerical methods were developed to characterize the mechanical behavior of wood dowel joints and to analyze the performance of repair techniques using carbon-fibre reinforced plastics.

Concerning the area of digital image processing the tracking based movement analysis methodology has been extended to a dynamic one with the incorporation of the previous novel multi-thresholding and edge detection techniques.

Studies were carried out on the evaluation of functional recovery in animal model using a new treatment protocol where the former analysis model of the animal movement was extended including now a 3D bi-lateral analysis.

In the area of signal and data processing in biological and ecological contexts embedded wireless systems for environmental and physiological parameters monitoring and data processing were developed, as well as an intelligent gateway infraestructure for in-field data integration and aggregation.

The implementation and evaluation of multi-powered data acquisition system for prevision viticulture applications (a WO Patent applies) that have evoluted to an international colaboration;

Within the development of specific sensing devices a low-power soil moisture sensor (a WO Patent applies) was developed.

6.3.5 – Group productivity

Publications in peer review Journals

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Industry contract research

N/D

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José Joaquim Lopes Morais, Laboratoire de Mécanique et Procedés de Fabrication, École Nationale Supérieure d'Arts et Métiers, Prof. Fabrice Pierron: collaborative publication.

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Government/Organization contract

N/D

6.3.6 – Future research

Objectives

The Biosystems Engineering research unit consists of three research groups and is focused on the effective and pragmatic applications of engineering for Biomaterials, Digital Image Processing and Signal Processing and Biotelemetry.

Within the Biomaterials group research is performed on the characterization and exploitation of different biomaterials and is focused on the following major activities:

- Development of identification methods of mechanical and fracture properties of wood, cortical bone and structural polymers and composites, based on full-field optical methods. A particular attention will be given to identification methods based on the Virtual Fields Method. This will lead to the development of a direct method to determine the cohesive law parameters controlling the fracture behavior of wood and an inverse method to evaluate elastic properties fields of wood at the growth ring scale.

- Characterization of mechanical behavior of wood dowel joints and wood bonded joints, using advanced experimental (digital image correlation technique) and numerical (finite element method and cohesive models) methods. This will lead to the development of advanced numerical tools to simulate the fracture behavior wood dowel and bonded joints.

- Development of identification methods of thermodynamic properties of lignocellulosic biomass as primary energy source. From this research a model of structure-properties relationship will be produced concerning the moisture diffusion thermodynamic properties at the scale of the growth rings.

- Improvement of energy efficiency of energy conversion processes employing lignocellulosic biomass from agro-forestry resources and wastes. Experimental and numerical modeling of anaerobic digestion process of biomass will be generated to optimize biogas production.

Within the Digital Image Processing group research is focused on engineering applications in relation to Agro-Forestry, Environmental and Biological contexts:

- Development of a dynamic tracking based movement analysis methodology.

- Development of image based methods applied to bio-materials micro-structure characterization. A shape descriptor (through image based parameterization) of wood micro-structure will be generated.

- Application of local hyperspectral imaging techniques for grape analyses in order to assess the grape maturity by measuring pH, sugar content and anthocyanin content. From these studies a non-destructive grape evaluation method will be developed.

Within the Signal Processing and Biotelemetry group there are two major applied research activities:

- Development of new methods for energy harvesting in agricultural environments.
- Development of smart data acquisition devices.

Pending and expected funding

N/D