

# The agro-industrial system regional sustainable development, a coherent strategy

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## Abstract:

The agro-industrial system represents annually circa  $3,6 \times 10^9$  € in the formation of the Centro Region of Portugal gross income and that accounts for 39% of the Portuguese overall return for this sector. Given this dynamics it is of utmost importance to perform a consistent strategy to promote the sustainable growth of this regional system income.

Therefore, the CERNAS/IPC research unit has developed an integrated approach bringing together several regional actors under a networking logic that links the industrial needs with the academia R&D capabilities, and of capacity building and entrepreneurship (2011-2013).

This strategy is rooted in the InovCluster, where CERNAS leads two anchor projects, the in\_AGRI and the ECODEEP, and collaborates with a third one, the AGRITRAINING. The in\_AGRI aims the upgrade of the system value chains by bridging the academia with the industry in a series of workshops, supported with a knowledge transfer platform and a network of research facilities, and ECODEEP will develop eco-efficiency tools, based on a LCA approach to enhance the overall sustainability by improving practises and find new solutions within an industrial ecology framework. The AGRITRAINING surveys the training needs of the system, looking forward to complement the actual capacity building achieved by the Master courses in Food Engineering and Environmental Management. In addition, an advanced training in Environmental Entrepreneurship is being implemented, and an Innovation Management for SME's program is being designed, promoting a cultural change towards the sustainable welfare of our present and future generations.

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## Introduction:

Following two decades dominated by the European set aside policies, that implied a high carbon footprint in the food products consumed in the Centre Region of Portugal, due to the long travel distances, the Research community linked to the agro-industrial sector in the region is now facing the pressure to increase the competitiveness and the productivity of the sector in order to promote regional sustainable development, growth and food and energy sovereignty. This paper presents the strategies that are being implemented and the reasoning that support them, in the quest for improved management, resources use optimization and overall competitiveness of the agro-industry sector, based on the novel industrial ecology approaches that aim to increase the complementarities between the production chains.

### **Região do Centro – Portugal**

Central to the problematic is the Portuguese *Centro* Region, where a new paradigm of integration in the agriculture and food industry is being sought after. The region is considered the more effective scale to develop new strategies towards sustainable development as stated by [Renn et al. 1998<sup>[48]</sup>; Wallner 1999<sup>[54]</sup>]. Still, the Regional Innovation Scoreboard (RIS) 2009<sup>[32]</sup> frames the *Centro* region performance as medium-low innovators, far from the top high innovative regions of Europe.

In the 2011 Census (INE), the Central Region of Portugal (*Região do Centro*) had 2.327.026 inhabitants<sup>[14] (2012)</sup> with an uneven distribution within the region, where circa 70% live in the littoral (up to 30 km of the costal line) and the other 30% inhabits more inland, in a region that represents more than 75% of the region total area of 28 200 km<sup>2</sup>. The region is very diversified in what concerns the landscape, with a central mountain range and several agricultural regions with marked differences between them. This is more exacerbated by the distinct climate characteristics of the Atlantic (wetter) and inland regions (drier) produced by the mountain ranges.

The Central Region of Portugal presents a framework of multiple risks in the context of the European regions, showing vulnerabilities towards current and prospective challenges, such as globalisation, demographic change, climate change, secure, sustainable and competitive energy, and social polarisation [Aversano-Dearborn *et al.*, 2011]<sup>[18]</sup>. In the 20 key vulnerabilities identified, the Central Region of Portugal is only prepared to respond to 5 of them, such as an overall positive mobility of persons and goods and a correspondent increase in the population (although moving from the interior to the coastal zone), well preserved natural and semi-natural ecosystems, well prepared to face natural hazards and coastal threats and with a stable fossil energy supply. But the region it is not prepared to act as a global player, it lacks accessibility infrastructures and it has a low knowledge and know-how level in its working population, that it is ageing, and that do not welcomes international migration movements. Agriculture and forestry conditions are quite vulnerable to climate change, as of health related problems associated to more frequent and more extreme heat waves, raising the water dependency and decreasing the summer tourism demand. It presents weak energy capacities unable to respond to peak energy demands, and the income distribution is highly polarised, with week labour market transformation, high youth unemployment and difficulties in the access to social services such as public education and health in its vast rural areas<sup>[18] (2011)</sup>.

The Region *Centro* fits a highly vulnerable european periphery<sup>[18] (2011)</sup>; it is a convergence region and the average GDP/head (PPS) it has reduced -5 % in the period 2000-2008<sup>[13] (2011)</sup>. Labour productivity is inferior to 67,8% of the correspondent EU-27 index (2007)<sup>[7] (2010)</sup>. 20% of the population is at risk of poverty after social transfers (2008) while circa 14% of the population suffers from severe material deprivation. Therefore the region is mainly a totally to partially less-favoured predominately rural region<sup>[7] (2010)</sup>, where less than 20% of people aged

24-64 attain high education <sup>[13] (2011)</sup>, more than 60% of the population only have basic education <sup>[7] (2010)</sup> and more than 16% of the population aged 18-24 leaves school without accomplish a secondary school diploma <sup>[13] (2011)</sup>. Lifelong education and training of adults aged 25-64 only serves less than 6% of the population.

Agriculture still employs circa 20% of the actual workforce in the rural interior and circa 10% in the littoral <sup>[8] (2010)</sup>. Food industry employs 2-3% of the working force, generating a turnover of around 3662 million euro (2005)(INE), representing 8,2% of total turnover of companies established in the Region, almost twice the weight that these activities have on the turnover of similar companies at the national level (4,5%). This witnesses the importance of this sector and the potential to attain sustainable development by investing in it. On the other hand, the companies that develop their activity in the fields of agriculture, animal production, hunting and forestry in the Central Region are responsible for 39,2% of the total turnover of the country in these activities, while in the field of food industries, this ratio is 21,3%. With respect to the gross added value, wages, employment and gross fixed capital formation, the proportion is similar, compared with national averages; these activities have a greater importance in the economy of the *Centro* Region.

### **CERNAS vision for the sustainable development of the Portuguese *Centro* Region**

These and several other analyses have long pinpointed the need to take actions to perform urgent change to improve the sustainability of the sector and the well-being of local populations. To this end, the investment in the know-how acquisition, the buildings of professional capacities and to structure a regional network towards a knowledge economy shift are touchstones of growth and sustainable development.

To this end, CERNAS presents an integrated comprehensive strategy to develop fundamental competences and capacities towards regional sustainable development, with particular emphasis for regions with limited sovereignty in what concerns food, renewable raw materials, energy and with deep competitiveness problems. The strategy aims at the development of competences and capacity building at the food production, product added value, environmental management and governance dimensions.

1 - Improvements in food, renewable raw materials and energy production will be achieved through the investment on environmental friendly agriculture practices and technology, betting on precision agriculture, on sound and adapted production systems and on genetic improvement endogenous plant species and animal breeds, including molecular assisted tools. In this context, the main objective is to increase yield and animal breeding while finding new ways of maintaining the productive capacity of ecosystems.

2 – The upgrade of the added value of food processing is fundamental to increase the net income and the livelihood of the region. This includes the study of functional foods and the use of nanotechnologies in food processing, along with the control of several diseases such as listerese, brucellosis, tuberculosis, and the potential toxicity of chemical components, in the fat and protein that is then transformed for instance in cheese.

3 – Environment is becoming increasingly a factor of competitiveness, by reducing health hazards, promoting tools to increase eco-efficiency and taking advantage of the environmental services provided by natural ecosystems. In this context, the CERNAS will sought after the development of eco-efficiency tools to improve the competitiveness of regional food, renewable raw materials and energy production and processing chains, will develop strategies for a more proactive management of natural systems, aiming at a better conservation and improving the environmental services; will strive to develop new, more robust environmental indicators; will develop new recycling strategies and solutions to recover derelict ecosystems.

4 – Society and management are fundamental issues in pursuing sustainable development. In fact, the way society organizes itself to tackle with adversity and develop mitigation and

adaptation strategies are of paramount importance to the sustainability, well-being and livelihoods of their citizens. In addition, the market demands have to be considered and new management strategies have to be sought after.

5 – A major aim is to increase the impact of research innovation products in the increase of value and therefore firms competitiveness and long term sustainability. To this end, CERNAS aims to establish an effective dissemination and participatory networking strategy.

The ultimate aim is to build the capacity to deal with the challenges posed by the global change processes we are experiencing, to improve regional food, raw materials and energy sovereignty, the livelihood and quality of life of the inhabitants and develop new governance strategies based on a participatory and commitment process involving all citizens. In fact, an important institution for regional resource management is civic interest and engagement in local affairs, including resource and land use issues [Brunckhorst et al. 2006]<sup>[22]</sup>.

A further global objective concerning CERNAS is to strengthen the existing and to develop new strategic partnerships between CERNAS and other European research centres with similar or complementary domains in the various areas of intervention, followed by a dissemination strategy to allow the transfer of eco-innovation and regional sustainability methodologies to the organizations and to foster the overall publication record, especially in international journals.

### **CERNAS focus**

CERNAS started its activities in 2003, aiming at the development of novel strategies to improve regional sustainability, and has developed ever since its activities in the pursuit of sustainability in the Portuguese *Centro* Region, aiming to influence the political debate and develop innovative approaches and technical solutions to meet sustainability and improve the quality of life of local populations.

CERNAS is the only Research Centre located in the Portuguese Central Region directly addressing the problems of the rural world and, since its foundation, it has placed in the forefront of its concerns the question of how to increase the added value of research, namely in what concerns the development of innovative products, production processes and services, and how to engage with the civil society to become a key actor in promoting the livelihoods, welfare and sustainable development at regional level. This effort was accompanied by a participatory bottom-up strategy, rooted in the involvement of regional and local key actors and stakeholders to develop new governance strategies and the deepening of citizenship and commitment by the local populations in the process of sustainable development, sharing the assets but also the burdens related with the new approaches.

Milestones in the process undertaken so far are: (i) CERNAS creation in 2003 with the objective to fulfill a need to develop RTD activities in the Portuguese *Centro* Region, since all the RTD organizations in the field of agriculture, forestry and rural development were dismantled some years before. (ii) In 2003 and subsequent years, a number of European and National RTD projects were implemented and developed in several research lines. Some of them achieved international recognition winning international prizes. A relevant number of international and national publications were produced, along with some patents. (iii) In the periodic evaluation of 2007, under the auspices of the Portuguese Science and Technology Foundation, performed by an independent panel of international top researchers, some of the CERNAS research areas were considered as excellent.

Nevertheless, the weak impact of the research performed until then was a matter of concern for the researchers that initiated a second cycle of research (2008-2011) with a strategy to gain capacity of intervention in the regional path towards sustainable development. Milestones within this new cycle were (iv) CERNAS internal workshop held in September 2008 to establish in a

participatory way the research agenda, highlighting the regional needs to attain sustainable development and the competences and interests of CERNAS researchers, followed by (v) a round table held in January 2009, joining CERNAS researchers with the regional key actors to establish the research priorities towards regional sustainable development. (vi) Simultaneously, in September 2008 a process was started to create a research and development cluster, the INOVCLUSTER, aiming at the development of quality and competitiveness in the agro-food chain in the Portuguese *Centro* Region. This cluster binds together the researchers of the region, almost entirely belonging to CERNAS, with the relevant regional key actors to develop methodologies and new approaches towards competitiveness, food and energy sovereignty and sustainability. (vii) Four of the INOVCLUSTER projects are already operating in the terrain, seeking to promote innovation competitiveness and long term sustainability along the agro food chain. These four projects have a short duration and very specific objectives, namely INOVENERGY [developing energy efficient solution], ECODEEP [Developing eco-efficient tools], inAGRI [aiming to generate a participatory research agenda in response to add value to processes, products and services], AGRITRAINING [to set a capacity building agenda to prepare highly qualified technicians]; and (viii) The process of elaboration of a green book, which aims at the articulation of research capabilities with the regional strategic development plan to identify critical issues and specific response measures, which have to be met to attain environmental compliance, economic growth and the improvement of regional quality of life.

CERNAS vision is thought to develop several activities, that we consider essential to renew the entrepreneurship framework and matrix. It is our believe that growth can occur in a resource limited context, provided that the entrepreneurship efforts are focused on the five pillars that hold CERNAS strategy, namely by optimizing production, increasing products added value, increasing the integration between the various activities in an industrial ecology philosophy, where complementarities in what concerns reuse, recycling, reduce and recover activities that bind together the companies at the local and regional scale are sought after.

Renn et al. [1998]<sup>[48]</sup>, list four reasons for incorporating an idea of growth into a sustainable development approach. (1) Within market economies, structural change takes place almost exclusively because of growth expectations, as can be seen in the present conditions. As long as we depend on free and active investment, a keystone of free market systems, market players must be encouraged to hope for growth. (2) Increases in welfare are often linked with increases in material consumption. However, efforts can be made to reduce the stress on natural capital, by promoting growth based on artificial capital. “Knowledge” plays an important role in this context as a production factor with special characteristics that once acquired, can be reproduced *ad aeternum*. (3) Sustainability does not mean decreasing welfare, if prices and other mechanisms in an economy reflect relative scarcities and enable preservation of natural capital, there is no reason why people should not try to improve their lot. Conceptions of welfare may embrace more and more the values of sustainability. (4) Zero aggregate growth is not so obviously bad for industrialized countries living in relative affluence, but is terrible for people in developing nations living in poverty and desperation. Sustainable development must encompass real economic progress for the developing world.

The increase in the performance of a regional economy attained by growth is to be continued, by using fewer non-renewable resources, and causing less environmental damage. Care is required so that renewable resources are used only at the rate that they can regenerate themselves continually under the strained conditions of cultivated land, or at the rate that they can be replaced by equivalent forms of artificial capital. Every unit of nature should become more a way that regional economies need less of nature altogether [Pfister 1994]<sup>[44]</sup>. We need to initiate a new era characterized by a rising productivity of natural resources (per unit of energy or raw materials). Qualitative growth can push an increase in gross regional product, while the use of resources and environmental damage decrease. This is possible because

knowledge and nonmaterial services replace material resources and manual work: structured knowledge and software replace raw materials, energy, and time.

### **The regional dimension of sustainable development**

A region can most effectively put into effect measures for sustainable development, since it is easier to establish links and networks between the organizations within. The regional scale allows an improved management of resources, since the regional focus is maintained, (i) the analysis and rules for implementation apply to activities directly involving people of the region and are therefore easily implemented; (ii) it eases analysis feasibility, since each material flow can be investigated individually, taking into account the specific conditions; (iii) regional authorities and institutions are direct parties sharing responsibility for regional policies applied to the different sectors.

A region offers reasonable homogeneity in population characteristics, agricultural and industrial practices, and the same environmental context. To be realistic, approaches to sustainability must make good ecological sense and be politically and economically feasible and both aspects are best pursued within the confines of a region [Jaeger 1993]<sup>[34]</sup>. Even though a nation also has political tools and institutions and these are often more prominent, regions are likely to be preferable as a focus for implementation, because of their relative homogeneity, but also due to the opportunities provided for experimentation, competition, exchange of information, and mutual learning [Renn & Goble 1996]<sup>[47]</sup>. Regions can develop their own approaches and share experiences with one another. Such efforts will encourage adaptation and evolution in developing solutions to typical problems. These are likely to be more effective over time than organized approaches on the national level, because of the heterogeneity of structures and interests within a country.

In addition, the diversity of activities within a region allows a wider diversity of relations between them, using complementarities to increasing the integration, by closing loops between them. This is by increasing network and nesting. Real achievements will be obtained only when common ground is found amid diversity and many different parties have adjusted their expectations and their practices [Renn et al. 1998]<sup>[48]</sup>. There is a lack of methodologies that can assess regional sustainability because most existing assessment methods are based on a top-down definition of sustainability and fed by national-level data [Riley 2001]<sup>[51]</sup>. If a sustainability assessment method is to be useful in guiding well-informed policy development and decision-making, it must provide information about: 1) the whole system's progress to sustainability, 2) what pressures exist on supporting systems (social, economic and environmental); 3) the conditions of these supporting systems; and 4) inter- and intra-generational equity [Graymore et al 2008]<sup>[30]</sup>.

Regional sustainability requires the human population to live within the limits of the region's supporting systems (social, economic and ecosystem), ensuring equitable sharing of resources and opportunities for this and future generations in the region [Graymore 2005]<sup>[29]</sup>. That is increasingly an aim of strategic planning, particularly for natural resource management. To ensure this aim is achieved, an assessment method is needed to monitor the progress to sustainability and the performance of regional planning. Nevertheless, current assessment methods are partially effective, at best, in assessing regional sustainability [Graymore et al 2008]<sup>[30]</sup>.

Therefore regional frameworks for natural resource management and governance must be able to scale up from local to broader regional contexts as appropriate for effective resource management and administration, while maximising capture of communities' areas of interest and similar natural landscapes [Brunckhorst et al. 2006]<sup>[23]</sup>. A loosely networked hierarchy [Meidinger 1998]<sup>[40]</sup> that captures communities of common interest and similar natural

landscapes might also balance bottom-up citizen participation and engagement with administrative control while allowing for variable task organisation, knowledge sharing, efficient resource use, coordination and integration [Meidinger 1998 <sup>[40]</sup>, Shannon 2000 <sup>[52]</sup>, Brunckhorst 2001 <sup>[23]</sup>, Marshall 2001 <sup>[38]</sup>].

The regional framework is required to: [1] maximise the spatial capture of 'sense of place'; that is, the landscape area of interest to residents and in which they are willing to engage in decisions for the future; [2] maximise the spatial capture of similarities of the ecological resource base (homogeneity of the biophysical landscape); and [3] regions are capable of being scaled up from a local level to broader regional contexts (nesting) while not compromising the first two principles [Brunckhorst et al. 2006] <sup>[22]</sup>.

### **Why root sustainable development on a research centre?**

Science can be considered as one of the constitutive elements of modern civilisation and a major source for legitimating various policy arguments [Funtowitz 2007] <sup>[27]</sup>. Discussions about the potential role of academic and research institutions in regional sustainability initiatives inevitably raise the issue of the role of science in society in general. In democratic societies, it can be argued that science–society relationships should be based on establishing and institutionalizing mutual dialogues, making public concerns not only visible but the public as equal partner. In order to fulfill the social responsibilities of academic institutions involved in regional sustainability initiatives is through establishing dialogues with diverse stakeholders, promoting a participatory action research [Bodorkos and Pataki 2009] <sup>[19]</sup>.

CERNAS has already started these processes, which lead to the evidence of major strategic obstacles to the optimization of CERNAS research impact at regional level, and therefore its impact on the processes leading to the pursue of regional sustainable development. These constraints are mostly rooted in the poor conceptual structure used to interact with the local and regional key actors and stakeholders, which in part derives from the novelty that is, for higher education organizations, to appear in the forefront of sustainable development processes. In fact, traditional forms of higher education and academic research are in a process of change with regard to their role in knowledge production and reproduction. Partly due to the increased pressures from community and voluntary groups who require expert skills to develop their daily work and partly due to the changing role and authority of science in society, there is a growing trend in academic and research institutions for opening up to society's real problems and gradually becoming more receptive to the social responsibility of the academic sphere. These pressures are transforming education and research as well [Ferreira et al. 2006] <sup>[26]</sup>, Nielsen and Lauridsen 2002 <sup>[42]</sup>.

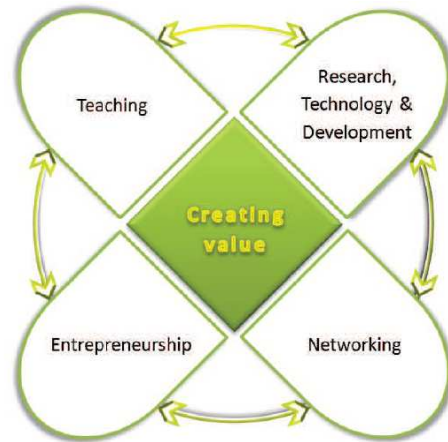
Martinez et al. [2006] <sup>[39]</sup> claims that Universities can play an important role in the integration of local and scientific knowledge for sustainable development. Thus, space for so-called transdisciplinary and participatory research may be provided contributing to emergence and spread of sustainability initiatives. An increasing number of scientists and policy makers are turning their attention to ecological sustainability issues related to land use, landscape function and ecosystem services, urban infrastructure and services, regional development, policy and institutional arrangements [Knight and Landres 1998] <sup>[55]</sup>, Turner et al. 2001 <sup>[53]</sup>, Pickett et al. 2004 <sup>[45]</sup>.

CERNAS elected since its foundation in 2003 the problem of sustainable development in the face of the new global challenges as its *raison d'être* and its overall objective is to develop new strategies and roads towards sustainable development and to establish processes to bridge the gap with the productive sector, to seed new ideas, strategies and tools that allow SMEs to gain competitiveness and promote growth (Fig.1).

Fig. 1 – The CERNAS concept: How to reach sustainable development at the regional level.



Fig. 2 – Strategy to increase the added value of the food chain and the rural world.



So far, novel scientific knowledge has often had poor impact in promoting entrepreneurship and in producing the added value needed to promote the economy. CERNAS has performed an internal reflection on this critical issue, and has developed a strategy to foster sustainable development, through the entrepreneurship in environment and sustainable services, manufacturing processes and goods, together with the fostering of optimal organization solutions at the relevant scales.

The solutions developed so far are based on the integration of activities and on increasing the internal coherence and consequence of the actions performed by CERNAS and its host institutions. This includes the teaching and competence building dimension, research and development, and the networking with the regional key actors (present at the advisory board), and the joint effort to promote avant-garde ideas in the direction of entrepreneurship. Therefore an issue present in the forefront of CERNAS's researchers concern is how to improve the impact of the knowledge we produce on the economic growth and on sustainable development. To this end, CERNAS is already applying a strategy, based on education [teaching], research, networking and creating the means to foster innovation based entrepreneurship. The approach design to improve the fruitfulness of scientific and technological innovation knowledge is shown in Fig. 2.

To achieve sustainable development, we have to overcome the current simple linear production systems and develop novel solutions, more complex, at the image of natural ecosystems. Wallner [1999]<sup>[54]</sup> points out the need to strengthen local relationships based on mutual trust, complex networks and sophisticated systems of supply and use. The self-organised societies that needed to pursuit sustainable development can only be framed at the local or regional level, where the citizenship and the level of commitment of all the stakeholders will be able to make responsible decisions that will automatically adjust to the criteria of sustainable development.

## Conclusion

The work that CERNAS performed so far pinpoints the imperative of networking with the regional key actors to increase the effectiveness of knowledge transfer to and from the SMEs, entrepreneurs and other stakeholders.



Therefore, it is required to:

- (i) identify companies and entrepreneurs needs and potential to innovate;
- (ii) deliver the RTD solutions in a format readily usable by the companies and entrepreneurs;
- (iii) identify the needs for competence acquisition and capacity building at companies' level.

CERNAS has tracked a long way in networking with the relevant key actors and stakeholders, through the INOVCLUSTER initiative and connected anchor projects, but needs to go further, based on that effort, to permanently identify the agro-industrial system weaknesses and potential and embed it into its RTD agenda, and to increase the food sector and rural world SMEs collaborative advantage for sustainable innovation and competitiveness, thus promoting a cultural change towards the tenable welfare of our present and future generations.

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