

A experiência do Prodemá na pós-graduação brasileira: ciência para a sustentabilidade na UFC

The experience of PRODEMA in Brazilian postgraduate education: science for sustainability at UFC

La experiencia del PRODEMA en el posgrado brasileño: ciencia para la sostenibilidad en la UFC

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Resumo

A sustentabilidade insere-se em um contexto em que é necessário desvincular-se da visão disciplinar e adentrar na construção do saber interdisciplinar e complexo. A Rio+20 trouxe à tona a urgência da mudança para um sistema econômico inclusivo denominado Economia Verde. Essa transformação irá demandar novos profissionais e cientistas que possam melhor transpor as barreiras para a real mudança. Dessa forma, o presente artigo tem como objetivo apresentar as contribuições do Programa de Pós-Graduação em Desenvolvimento e Meio Ambiente, da Universidade Federal do Ceará, na construção do saber interdisciplinar frente às questões relacionadas ao desenvolvimento sustentável no ensino de pós-graduação e na formação de profissionais aptos a contribuir para a efetivação dos ideais propagados pela educação para a sustentabilidade.

Palavras-chave: Sustentabilidade. Pós-Graduação. Interdisciplinaridade. Prodema.

Abstract

Sustainability is inserted in a context in which it must be extricated from a disciplinary vision and included in the construction of complex and interdisciplinary knowledge. Rio+20 raised the urgency of moving to an inclusive economic system called Green Economy. This transformation will require new professionals and scientists that can better overcome barriers to real change. Thus, this paper aims to present the contributions of the Postgraduate Programme on Development

and the Environment at the Federal University of Ceará (UFC) in the construction of interdisciplinary knowledge in the face of issues related to Sustainable Development arising in the context of graduate education and professional training.

Keywords: Sustainability. Postgraduate Studies. Interdisciplinarity. PRODEMA.

Resumen

La sostenibilidad forma parte de un contexto en el que es necesario desvincularse de la visión disciplinaria y adentrar la construcción del conocimiento interdisciplinario y complejo. La cumbre Río + 20 planteó la urgencia de hacer un cambio hacia un sistema económico inclusivo llamado “Economía Verde”. Esta transformación requerirá de nuevos profesionales y científicos que puedan superar de una mejor forma los obstáculos para que haya un verdadero cambio. Por lo tanto, este trabajo tiene por objetivo presentar los aportes del Programa de Posgrado en Desarrollo y Medio Ambiente de la Universidad Federal de Ceará, en la construcción del conocimiento interdisciplinario frente a cuestiones relacionadas con el desarrollo sostenible en la enseñanza de posgrado y en la formación de profesionales capaces de contribuir a la realización de los ideales propagados por la educación para la sostenibilidad.

Palabras clave: Sostenibilidad. Posgrado. Interdisciplinarietà. PRODEMA.

Introduction

The complexity of the problems related to sustainability escapes from positivist methods and refers to interdisciplinary and systemic thinking. Analyzing it pervades the need for broad knowledge of the Earth's sustainability capacity, and of the processes that may hinder or stimulate the continuity of life. A new way of thinking – that allows the understanding of systemic and emerging properties of systems that make up the society-nature relationship – is essential.

Rio+20 fostered the debate on the transition to an inclusive economic model called Green Economy, which will require the construction of new paradigms. Its implementation requires changes in productive sectors and in society, and thus the need to insert the issue of Sustainable Development in the academic curricula of universities, traditional places of human resources training. The great challenge of universities is to prepare new professionals and stimulate the creation of science and technology able to overcome existing barriers to the achievement of Green Economy.

Such a challenge requires urgency in implementing the principles placed on education for Sustainable Development. In this context, it is urgent to train teaching staff that know the conceptual framework of Sustainable Development and are able to incorporate changes into traditional disciplines. This is one of the proposals of the Postgraduate Programme on Development and the Environment (Prodemá).

This article aims at presenting the contributions of the Postgraduate Programme on Development and the Environment, at Universidade Federal do Ceará, in the construction of interdisciplinary knowledge to the questions related to Sustainable Development in postgraduate education and the training of professionals able to promote the realization of the ideals propagated by education for sustainability.

Higher Education for Sustainable Development

The importance of education in environmental issues has its roots in the Stockholm Declaration, the document resulting from the Earth Summit in 1972, which defined the term environmental education and its purpose of ecological awareness of the ordinary citizen. Among its many recommendations, it was established that UNESCO¹ and other competent international institutions would adopt the provisions necessary for the establishment of an international education program of formal and non-formal interdisciplinary education, concerning the environment.

¹ United Nations Educational, Scientific and Cultural Organization.

In 1975, the International Environmental Education Programme (IEEP) was created in order to develop knowledge and foster actions that could contribute to environmental protection and management. A pioneering work, the IEEP consolidated the growing concern of the planet's inhabitants with environmental issues. However, at first, it was better absorbed in the curricular structure of primary and secondary schools.

As recommended by the Stockholm Declaration, the UNEP² and UNESCO held the First Seminar on Universities and the Environment for Latin America and the Caribbean, in Bogota, Colombia, from 28 October to 01 November of 1985. It was the first attempt to diagnose the degree of advancement of environmental programmes in higher education and thus promote exchanges of experiences, discussion of concepts, guidelines and incorporation of criteria about the environmental dimension in academic and investigative practices. In December 2002, the UN General Assembly approved Resolution 57/254, declaring the period of 2005-2014 as the UN Decade of Education for Sustainable Development (DESD).

Education, which aims to raise critical awareness about issues that affect the society-nature relationship, has been appointed as critical for the completion of the transition to Sustainable Development. Integrating values, activities and principles inherent in Sustainable Development into all forms of education and contributing to a change in attitude, behaviours and values that can ensure a sustainable future in social, environmental and economic terms (UNESCO, 2007) is the audacious goal of the Decade of Education for Sustainable Development, not to be confused with Environmental Education.

Education for Sustainable Development extends its scope to deal with the complex amalgamation of issues relevant to the environment, society and the economy. ESD prepares people to cope with and find solutions for the problems that threaten the sustainability of the planet (UNESCO, 2007, p. 6).

² United Nations Environment Programme.

The basis “natural resources” is a priority for both, but Environmental Education emphasizes this bias by focusing on the management of such resources, either by environmental conservation or preservation.

Education for Sustainable Development brings a broader context of this society-nature relationship by pointing out other items that also interact with socio-cultural and environmental perspectives and socio-political and economic issues, as can be seen in Table 1.

Table 1. Aspects addressed by Education for Sustainable Development

Socio-cultural Perspectives	Environmental Perspectives	Socio-political and Economic Perspectives
<ul style="list-style-type: none"> • Human rights • Peace and human security • Gender equity • Cultural diversity and inter-cultural understanding • Health • Governance 	<ul style="list-style-type: none"> • Natural resources (water, energy, agriculture and biodiversity) • Climate change • Rural development • Sustainable urbanization • Disaster prevention and mitigation 	<ul style="list-style-type: none"> • Poverty reduction • Corporate responsibility • Market economy

Source: UNESCO (2005; 2007).

Education needs revising. It is the vector to promote changes not only in its several dimensions – formal³, non-formal⁴ and informal⁵ education –, but also in its ability to form skills that encourage students not only to seek, but also to promote, a sustainable society. Therefore, in order to become effective, Education for Sustainable Development (ESD) needs certain structural characteristics, among which:

- a) To insert Sustainable Development, which must overarch the syllabus and not be a separate discipline, in an interdisciplinary and holistic fashion;
- b) To share values and principles grounded on Sustainable Development;
- c) To develop critical thinking and the ability to find solutions to the challenges regarding Sustainable Development;
- d) To use several teaching and analytical methods to shape the process according to Sustainable Development;

³ Content with adequate methodology included in the education of a teaching institution.

⁴ Content with methodology, but outside a teaching institution.

⁵ This type of teaching is not systematized and does not involve a methodology, as in day-to-day relationships. (TOZONI-REIS, 2004)

- e) To stimulate the participatory decision-making process;
- f) To apply learning experiences from Sustainable Development to people's everyday lives; and
- g) To contextualize local and global issues in the search for Sustainable Development (UNESCO, 2005).

The role of empowering people, especially to the needs of the labour market, does not summarize the teaching project of universities. Science and technology deserve being highlighted. While science can provide the means to understand the world and the limits of human beings on the planet, technology provides tools for changes, including paradigms. And such visions can be applied in postgraduate courses, “[...] devised to train decision makers” (AGENDA 21 GLOBAL, 2012 chap. 36).

A scientific understanding of sustainability, together with new inter- and transdisciplinary methods of evaluation, will lead society to a process of transition to Sustainable Development. However, it is necessary to strengthen scientific capacities (Ibidem, chap. 35) so that society's increasingly complex new needs may be met. And if it is through higher education that one has access to science and technology, then its role – which has been modified depending on the evolution of society itself – must be rethought.

From that vision sprung the Global Higher Education for Sustainability Partnership (GHESP), which encompasses the International Association of Universities, the Copernicus Campus, UNESCO and the Association of University Leaders for a Sustainable Future, which, in a joint effort, promote a better understanding and application of the insertion of Sustainable Development at universities and higher education institutes of Sustainable Development, by means of an interdisciplinary approach to teaching, research and extension curricula, in response to chapter 36 of Agenda 21 Global (UNESCO, 2012).

The path to a sustainable society crosses University, an institution that has not always had the format now known, and that is not globally unified. Although most universities have the teaching, research and

extension tripod, university did not originally have this structural design or its current social function. It has evolved from the longings and difficulties of many social players and today it requires changes, such as the insertion of interdisciplinarity in the training of its professionals, something that would guide them in understanding the – more complex and dynamic – new world, and in proposing solutions for current unsustainability.

From disciplinary certainties to interdisciplinary searching

The establishment of the Napoleonic University in France, pursuant to a Law of May 10, 1806, abolished the institution of the medieval university, and set up compartmentalized higher education schools, which gave importance to the graduate ceremony and the diploma. Its new members were no longer Jesuits devoted to the Church, but rather to the Government, and vowed to comply with statutes and to subject to the Emperor. Higher education was no longer a search for the certainties of science, but a search for professional training; the diploma was a requirement to exercise a profession (ROSSATO, 1998).

The establishment of the University of Berlin, in 1809, brought something new to the concept of modern university, by incorporating research as a tool, together with teaching, to achieve the development of science. The valuing of research turned this model of university into a place of scientists, who enjoyed freedom of expression in teaching – deemed to be supplementary to research (Ibidem). This model of university opened the way to the contemporary university, exporting this structure to many other universities globally, which also adopted research as a priority and teaching as a complement, thus forming the academic triad of teaching, research and extension.

The Industrial Revolution and capitalism have greatly influenced universities, by increasingly requesting useful knowledge with immediate application. As such, the scenario of autonomy of science has changed, becoming porous to politics, and being penetrated by the economy. By becoming professional, it began to be defined as an activity geared not

so much by a desire for the truth, but the capacity to produce practical results immediately applicable in the political, military or economic spheres. The modern university as an institution brought not only the function of forming individuals, but also the place of research and production of new knowledge as a priority to its region or country. It is thus possible to perceive a new vision on higher education, and in particular on research, by the Government.

As a consequence, the fact that it integrates scientific production to productive processes has shaped a new world and leveraged economic progress (LEFF, 2000; 2002), first locally and then globally, bringing new responsibilities to science, which previously sought only to understand cause and effect relationships. Hence, science in universities is included (or should include), as a priority area of any country, traversing paths directed by Government and market needs, by means of the several call notices that foster it.

Today, we are invited to use everything that science builds to facilitate human life, thus recognizing our dependence on science with politics, with the economy, or with everyday life. If science can be modified due to politics, the economy, or our everyday lives, universities – along their history – have tried to follow these transformations and accept new approaches to this reality, no longer seen in a disciplinary manner, because it started to address increasingly complex issues. And as environmental issues are contradictions between what the world is and what it should be (GROOT, 1992), this science must be able to foster the transition into sustainability – towards development patterns that promote human well-being and that preserve life in the most different ecosystems.

Sustainable Development – whose scenario is the complexity of nature-society relationships – requires new knowledge and new ways of analyzing such a reality, different from technological rationality and knowledge fragmentation. The scientific method, which guides the main model of modern science, grounded on positivist assumptions, was necessary to build a new knowledge and specialized technological advance, but left disciplinary blindness as legacy, arising from the

fragmentation of knowledge, powerless in the face of the problems enhanced or triggered by progress.

Accordingly, there are two possible strategies to analyze environmental issues. The first would require appealing to the specialization of each knowledge field and searching for adequate solutions. In this scenario, choosing a discipline, however promising it may look, makes a proper analysis unviable, due to the fact that environmental issues pervade several areas of knowledge. The second strategy would be to bring several disciplines into convergence, which is made possible by interdisciplinarity (BÜRGENMEIER, 2005).

The insertion of Education for Sustainable Development in higher education further implies the need to see the world from a holistic and interdisciplinary viewpoint, which is often forgotten and conflicting to universities.

a. Interdisciplinarity as a category for reflection on sustainability

The term interdisciplinarity was first used in the 1930s, as a shortcut to studies that overarched disciplines, described in the Social Science Research Council. Some examples may be found in agricultural research carried out in the 1940s and educational experiments performed in the 1960s and 1970s (KLEIN, 1990). But it was with Jean William Fritz Piaget (1896-1980), the defender of the interdisciplinary approach to epistemological investigation, that interdisciplinarity gained strength at the First International Seminar on Pluri- and Interdisciplinarity, carried out at the University of Nice, in France, in 1970 (LEFF; MONTES, 1986).

The interdisciplinary movement began in Europe in the late 1960s, along the economic and political crisis of the capitalist system in the 1970s, that is, the oil crises. The political-cultural movement that opposed Taylorist/Fordist models, the competitiveness among countries – organized in blocks –, and the technological changes that brought a new reality, were no longer understood by the educational model in force. Student movements in France, Germany, and Italy demanded changes to the statute of universities, opposing the alienation of academia

before society's daily issues and curricula that privileged specialization excessively (KLEIN, 1990; FAZENDA, 1994; ALVARENGA; SOMMERMAN; ALVAREZ, 2005; ROHDE, 2005).

During this period, fierce competition forced companies to restructure themselves to intensify their production based on a management model that did not accept waste. Accordingly, a lean production model arose, which demanded total quality. Such a production model required the commitment and collaboration of employees by disseminating their experiences and knowledge – encouraging team work. Under this new model, disciplinary training was inadequate, because professionals needed to combine production flexibility with the flexibility of markets, i.e., multifunctionality was a basic condition to ensure profitability and productivity (MANGINI; MIOTO, 2009).

In response to the formation of new individuals able to integrate, collaborate with and coordinate a more flexible stance before a changing world, Georges Gusdorf (1912-2000) was a major supporter of interdisciplinarity, and defined it as a result of the dialogue between specialists and the affective interaction among disciplines. The success of interdisciplinarity would depend on the in-depth conversancy of each one of the participating disciplines, so that a whole could be built, not annulling disciplinarity (ALVARENGA; SOMMERMAN; ALVAREZ, 2005; MINAYO, 1994).

The interdisciplinary movement began its journey influenced both by social demands – that construed specialized knowledge as a direct link between technological rationality and the commitment to the logic of the market –, and by the evolution of the scientific discourse, i.e., by external and internal influences on scientific thinking (FOLLAN, 1995). Interdisciplinary production was required to use its knowledge in applying and planning economic development, while at the same time interdisciplinary phenomena were not addressed by disciplinary theoretical objects – what was real belonged to science not as an isolate object, but as the meeting of the parts of a whole. Because real-world research issues rarely arise ordered into disciplinary categories and much less their solutions (REPKO, 2012), interdisciplinarity is proposed

as an advance of knowledge to solve problems of the new world – among them environmental issues – giving rise to the Environmental Sciences (LEFF, 2002).

The society-nature relationship became the object of study of the Environmental Sciences (GROOT, 1992). However, nature and society are not concepts or objects of any science, neither are they terms of scientific articulation (LEFF, 2002). This articulation will occur by means of their interaction and effect on the real world, by transforming ecosystems, for example, by incorporating nature into the productive process.

Environmental issues, emphasized in recent decades with the crisis of civilization, questions dominant technology and economic rationality, in which both have been driven by a positivist science that prioritized the fractioning of knowledge in search of scientific, technological and economic progress. Today, this science is required to revisit its legacy and review the model of progress, whose limiting factor is not only nature, but society itself, which is also an integral part of that system.

There are several reasons for the existence of interdisciplinarity, such as the unity of reality, the interception or similarity of different theoretical objects, the convenience of more knowledge as a support of a social intervention, researchers' awareness of the existence of other "complementary" discourses, the perception that "little things" can be important to being and acting, and, mainly, the creation of a social environment conducive to the exchange of knowledge (POMBO, 2005).

Interdisciplinarity has intensified in recent years and is based on three areas, with their own dynamics: a) scientific investigation; b) teaching-education; and c) action (LEFF, 2000; PIMENTA, 2008). In scientific research, interdisciplinary phenomena arise permeated by distinct apprehension logics, requesting the several fields of knowledge to generate knowledge, with environmental interdisciplinarity as an example.

Accordingly, environmental issues necessarily refer to an interdisciplinary vision, because there is an insufficiency of fragmented knowledge to

treat environmental complexity, in which different interventions happen on also diverse spatial-temporal scales (PENA-VEJA; ALMEIDA, 1999). However, not every group of people from different specializations can be considered an interdisciplinary team.

To this end, interdisciplinarity must be known conceptually from some definitions:

[...] it is a research and teaching method that can make two disciplines interact between themselves. This interaction can range from the simple communication of ideas to the mutual integration of concepts, of epistemology, terminology, methodology, procedures, data, and organization of research (JAPIASSU, 2006, p. 109).

[...] any form of combination of two or more disciplines for the understanding of an object from the confluence of different points of view and having as ultimate goal the development of a synthesis concerning a common object. Interdisciplinarity implies, therefore, any reorganization of the teaching-learning process and presupposes a continued work of cooperation of the professors involved (POMBO; LEVY; GUIMARÃES, 1993, p. 13).

Conceptually, an interdisciplinary study is a process that responds to a question, solves a problem, or is the solution for a theme that is too broad or too complex to be addressed by a single discipline, based on disciplinary perspectives, but able to integrate their expertise through a wider perspective. It may be added that, in interdisciplinary research, in addition to the need for criticism and self-criticism, there is also an integrated and intentional vision of the problem. Interdisciplinary studies depend on the disciplines for their perspectives, insights, data, concepts, theories and methods in the process of developing an interdisciplinary understanding of a particular problem, but not of a class of similar problems (REPKO, 2012).

Such demands generate methodological, technical and language adaptations of each discipline in a task that is characterized by a dialectical process – when it brings contradictions that characterize the effort in interfacing knowledge –; a systemic process – by forcing a dynamic analysis between relationships and complements –; a selective

process – when searching the critical categories of each problem –; and an interactive and open process (REPKO, 2012).

To further deepen the approach, it is necessary to remember that not all interdisciplinaries are the same. If there are disagreements about the definition, they are reflected in the purpose of research and education. Klein (1990) presents two classes of interdisciplinarity: a) endogenous, which is concerned with the production of new knowledge; and b), exogenous, which questions the disciplines about the demarcations which apply to real life and require a social role from universities.

Paviani (2008) also proposes that instrumental interdisciplinarity is a problem-solving activity that can be designed to meet the demands of the industry and the Government, while conceptual interdisciplinarity is concerned with the theoretical and epistemological issues of knowledge. Nevertheless, the distinctions presented are not absolute, because interdisciplinarity is not a homogeneous and uniform phenomenon but, instead, it has varying levels and degrees of affection.

Interdisciplinarity can be worked in a theme or study subject, in which two or more disciplines intentionally relate, without losing their characteristics, but are added to reach more comprehensive and systemic knowledge. However, the construction of a new scientific object from the collaboration of several disciplines, and not just as the common treatment of a subject, is a process implemented only in few cases in science, which in turn are not generalizable to the point of assuming a methodology is applicable to produce similar effects in other fields of knowledge and research (LEFF, 2002).

It may be noticed that interdisciplinarity is also a rescue of human beings with its real-world designed synthesis, also needing reflection on the attitudes deemed interdisciplinary, so there will not be any diversion from its practice (TRINDADE, 2008).

Although interdisciplinarity has grown within scientific thinking, its use is not a requirement in all scientific objects analyzed; that is because

there is no claim to replace disciplinarity and specificity required in certain areas of science, but specifically in complex, nonlinear and dynamic systems, as are all systems involved in environmental issues, in which different rationalities, orders of materiality, and temporal scales are involved (UNESCO/ UNEP, 1985).

The solution to the transition to Sustainable Development cannot result only from a rational management of nature and the risks of global changes. Knowledge generated around the world has contributed to the permanence of the global development model. And if previously science did not take into consideration the limits of nature, the time of matter, and the history or even diversity, currently complexity reopens all these reflections on the real time, which manifests itself in the irreversibility of processes, now distant from a balance and influenced by the cultural being, man (MORIN, 2000).

The new being needs to understand the complexity of interrelationships of this new system – the worlds of life. This is because even if a high level of critical capacity is acquired, no individual can solve a crisis alone. This effort is always cumulative and social, while knowledge is relative, partial and incomplete (FOLLAN, 1995).

As a complex phenomenon, Sustainable Development calls for interdisciplinary, holistic and systemic studies, adopted not only by small groups of pioneering scientists, so that it may acquire importance in the long-term, enabling both local and global integration.

In this sense, postgraduate programmes in Brazil were pioneers when inserting interdisciplinarity in the thematic focus of the environment, most notably in the following postgraduate courses (in chronological order): Environmental Science Programme (Procam), created in 1989 by USP/São Paulo; Environmental and Development Programme (Made), created in 1994 by UFPR/Paraná; Sustainable Development Programme (CDS), at UnB/Brasília, created in 1995; and Postgraduate Programme on Development and the Environment (Prodema), created in 1996, in a network.

Prodema UFC – an interdisciplinary experience

The Postgraduate Programme on Development and the Environment (Prodema) at Universidade Federal do Ceará is part of a network of seven universities established to understand and incorporate the complexity of Sustainable Development in studies concerning the Northeastern region of Brazil. In 1996, Prodema-Network was implemented initially with the participation of six Higher Education Institutes (IES); however, as Ramalho Filho states (1999), due to academic pressure these IES implemented academic activities at different times: Universidade Federal de Sergipe (UFS), Universidade Federal do Ceará (UFC) and Universidade Regional do Rio Grande do Norte (URRN) did so in 1995; Universidade Federal da Paraíba (UFPB), together with Universidade Estadual da Paraíba (UEPB) did so in 1996; and Universidade Federal de Alagoas (Ufal) in 1997.

Along nearly 18 years of Prodema-Network, postgraduate programmes have been implemented and others have been discontinued. In 2010, with the maturing of the masters' degree, the doctorate degree in Development and the Environment was created in a new organizational structure – Associação Plena em Rede das Instituições (full association of institutions in a network) –, including a general coordination, currently institutionalized at UFC, and several sub-programmes subordinate to it. Today, Prodema-Network is formed by the following universities: Universidade Federal do Piauí; Universidade Federal do Ceará; Universidade Federal do Rio Grande do Norte; Universidade Federal da Paraíba; Universidade Federal de Pernambuco; Universidade Federal de Sergipe; and Universidade Estadual de Santa Cruz.

The proposal of Prodema-Network encompasses four innovating items: the issue of Sustainable Development in postgraduation and the interdisciplinary, inter-institutional and intraregional character. The incorporation of the concept of Sustainable Development into the academic discourse, with concerns related to the development of a historically fragile region, has brought the prospect of a medium- and long-term planning able to benefit future generations. In addition to that, the interdisciplinarity required for such a process tends to break the paradigm of departmentalization in universities, encouraging not only

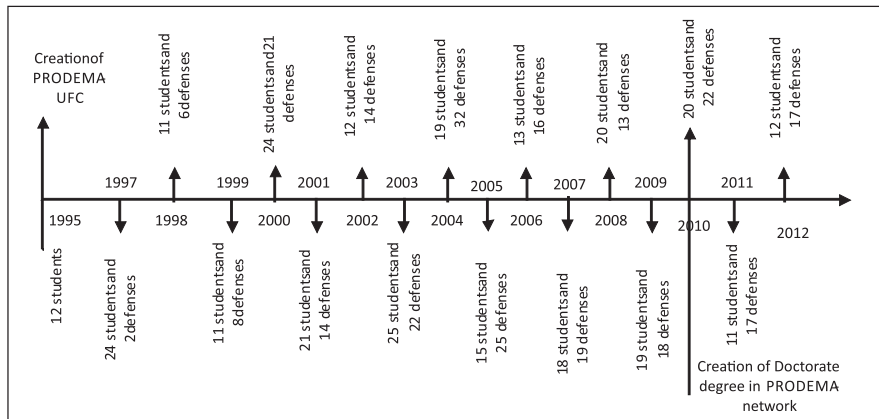
the formation of interdepartmental research groups, but also allowing teachers to understand the importance of interdisciplinary research.

The inter-institutional character, in turn, strengthens the programme by adding the best specializations of each university as a network, in view of common study objects, covering not only its location, but a whole region, from intra-regionality, which enables comparative studies and greater breadth of institutional capacities.

a. Contributions of Prodema-UFC to sustainability

Prodema-UFC began its activities on the outset of its first group of masters' candidates in 1995 and with the effective participation of professors in the Biology, Agricultural Economics, and Geography departments of the institution. Other departments also contributed with quality human resources over time, such as the departments of Language, Geology, Soils, Chemistry, Agricultural Engineering, Medicine, Fishing Engineering, and Economics. The above-mentioned departments are units inside different centres at Universidade Federal do Ceará: the Science Centre, the Agricultural Sciences Centre, the Health Sciences Centre, and the Humanities Centre, which strengthens the predisposition to interdisciplinarity.

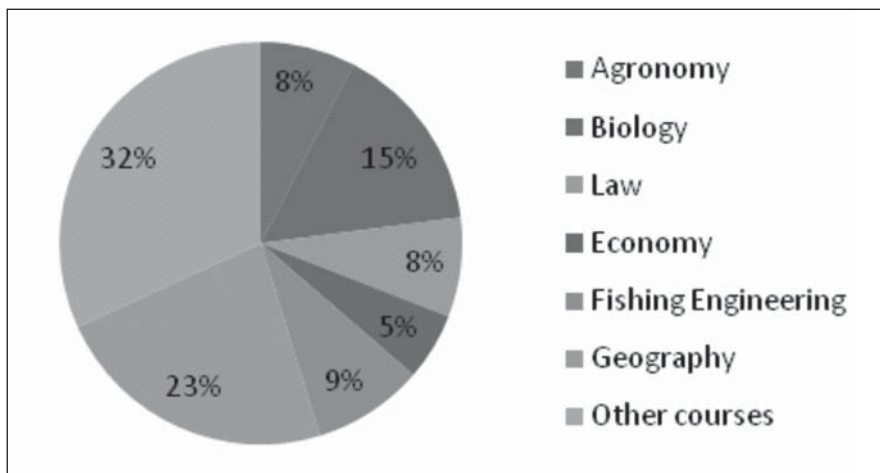
From the establishment of Prodema to 2012, 287 students were selected, and 266 dissertations were defended (Figure 1).



Source: Prodema-UFC, data updated in June 2012.

Figure 1. Timeline of Prodema-UFC

The diversity of students in the programme is revealed by the variety of undergraduate courses from which they come (Figure 2). Professionals from 37 different courses, distributed into areas generally directly related to environmental issues, were qualified by Prodem-UFC, with an emphasis on the following courses: Agronomy (24 students), Biology (48 students), Law (25 students), Fishing Engineering (28 students) and Geography (72 students), in the period 1995-2012. With this profile, it is possible to see which areas that most seek the insertion of sustainability in their professionalization.



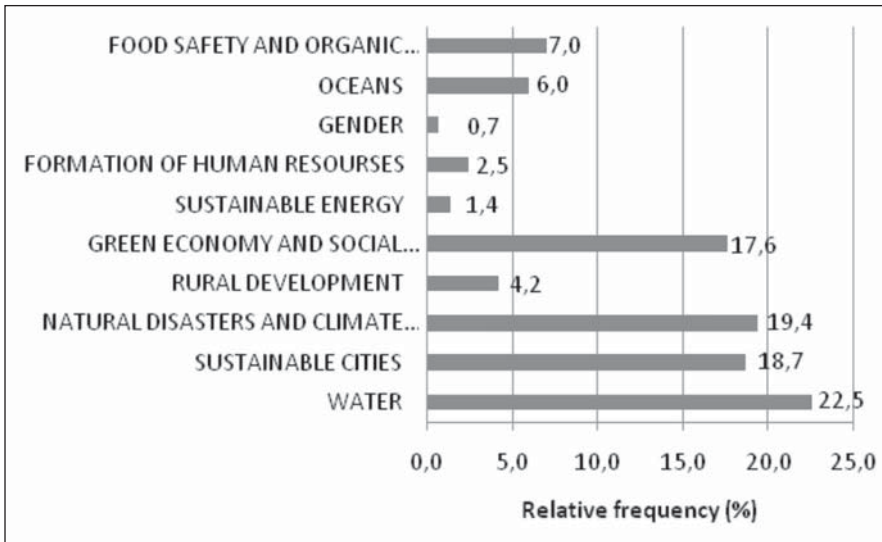
Source: Prodem-UFC, data updated in June 2012.

Figure 2. Relative distribution of students selected for the masters' degree at Prodem- UFC, according to the undergraduate programme, 1995-2012 (%).

It is worth noting that in 2004 the master's in geography was created; in 2008, the Programme on Ecology and Natural Resources; and, in 2009, the PhD degree in Geography. Even with these new postgraduate degrees at UFC – which insert a bias of sustainability in their specialties – the search for interdisciplinarity provided by Prodem-UFC has grown. In 2008, there were 20 new students – 10 with a graduate degree in Geography and three in Biology.

The knowledge generated by interdisciplinarity involves a subjectivity that cannot be quantified. However, the classification of the 266

dissertations defended from 1997 to 2012, on the different themes prioritized by Rio+20 – water, sustainable cities, natural disasters and climate change, green economy and social inclusion, sustainable energy, oceans, food security and organic agriculture – presents the programme’s contribution in the search for a more sustainable model for the region (Figure 3). The categories rural development, training of human resources, and gender, are related to the regional needs of the programme.



Source: Prodem-UFC, data updated in June 2012.

Figure 3. Relative distribution of dissertations defended at Prodem-UFC according to the themes of Rio+20 (classes of 1995 to 2010).

These themes are closely related to socioeconomic and environmental vulnerabilities of the State of Ceará, the main study object of the programme. The insertion of the State of Ceará in the Caatinga biome requests, for a coexistence with the semi-arid, prior scientific knowledge that can subsidize the decision-making process. Along its history, research developed by Prodem-UFC has given priority to the following categories: water, sustainable cities, natural disasters and climate change, and green economy and social inclusion; inherent in local concerns, these categories also deserve global attention, by being given priority at Rio+20. Although many of the themes worked by masters’ students may be encouraged by research groups, led by teachers, others

enter the programme due to the student's professional need. Therefore, the contribution of the programme may be realized not only in the scientific study about research objects that can aid in the transition into Sustainable Development, but also in preparing new professionals, critically instigating them to break paradigms.

b. Evolutions and limits of interdisciplinarity

Three different dimensions that empower interdisciplinarity in postgraduate courses are perceived at Prodemá-UFC: the interaction among students of different backgrounds; among students and the teaching staff; and, finally, among professors.

The teaching staff of Prodemá-UFC is currently composed of 24 professors, distributed into nine departments at Universidade Federal do Ceará: Biology, Home Economics, Agricultural Economics, Education, Agricultural Engineering, Geography, Geology, Medicine, and Soils. Students, considering the classes of 1995 to 2012, come from the most diverse undergraduate courses.

The interdisciplinarity that rises among the knowledge of students, concerning their specialties, coming from their undergraduate training, with professors and counsellors – with their departmental knowledge – is one of the most complex. In this process, it is obvious that the academic work flows better when the student's graduate education falls in the areas covered by the supervisor's department.

However, interdisciplinarity is best experienced when the areas appear to dissent, as, for example, a biologist with an economist as supervisor. The deconstruction of knowledge and the doubts about the study object are rediscovered by the peers, who, in general, require a third member – a co-supervisor – to balance the dialogue. The student is the one who gets the best interdisciplinary result from this experience, because he is the human resource formed in the postgraduate school. Although professors also learn from the students' findings, interdisciplinary postgraduate studies will absorb better, without methodological biases, the fusion of new perspectives to old problems of the world.

Prodema-Network has two areas regarded as basic in the programme – Economy and Ecology –, and which must be connected by disciplines in common. In the masters' course, three disciplines, with summary, programmes, and basic bibliography, may be adjusted by the teaching staff in charge, depending on local needs. In this format, the disciplines are worked locally and managed generally with another local professor. The role of these disciplines is not only the transfer of knowledge, but also the need for a critical construction from the perspective of Sustainable Development.

There was an advance in the doctoral course. For being institutionalized at Capes, the networked format enables a better dialogue among the teaching staff and the subjects at the several universities that make up Prodema-Network. The common core consists of four disciplines, of which three are shared with the masters' course, and only one is exclusive to the doctorate course. This exclusive discipline is taught annually at the chosen university for the course's master class, necessarily being worked by at least two teachers. This is an important issue that must be further analyzed: the interdisciplinary interaction among teachers.

The interdisciplinary construction of the master's course has provided a subsidy for the doctoral course, to further understand the importance of “dividing to add”, when a discipline that must be worked in an interdisciplinary bias is taught. If on a local course interdisciplinarity among departments was sought, in a course of inter-institutional network interdisciplinarity also comes with inter-departmentalization, influenced by the organizational culture of the professor's university of origin.

The planning of a discipline in this format, when worked locally, is made face to face by professors at different departments within the same institution and according to professional affinity. However, when the professors involved belong to different institutions, such as doctorate professors, professional affinity is not always feasible, due to the size of Prodema-Network itself.

The insertion of interdisciplinarity in this format brings some limiting factors, among which the disciplinarity of the teaching staff, in addition to factors of educational training shared by the university of origin of participating professors. However, in both cases, it is difficult to find professors with holistic and systemic training.

For students, interdisciplinarity between professors of the same institution brings a new view on the institution itself, formerly seen only in relation to its departments, given that interdisciplinarity between professors of different institutions brings immeasurable wealth for learning, especially when the subject is broached by professors of knowledge areas that would apparently be antagonistic. The major challenge in the inter-institutional postgraduate model are the financial costs, mainly relating to the disciplines, requiring the physical displacement of students enrolled and their professors to one of the universities of the network.

Prodema-UFC is not connected to any department and does not have any undergraduate course connected to it. Its connection with UFC is made directly with the Dean of Research and Postgraduation. This has allowed, in its initial project, that the philosophy of the course crossed any department. However, in view of a departmental organizational structure, in which the financial or human resource allocations are also distributed, the 18 years of the programme were not sufficient to build a physical space for Prodema-UFC.

The lack of connection to a department also brings other important variables to be reflected on, particularly in the face of new demands for postgraduate courses in Brazil, be they inter- or disciplinary ones. From 1995 to 2010, there was a major leap in the number of students who joined universities, including master's and PhD candidates. This demand also required greater dedication from the professor to its Department of origin. If Prodema-UFC is not connected to any department, nor has it any undergraduate course connected to it, the dedication of its professors tends to be increasingly smaller, in view of departmental emergencies in fulfilling their goals with the university.

In addition to the common core curriculum and optional disciplines, the curricular structure of ProdeMa-Network also has seminars, whose proposal is to provide an interdisciplinary dialogue between students, faculty and special guests on the research for dissertations and theses by professors. Three seminars are listed in the proposal. The Second Integrating Seminar, for the master's course, and the First Thesis Seminar, for the doctorate course, both occur in the Network, with the participation of all students enrolled in this period, becoming a regional scientific event of all universities. This "academic Babel" enables the contact with various works, especially among students, and often with the knowledge of new methodological ways of analyzing objects of similar studies.

The visibility of ProdeMa-Network has grown regarding the number of students and participating universities. Today, it counts on the participation of students not only from the Northeastern region, but from all Brazil, and since 2009 several students from Portuguese-speaking countries, mainly at UFC, are internationalizing the course, which makes the interdisciplinary challenge even greater, due to the insertion of the cultural variable, which is part of this process.

Conclusions

By training human resources and generating knowledge, universities can contribute to the transition into Sustainable Development, going from the theoretical-conceptual clash to the pursuit of its applicability. It is necessary to review the real role of higher education in this journey and to enable universities to become models of transforming sustainable practices, inserting sustainability in the architecture of physical facilities, management models, and mainly in teaching, research and extension curricula.

A university that does not insert the priority in Sustainable Development in its mission cannot form leaders in sustainability or make science towards sustainability. It is the social responsibility of universities to bring new technological and socioeconomic responses in solving

problems in the areas of production and development, among which the transition into Sustainable Development.

Interdisciplinarity is the starting point in addressing this necessary transition. Adopted by a group of pioneering researchers of Prodema-Network since the 1990s, it can be noted that much has been learned from interdisciplinary practice, which never ends, but changes with old and new challenges.

Prodema-Network's differential and greater contribution to the experience of interdisciplinarity in postgraduate school is Sustainable Development, as an attempt to deepen the debate on one of the most discussed and complex themes in recent decades.

By bringing together faculty and students with different academic formation, Prodema-UFC has overcome the expectation of interdisciplinarity and created a favourable environment to breaking paradigms on human resources training by showing possible changes in the productive sectors and in society, by means of the dissertations defended.

This experience has contributed to insert the issue of Sustainable Development in the academic curricula of universities. Nevertheless, there are still major challenges. Perhaps the greatest of them is to prepare the new sustainability professional and encourage the creation of science and technology able to overcome existing barriers to the completion of green economy. Such a challenge requires urgency in implementing the principles embedded in Education for Sustainability.

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