

Comprometimento e alinhamento da pós-graduação da PUC-Rio com o desenvolvimento sustentável

Commitment and alignment of PUC-Rio's postgraduate programme with sustainable development

El compromiso y la alineación del posgrado de la PUCRio con el desarrollo sostenible

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Resumo

Em sintonia com a temática “a pós-graduação e o desenvolvimento sustentável” desta edição da Revista Brasileira de Pós-Graduação, o artigo reflete o comprometimento da Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio) com o desenvolvimento sustentável. Destaca ações já empreendidas em resposta a recomendações das conferências das Nações Unidas sobre o meio ambiente e o desenvolvimento sustentável (1972, 1980, 1992 e 2012) e do Colóquio Global de Reitores de Universidades (N. York University, 1987), do qual participaram reitores

das principais universidades do mundo. Cônsua de sua responsabilidade, a PUCRio pautou o seu compromisso na ética ambiental voltada para a transformação da cultura antropocêntrica com vistas à integralização do ser humano pela preservação da biodiversidade e do meio ambiente. No contexto de uma ação integrada da universidade, discute a consolidação do pilar sustentabilidade no seu Programa de Pós- Graduação em Metrologia para Qualidade e Inovação.

Palavras-chave: Desenvolvimento Sustentável. Sustentabilidade. Pós-Graduação. Metrologia. Qualidade. Inovação.

Abstract

In line with the theme “postgraduate education and sustainable development” of this issue of the *Revista Brasileira de Pós-Graduação*, this article reflects the Pontifical Catholic University of Rio de Janeiro’s – PUC-Rio – commitment to sustainable development. It highlights the actions taken in response to recommendations from The United Nations Conferences on the environment and sustainable development (1972, 1980, 1992 and 2012) and from the “Global Colloquium of University Presidents” (New York University, 1987), attended by rectors of leading universities in the world. Being aware of its responsibility, PUC-Rio has oriented its commitment to environmental ethics to target the transformation of anthropocentric culture for the wholeness of human beings through biodiversity and environmental preservation. In the context of an integrated action by the university, the article discusses the consolidation of the sustainability pillar in its Postgraduate Programme in Metrology for Quality and Innovation.

Keywords: Sustainable Development. Sustainability. Postgraduate Education. Metrology. Quality. Innovation.

Resumen

En consonancia con el tema “el posgrado y el desarrollo sostenible” de esta edición de la Revista Brasileña de Posgrado, este

artículo refleja el compromiso de la PUC-Rio con el desarrollo sostenible. Se destacan medidas adoptadas en respuesta a las recomendaciones de las conferencias de las Naciones Unidas sobre el medio ambiente y el desarrollo sostenible (1972, 1980, 1992 y 2012) y del Coloquio Mundial de Rectores de Universidades (N. York University 1987), al que asistieron rectores de las principales universidades del mundo. Consciente de su responsabilidad, la PUC-Rio orientó su compromiso con la ética ambiental hacia la transformación de la cultura antropocéntrica con el fin de integrar el ser humano a la preservación de la biodiversidad y del medio ambiente. En el contexto de una acción integrada de la universidad, se analiza la consolidación del pilar de la sostenibilidad en su Programa de Posgrado en Metrología para la Calidad y la Innovación.

Palabras clave: Desarrollo Sostenible. Sostenibilidad. Posgrado. Metrología. Calidad. Innovación.

The term sustainability and the risks of its multivalence

From the linguistic point of view, the etymon “sustain”, from which the term “sustainability” originates, derives from sustentare (sustinere), a Latin verb that designates verbal actions of a similar content. Figuratively, it extends its meaning to express contiguous ideas (to uphold; to state categorically; to nourish; to endure; to support) and so forth. Regardless of being an ancient concept – to support from below; to bear; to prop up; to help; to assist; to serve; to prevent an imbalance or fall; to serve as a barrier (LELLO, 1926; BOFF, 2012) – sustainability is a concept that has won the world in recent years to designate the good use of the planet’s natural wealth (UNCSD/RIO+20, 2012).

It can be noted that the significance of its congeners do not differ greatly from one another. However, attention is drawn to their current and insistent application in academic dissertations, theses and other scientific publications in different fields of knowledge, the media in general, public policies throughout the world, in political-ideological discourses, in advertising and marketing subjects as diverse as food and

automobiles. This often random over-exposure of the word has given rise to an unusual meaning: that of imminent threat against human life and the natural universe. What is the danger? The danger is that, due to the exhaustion and fatigue of its natural forces and the impotence to neutralize the wreckage caused by humankind's intervention in nature, the planet may no longer sustain life on Earth in the broad sense. Two mutually dependent terms are then uttered, "natural habitat" and the "preservation of life" - i.e., the environment and living conditions - with an intensity that grows as the information on this devastating process advances and reaches virtually all social strata. Contemporary thinking has thus elected the noun "sustainability" to support theses concerning the need to align development processes with the maintenance of living conditions on the planet (UNCSD/RIO+20, 2012). In other words, to preserve a feasible balance between the need for development and the preservation of natural resources that ensure the survival of the binomial "development" and "optimum living conditions".

From a purely philosophical point of view, sustainability can be understood as a means of enabling a civilising human project whose ultimate purpose would be to reach a universal balance between development and the preservation of sources of future life, and from a pragmatic point of view, as a strategy to achieve this means. The indiscriminate and sometimes opportunistic use of the term "sustainable" and its cognates as reference for developmental policies in areas as diverse as social, cultural, economic and even religious has ended up generating a polysemy that prevents universal comprehensibility as well as clear limits of equally universal "sustainable" practices.

Although the introduction of the sustainability concept is commonly attributed to the World Commission on Environment and Development (BRUNDTLAND, 1987), *nachhaltigkeit* was already quoted in 1560 in Saxony (Germany) to refer to what is understood today as sustainability. In reality, a movement born from the preoccupation with the intensive use of timber resources and the diminishing forest treasures led to a new vision of redirecting sustainable forest exploitation so it would be "able to maintain itself and regenerate its treasures" (CARLOWITZ, 2000, p. 105), "allowing future generations to have the same advantages as the current one" (GROBER, 2003, p. 167).

Notwithstanding the questions and contradictions that the concept of sustainability still raises in the context of scientific research, the Brundtland Report contribution to its understanding is recognized:

Sustainable development: development which meets the needs of current generations without compromising the ability of future generations to meet their own needs (BRUNDTLAND, 1987, p. 54).

In the context of this report, the definition contains two key concepts in essence: (i) the concepts of needs, in particular the essential needs of universal poverty, which should deserve absolute priority; and (ii) the idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs. It was this UN initiative that brought recognition that it was a common interest of all nations to establish common policies for sustainable development and that environmental problems are global in nature.

This definition seems to have become popularized and a current jargon in the official discourse of contemporary society. One notices an attitude of approximation to the principles and criteria outlined in the Brundtland Report by governmental and non-governmental institutions, which began to publicly announce the adoption of the Triple Bottom Line as a standard development model based on three pillars: economically viable, socially fair and environmentally correct (ELKINGTON, 1990).

The reading of the default development model comprised in the Triple Bottom Line contained in the Brundtland Report leads to the following questions: to what extent can one define and determine the needs of current generations and, above all, of future generations? What degree of reliability does this definition and determination process have? What are the processes involved in the planet's physical capacity to fulfil these needs? What are the limits of the support capacity of ecosystem resources and services? What are the physical quantities involved in the fundamental processes that maintain climate homeostasis? How do such processes unfold? How does one establish desirable limits and paths for patterns of use, operation and consumption of resources and ecosystem services? How does one physically quantify and qualify

regeneration / restoration and biodiversity? What are the criteria used to select the metrics and indicators needed for the correct assessment of development? How does one guide an innovation process in stable conditioning of the planet's habitability and the prosperity of the civilising project? How does one determine the real anthropic impact on the physical, chemical and biological interconnectedness of all life and processes on the planet? How does one prepare effective local and global level strategies that are capable of imparting adaptation to climate change? And taking the questions above into consideration, how does one reliably measure, quantify and qualify in the Triple Bottom Line model what is economically viable, socially fair and environmentally correct? (MEADOWS; RANDERS; MEADOWS, 2004; IPCC, 2007).

Such questions indicate a need to construct an amalgam of knowledge capable of understanding the intrinsically complex sense of the sustainability of life and of quality of life on the planet. In this context, a unique challenge and great responsibility are revealed to society: to seek solutions that allow the construction of a reliable and therefore verifiable sustainable development model.

The role of universities in sustainable development

Universities are classically defined as centres that produce knowledge and wisdom. They produce knowledge without losing sight of the horizon and their direct application in the transformation of humankind and society, which are in fact their objective and the very reason for their existence. In this process of transmitting knowledge in which social interaction is an essential condition, university educates in the original sense of the term. That is: it leads, conducts and guides, which consists of the actual weight of its responsibility for the education of the human stock that emerges from it to act and largely to lead in various fronts of the social fabric, be it political, social or religious. In the context of this understanding, it is clear that the degree of interference in social development almost always refers back to the university embryo, which includes in an incisive manner in the current political moment the

issue of the importance of sustainability for the safety of optimum life conditions, both in the present and in the future. Thus, if the reason for existence of the university as an institution can be understood in the context of merely scientific “asepsis”, its purpose betrays the singularity of this unique nature due to its very purpose – humankind and life – in which the notion of value is permeated: what is worth and what is not worth; what adds and what deducts from the context of human existence and its habitat. This concept of value ultimately compels one towards education for solidary ethics, as well as to the development of languages, symbols, and scientific and technological tools appropriate for this purpose (LUKMAN; GLAVIC, 2007).

The promotion of the importance of sustainability in universities can and should be achieved through the creation of academic programmes with a concrete “sustainable” profile. In essence, this should be done through partnerships and cooperative networks so as to consolidate within and beyond university walls a culture of this subject targeted to sustainable development, since due to their natural vocation, university institutions are those that promote the ideal and spontaneous synergy among teachers, students, employees and the society, thus potentiating the creation of innovative solutions.

The worldwide recognition of the role of universities in the construction of knowledge targeted to sustainable development can be seen in official documents dedicated to discussing the incorporation of sustainability in education and research institutions. Among them, we can mention:

- The Stockholm Declaration (SOHN, 1973): the first to explain the need for education and training in environmental education ;
- The Tbilisi Declaration (1977): reinforced the importance of environmental education for the preservation and improvement of biodiversity and the environment;
- The Talloires Declaration (1990): commended the leadership role of universities in inducting conscience for environmentally sustainable development; in creating an institutional culture of sustainability; in educating towards environmentally responsible citizenship; in proposing institutional ecology practices; in engaging stakeholders;

and in collaborating constructively towards the expansion of interdisciplinary approaches;

- The Halifax Declaration (1991) and the Kyoto Declaration (1993): both proposed a set of actions for universities, such as using their intellectual resources to encourage society's understanding of the risks of anthropic impacts and climate change; to emphasise the current generation's responsibility for sustainability and the resulting damages from failure to observe the correct use of natural resources and environmental services; and to teach and practice sustainable principles;
- The Thessaloniki (1997) and the Swansea Declarations (1993): these sounded the warning that regression of non-sustainability would only be feasible if all segments of society fought bad practices currently in force;
- The Copernicus Guidelines (1993): compiled a set of strategic guidelines aimed at facilitating the incorporation of sustainable development and climate change topics at European higher education institutions;
- The World Declaration on Higher Education for the Twenty-First Century: Vision and Action (WORLD, 1993): consisting of 17 articles, declares teaching the fundamental pillar of human rights, democracy and world peace, while making the pursuit of sustainable development its major premise; and
- The Luneburg Declaration (2001): it emanated from the conference on Higher Education for Sustainability: Towards the World Summit on Sustainable Development 2002 and outlined a set of criteria and principles for the incorporation of sustainability into higher education institutions, preceding the many other documents that followed.

One can see that the extraction of a common denominator for the assimilation and adoption of measures to protect and develop sustainability by such different yet complementary institutions (e.g.: teaching institutions, governments, associations and free civil society organisations) had fundamental importance in the definitive awareness of this life-threatening problem.

Therefore, and considering the propositions and results of UNED (United Nations Environment and Development) (chapter 36 of AGENDA 21,

1995); of the International Work Programme on Education, Public Awareness and Training for Sustainability adopted by the United Nations (Commission on Sustainable Development, 1996); of the conclusions of the International Conference on Environment and Society (THESSALONIKI, 1997); the definitions of the World Conference on Higher Education (Paris, 1998); the World Conference on Science (Budapest, 1999); the World Education Forum (Education for All, Dakar, 2002); and also reporting to the advances in the formation of networks by three academic associations that are part of GHESP (Global Higher Education for Sustainability Partnership, which has the initial support of one thousand colleges and universities committed to the implementation of actions targeted to understanding sustainable development), the following concluding measures of unquestionable relevance were summarised:

- to ensure the updating and review of the scientific concept of sustainability;
- to give sustainable development priority in continued education for teachers;
- to provide formal and continued refresher courses in sustainable development to teachers, leaders and the general public;
- to encourage educational institutions to include reflections on values and standards involving sustainable development as part of their activities;
- to raise the degree of watchfulness and to improve the understanding of the importance and relevance of a technological assessment and of the risks related with the absence of sustainability;
- to encourage creativity for the development and implementation of projects directed to sustainability at higher education institutions and others;
- to pay attention to the problem's international dimension and to encourage international exchange in the field of environmental knowledge;
- to increase the focus on developmental potential and to intensify the formation of networks (entanglement) involving educational institutions;

- to strengthen the integration between training and research, and the interaction with fund providers throughout the development process; and
- to press governments in order to ensure that education in general and higher education in particular are included in the international work programme (World Summit on Sustainable Development).

Finally, the Declaration of Ubuntu (2002) should be highlighted, which proposed a global alliance among all institutions in favour of education, research and the culture of sustainable development.

The discussions established by these declarations attest to the worldwide recognition of the role to be played by universities in the construction of a model of sustainable development, although the challenge of overcoming the very definition of the concept of sustainability is real and clear, in other words, the difficulty of concurrently embracing different cultures and groups whose understanding of the term is conditioned to specific interfering elements such as culture, their own vision of the world, specific purposes and interests. Therefore, materialising and operationalising concepts of sustainability science is a complex challenge that requires difficult (but not impossible) synergy involving knowledge, people, institutions and societies.

The role of PUC-Rio in the construction of sustainability

In parallel with its immediate mission of generating and distributing knowledge, the Catholic University of Rio de Janeiro (PUC-Rio) as a recognised campus of production of knowledge remained aligned with the humanist theses of appreciation of humankind as being committed with the spirituality inherent in the edification of life as a whole. Therefore, its conformity with the current emphasis on the concept of sustainability as a way of rebuilding a future world that is more human and subsequently more solidary, has always existed in the fundamental base of its educational project – a differentiated project in which a kind of cognitive civism has prevailed and still prevails upon the pure

pragmatism of science and knowledge technologies. The concept of sustainability is almost inherent in its purpose, only perhaps without its conformation into a tight discipline and academic highlight.

The Catholic University of Rio de Janeiro (PUC-Rio) was established by resolution of the 1st Brazilian Plenary Council as a national centre for Catholic culture and is recognized by the Brazilian Federal Government under the terms of Law Decree no. 8631 of 15th January 1946, and made canonically official by Decree of the Sacred Congregation of Seminaries and Universities of 20th January 1947. It is a private non-profitable institution of a religious, community and philanthropic nature dedicated to teaching, research and extension (PUC-RIO, 2012). PUC-Rio was declared a public utility by federal Decree no. 43454 of 26th March 1958, and in order to fulfil its mission to serve Brazil and the universal community through the pursuit of truth, its funds are entirely allocated to: (i) promoting culture on the intellectual, aesthetic, moral and spiritual spheres; (ii) developing teaching, research and extension as part of a vision of a pluralistic world of knowledge; and (iii) promoting exchange and cooperation with private and public, domestic and foreign institutions, especially those of an educational, scientific and cultural nature, with the purpose of lending universality to the meaning of its mission.

Compassionate and conscious of his responsibility for the sensitive issues of sustainability, the current PUC-Rio Rector Fr. Josafá Carlos de Siqueira S. J. founded the Interdisciplinary Environment Nucleus (Nima) in 1999 with the objective of agglutinating all internal multidisciplinary skills into a common locus and establishing the desirable interaction between the university and society for the promotion of socio-environmental projects. Nima has conducted projects for 13 years in partnership with schools, businesses, municipalities and national and international institutions, combining the local scale and the global scale. In the vision of the university rector (SIQUEIRA, 2009), it should base its higher commitment on environmental ethics targeted to the transformation of anthropocentric culture for the completeness of human beings through the preservation of biodiversity and the environment, integrating technical-scientific thinking with axiological thinking.

Being submissive to such objectives and commitments, PUC-Rio maintains a permanent self-evaluation process of its performance, in search of continued institutional improvement. In response to the recommendations of the Global Colloquium of University Presidents held in December 2007 at the request of the United Nations Secretary-General, PUC-Rio embraced the challenge of becoming a university oriented to the promotion of sustainability and sustainable development, a decision with the purpose of turning the campus into a big laboratory that stimulates students and teachers into changing their habits. The university has therefore incorporated in its mission the search for solutions that guarantee sustainability and for innovations that act as benchmarks for the transition to a green economy and, as a result, that mitigate the perverse effects of climate change. This challenge, which requires extraordinary academic effort, is being faced with determination and constancy (PUC-RIO/NIMA, 2009).

In order to plan, materialise and operationalise sustainability, PUC-Rio created an environmental agenda in 2009 under the coordination and responsibility of Nima. This environmental agenda naturally congregates a plurality of thoughts and knowledge about the concept of sustainability as a result of its multidisciplinary composition and comprises a set of practices that enable and stimulate sustainability and a quality socio-environmental life at the university campus. It is structured into seven theme hubs: biodiversity; water; energy; atmosphere; materials; waste; and environmental education. Each hub makes clear at its introduction its ethical-environmental stance; a plan for its implementation; and a set of objectives in the short, medium and long terms (PUC-RIO/NIMA, 2012). It is currently in its fourth year and positive results have already been seen since its deployment. PUC-Rio has ranked 66th in the GreenMetric World University Ranking 2011 – a classification instrument that measures the commitment to sustainability by universities throughout the world – among 178 institutions assessed and 1st amongst domestic universities (GREENMETRIC, 2012). The PUC-Rio Environmental Agenda currently includes the participation of Sustainable University, a research group that consists of professors from many of the institution's units who monitor the agenda's implementation process and supervise undergraduate and graduate students in the production of monographs,

dissertations and theses dedicated to the rationale of concrete solutions to the challenges imposed by the pursuit of sustainability.

Actions of the Postgraduate Programme in Metrology, quality, innovation and sustainability

The Postgraduate Programme in Metrology for Quality and Innovation (PósMQI/PUC-Rio), through its newly deployed sustainability pillar, has its origins in a joint academic effort of the University's Scientific Technical Centre departments. While benefiting from the intrinsic multidisciplinary nature of a university such as PUC-Rio, PósMQI seeks to train interdisciplinary professionals with inherent characteristics that are different from the areas that characterise their original training. PósMQI/PUC-Rio is open to professionals from a variety of professional backgrounds. Its objective is not to offer specialisation to engineers, administrators, biologists, physicists and chemists, but to fully empower them to act at the interface of measurement sciences and knowledge. Interdisciplinarity refers to both the convergence of two or more areas of knowledge and the identification and search for new modes of relationship between them. PósMQI operates in areas of knowledge that can contribute to the advance of the measurement and instrumentation science, art and technology. It contributes to the dissemination of quality in new fields of human activity and to the creation and addition of value through technological innovation dynamics. This is a process that becomes ever more critical in a knowledge society that is structuring itself at the beginning of this century and that requires speedy transfers of knowledge from one area to another.

With the consolidation of its institutional vision, PósMQI has transcended the restrictive use of metrology as an instrument for industrial competitiveness and improvement of products and processes in the market. It has evolved to a vision that expands the employment of measurements towards social equity, economic prosperity, environmental valuation and preservation. In the context of its large-scale vision of the science, the quality (adequacy for use), the competitiveness, the technology and the art of measurement, PósMQI

began to promote metrology teaching and research according to a systemic model targeted to sustainability, aligned with the chapters of Agenda 21 (1995), and blending the social, economic, cultural and environmental dimensions of sustainable development into industrial society and other organisations. In the context of this new logic of sustainability-oriented quality and innovation, PósMQI has formally changed its area of concentration at Capes, evolving from “metrology for industrial quality” to “metrology for quality and innovation”, extolling sustainability in its institutional identity.

By ensuring solid and interdisciplinary education, PósMQI/PUC-Rio enables professionals to make use of the measurement and instrumentation science in their daily activities. In particular, it prepares professionals to meet the challenges of the labour market in a globalized world and, to a large extent, it is aware of the need for internalising the concept of sustainability and sustainable development. It thus encourages the search for solutions to typical problems of dynamic sectors of the economy and of sectors involved in the maintenance and improvement of quality of life, biodiversity and access to citizenship. In sum, by fulfilling its institutional mission, PósMQI aims at: (i) training and qualifying professionals that are interdisciplinary, innovative, enterprising and sensitive to competitiveness and sustainability issues; (ii) training and qualifying professionals for teaching and research, with a focus on quality, innovation and sustainability; and (iii) developing R&D activities in promising sectors that generate technological innovations and sustainable development.

There are three lines of research in the programme: instrumentation and measurement (metrological reliability and innovation of measurement techniques and methods); strategic management, innovation and sustainability (strategic management of innovation models; historical, anthropological and scientific bases of sustainable development; and climate change); and intelligent networks – smart grids – directed at technological innovations in communications and information, associated with intelligent energy networks.

Sustainability is a recurrent theme in these lines of research. It introduces a new reality, creating new perspectives to evolve and find practical

solutions in the context of an environment governed by technological innovation. Energy efficiency; strategic and operational efficiency; eco-efficiency metrics; smart grid processing technologies; alternative sources of energy; ecological footprint; carbon footprint; corporate carbon strategy; clean development mechanisms; climate change adaptation and mitigation strategies; fairer, better aligned charges; and collaborative participation of consumers are just some of the key issues approached in these lines of research. Brazil's continental size imposes challenges to overcoming the still existing lag in infrastructure. The interconnection of systems and subsystems is thus established, integrating the country and ensuring access to energy and information transmission, to basic living conditions and citizenship for sustainable development.

The PósMQI curriculum was structured according to the programme's lines of research. It incorporates a set of elective subjects that complement compulsory subjects, totalling 24 academic credits required by the *stricto sensu* academic master's programme. PósMQI has restructured its mission and identity, updating its curriculum and its lines of research based on the permanent monitoring of demands for professional training and research and on the challenges imposed by PUC-Rio's mission to become a model sustainable university. Sustainability was introduced in the new curriculum via specific subjects, among them Metrology for Sustainable Development; Metrology and Corporate Carbon Strategy; Preparation of Projects and Reports on Sustainability; Sustainability Measurement Systems; Strategic Innovation Management; Organisational Learning and Metrology Culture; Standardisation and Management Systems; Risks Regulation, Assessment and Management; Biometrology, Bioelectromagnetic Measurement, Introduction to Intelligent Energy Networks; Intelligent Energy Network Infrastructure; Regulation in the Energy Sector; Energy Efficiency; and Intelligent Cities.

Known for its institutional articulation and its systems of collaboration and cooperation among researchers and institutions, the research network structure optimizes and provides for the concrete attainment of interdisciplinary knowledge. It provides an analytical benchmark for the identification and characterisation of new and innovative research

objects. It becomes critical for the creation and addition of value, for the consolidation of competitive advantages, for the dissemination of citizenship and for the understanding of sustainability. Year after year, PósMQI is strengthened by the successful effort of investing in internal institutional articulation, which congregates actors from the university itself, and in external articulation, through collaboration and cooperation with domestic and foreign research centres and companies. In the external context, it benefits from its ability for articulation to enable the enrichment of its intellectual production, participation and representation in specific forums, in project implementation and in patent application. Over the past few years, the programme has participated in R&D projects developed by international organisations, among which are projects to evaluate the quality of the national infrastructure (metrology, standards, conformity assessment) of European and Asian countries, and guidance projects for Latin American countries in structuring their regulatory and metrology systems. The programme is increasingly sought by Master's degree candidates from other countries (e.g.: the programme has already graduated professionals from Peru, Paraguay, Bolivia, Colombia, Panama, Costa Rica and Germany).

As part of its strategy, PósMQI set up a research group in 2010 – ECOMQI: Metrology for Sustainable Development – to actively serve at the interface of metrology and sustainability areas. The group was registered in the CNPq directory of research groups. The ECOMQI considers that the paradigm of sustainable development assumes the institutionalisation of innovation and sustainability in processes and in political, cultural, social, technical, economic and environmental conditions. It considers social responsibility in its broadest sense, perceiving climate change adaptation and mitigation strategies as intelligent strategies to consolidate sustainability and ensure improved quality of life. The ECOMQI contemplates the articulation of policies and projects of interest to the theme's development and to the mobilisation of existing competences in research centres, universities, conscious companies, and public and promotion agencies with a view to creating mobilising synergies. By thus acting, it leverages efforts geared to articulating dialogue and organising and stimulating the promotion of sustainable scientific and technological development.

In 2011, PósMQI was officially made part of the university's environmental agenda, with the proposal of a consistent set of sustainability indicators for the evaluation of results from the agenda's implementation, defined by the analysis of key contents expressed in the guidelines of each theme hub (COSTA, 2012). "Sustainable Initiatives – Sustainability: everybody's commitment" won the second place at PUC's 15th Exhibition Award in the category Post-Graduations, Dissertations and Theses.

In 2012, a second study evaluated the University's Chemistry Department potential to adopt Green Analytical Chemistry methods, establishing conformity with international Green Chemistry principles (OLIVEIRA, 2012).

In 2013, a third study proposed a set of metrics for the valuation of resources and ecosystem services of the *Euterpe edulis Martius* palm tree – locally known as *Juçara* – in the Atlantic Tropical Forest (FERREIRA, 2013). The work was aligned with the demands laid down by the PUC-Rio Environmental Agenda and by the state of Rio de Janeiro's Frente Pró-Juçara Programme (NIMA, 2013) to be launched during an official event on 3rd June 2013 at PUC-Rio with the planting of one thousand *Euterpe edulis* seedlings on campus. Among its main actions, it should be pointed out that the Frente Pró-Juçara programme established the planting and monitoring of 10 million *Euterpe edulis* seedlings in degraded Atlantic Forest areas in the state of Rio de Janeiro by 2016.

PósMQI has recently joined the European Union's international collaboration project Bottom-up Climate Adaptation Strategies towards a Sustainable Europe (BASE, 2013) in collaboration with the Centre for Climate Change Impacts Adaptation & Modelling (CCIAM) of the University of Lisbon's Faculty of Sciences (FC-UL). Furthermore, two recent master's degree works are being developed; one is dedicated to the formulation of eco-efficiency metrics and indicators in Corporate Carbon Strategy and the other, to the formulation of metrics for the analysis of the carbon footprints of higher education institutions, PUC-Rio being the case studied.

PósMQI is already strongly inserted in R&D activities directly targeting innovation and sustainability in the electrical power, oil and

gas sectors. The following stand out among its projects: (i) R&D Project Future Industries and Emerging Technologies, in partnership with the Centre for Strategic Studies and Management, carried out from March 2010 to September 2011; (ii) R&D Project Clean Production: Sustainable Chemistry, Trends, New Business and Recycling, in partnership with the Centre for Strategic Studies and Management (CGEE/MCT), carried out between July 2009 and February 2011; (iii) R&D Project Light-Aneel R&D 80/11, in progress, called Technological Development and Innovation in the Use of Photovoltaic Technology and its Intelligent Integration with the Distribution Network: an Action Focused on Light's Major Customers. In partnership with the utility, R&D develops an intelligent system coupled with a supervisory system for photovoltaic conversion including the monitoring, control and management of solar energy. Assisted by sensors and data acquisition equipment operating continuously and in real-time, a photovoltaic system for distributed generation will be installed in Light's Energy Museum to cater for specific lighting demands, integration with the grid and awareness of museum visitors regarding the use of alternative renewable energies. Being original in its conception, R&D incorporates the supplementary assessment of the corporation's carbon strategy in the use of photovoltaic energy.

In the course of its Strategic Management, Innovation and Sustainability line of research, PósMQI is currently in collaboration with the Centre for Climate Change Impacts Adaptation & Modelling (CCIAM) of the University of Lisbon's Faculty of Sciences (FC-UL); with the Doctoral Programme in Climate Change and Sustainable Development Policies of the University of Lisbon, the Technical University of Lisbon and the New University of Lisbon; with inter-institutional research group Juçara Technology Network, which congregates researchers from many domestic institutions; and with the following ventures: Light – Energy Utility; Petrobras – Energy; Amável – the Sustainable Atlantic Rainforest; and CBPAK – Compostable Packaging.

Final Remarks

Regarded by experts as a kind of 'invisible technology' with results that are not always easily perceivable, metrology is not necessarily understood by common citizens or governments. Due to a lack of technical sensitivity, they do not perceive the results of its actions in the environment and the economic impact that results from the proper use of measurement systems to reduce waste and rework and especially, its strategic role in the construction of modern industrial societies. Over the years, the importance of Brazil's quality infrastructure (i.e.: access to reliable metrology, standardisation and conformity assessment services) – a public good from the point of view of economic theory – has been underestimated when economic policies are developed, trading being an essential component. But it was only a decade ago that the International Committee of Weights and Measures (CIPM), supported by the directors of the national metrology institutes (NMI) of 38 member states of the Metre Convention and by representatives of international metrology, accreditation and certification organisations (BIPM, OIML, Ilac and IAF) introduced a global regime to establish the global equivalence of national metrology systems. The basis for the Mutual Recognition Agreement (CIPM-MRA) was thus created. It establishes a consensus that enables measurements to be compared. This is a fundamental step to establishing a worldwide consensus on the results of critical and impactful measurements (e.g.: air and water quality, well-being, carbon footprints) that underpin international treaties for the maintenance of resources and ecosystem services.

The search for the preparation of a sustainable development model reveals a set of structural problems and brings an inordinate challenge to societies. Such a development model should be able to benefit the unique phenomenon of life, and contribute to a civilising project ballasted in parameters of prosperity, dignity and well-being in such a way that the Earth's major asset – the capital of life – remains forever ensured. Achieving sustainability will require reshaping the current cultural mentality in which waste, environmental degradation and disregard for the finite sources of nature preservation were and are overwhelmingly raped by humankind's greedy force, still primitive and uncivilised. It

should therefore draw on society's natural revolutionary forces so that the qualitative leap to future habitability can be taken without negative impact at the present stage of social life.

Universities and postgraduate programmes play a key role in this reassessment since sustainability does not arise spontaneously, but from humankind's interference in the transformation of values that one wants to survive the line of existence. It is necessary to ensure the reliability and the fair measure of knowledge and indicators that govern decision-making. It is necessary to understand behaviours, singularities, the limits and conditions governing ecosystem processes. It is necessary to qualify and guide innovation in order to maintain the planet's conditions of habitability. Once we understand the way sustainability is projected on Earth, on life and on society, it will be possible to formulate reliable hypotheses for a sustainable development model.

Based on the assumption that future technologies and technological innovations will boost more sustainable businesses and relationships providing institutions with new options for creating and adding value, the challenge will be to find out possible ways to operate in increasingly complex environments. And besides that, to be able to incorporate the social, economic, environmental and cultural sustainability vision into their strategies, processes and activities. In this context, PósMQI/PUC-Rio introduces a new look at its institutional mission and at research in metrology, quality and innovation. The interdisciplinarity that is intrinsic to metrology contributes to this end, not denoting a simple juxtaposition of other areas of knowledge or an agglutination of dissociated stagnant efforts, but a search for the production of new and innovative solutions for the generation and addition of a new value – sustainability.

Taking into account its 16-year experience and aware of the new demands from innovation and information society, PósMQI/PUC-Rio will continue to evolve. Its actions will carry on in order to fill a gap in the training of professionals with interdisciplinary vocation in metrology and solid complementary knowledge ranging from basic industrial technology to sustainability. All this should be done without losing sight of the constant challenge of extension and deepening quality, focused on

the interests of academia, the industrial sector and the services sector of Brazilian society at large.

Attention to innovation and newly produced knowledge should continue to guide the evolution process of PUC-Rio's Postgraduate Programme in Metrology in light of the concept of scientific progress by Dewey (1952, p . 271), "every great advance in science has issued from a new audacity of imagination". Bringing to the discussion the inconvenience of considering science and philosophy separately, Dewey argues that philosophy needs to reflect and take ownership of the specific results of newly generated knowledge, turning them into practical actions to favour humankind. In a convergent sense, he also proposes a reorganisation of the concepts of art (aesthetics) and science, entirely fading the diverse understanding of their nature: experimentation, inherent in science; and impression, inherent in art. That is because in both objects of expression/ experimentation, their natural and functional elements remain the same, in both varying the consequence that depends on value in its function of revealing or expressing nature's intimate nature.

There is no doubt that the creation of a sustainable world will, first and foremost, need imagination to create methods of persuasion before knowledge and all available science can be applied to summon technique at the service of its implementation.

PUC-Rio is committed to sustainability. It is an active participant in the sustainability debate on a global scale. The university's rector has set the tone by authoring approximately 60 scientific articles and 12 books geared to the themes of environmental education, socio-environmental ethics and ecological spirituality. His recent book "Rio+20: Reflections on environmental sustainability" (SIQUEIRA, 2012) discusses the concern of global and regional societies about the subject, involving economic, climate and ethical aspects. According to the view of philosopher Danilo Marcondes, who introduces the book, the rector of PUC-Rio

shows the need to overcome the dichotomy between human beings and nature, in an integrated vision of the natural reality in which we live. It is this ethics of caring and taking responsibility for what is not ours, but a

part of the environment that we share with all living beings and of which we are part, that forms the backdrop to these reflections. It points to the adoption of dialogical and integrating rationality that goes beyond instrumental rationality that is still dominant in a vision of technique for the domination and submission of nature (SIQUEIRA, 2012, preface).

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Bibliographical References

AGENDA 21. **Conferência das Nações Unidas sobre Meio Ambiente e Desenvolvimento**. Brasília: Câmara dos Deputados, 1995.

BASE. **Bottom-up climate adaptation strategies towards a sustainable Europe**. Available at: < <http://base-adaptation.eu>>. Accessed on: 31 May 2013.

BOFF, L. **Sustentabilidade**. O que é? O que não é? Rio de Janeiro: Editora Vozes, 2012.

BRUNDTLAND, G. H. **Our common future**. The World Commission on Environment and Development. New York: Oxford University Press, 1987.

CARLOWITZ, H. C. **Sylvicultura Oeconomica**. Anweisung zur wilden Baumzucht. Freiberg: Reprint der tu bergakademie, 2000.

COSTA, A. V. O. **Indicadores de sustentabilidade para instituições de ensino superior**: uma contribuição para a Agenda Ambiental PUCRio. 2012. Dissertação (Mestrado em Metrologia) Programa de Pós-Graduação em Metrologia, Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro, 2012.

COPERNICUS GUIDELINES. **The university chapter for sustainable development**. 1993. Available at: <<http://www.iisd.org/educate/declarat/coper.htm>>. Accessed on: 29 August 2012.

DEWEY, J. **La busca de la certeza**: un estudio de la relación entre el conocimiento y la acción. Tradução Eugenio Ímaz. México/Buenos Aires: Fondo de Cultura Económica, 1952.

ELKINGTON, J. **Cannibals with forks**: the triple bottom line of 21st century business. Journal of business ethics, v. 23, n. 2, p. 229-231, 1990.

FERREIRA, L. **Avaliação de sustentabilidade e captura de carbono na Floresta Atlântica Tropical**: formulação de métricas e estudo de caso da *Euterpe edulis* Martius. 2013. Dissertação (Mestrado em Metrologia)–Programa de Pós-Graduação em Metrologia, Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro, 2013.

GREENMETRIC UI World Universities Ranking. **Guidelines of UI GreenMetric World Universities Ranking 2011**. 2012. Available at: <<http://greenmetric.ui.ac.id>>. Accessed on: 27 August 2011.

GROBER, U. **Modewort mit tiefen Wurzeln**: Kleine Begriffsgeschichte von 'sustainability' und 'Nachhaltigkeit'. In: ALTNER, G.; LEITSCHUHFECHT, H.; SIMONIS, U. E. Jahrbuch **Ökologie** 2003. München: Beck, 2002. p. 167-175.

IPCC. **Climate change**: synthesis report. Fourth assessment report. An Assessment of the intergovernmental panel on the climate change.

Published by the Intergovernmental Panel on Climate Change. Geneva: 2007. p. 44-5.

LELLO Universal. **Dicionário Enciclopédico Luso-Brasileiro**. v. 2. Portugal: Editora Lello e Irmãos Editores Porto, 1926. p. 1130.

LUKMAN, R. G.; GLAVIC, P. **What are the key elements of a sustainable university?** Clean Technologies and Environmental Policy, v. 9, p.103-114, 2007.

LUNEBURG DECLARATION on higher education for sustainable development. 2001. Available at: <<http://portal.unesco.org/education/en/files/37585/11038209883LuneburgDeclaration.pdf/LuneburgDeclaration.pdf>>. Accessed on: 29 August 2012.

MEADOWS, D.; RANDERS, J.; MEADOWS, D. **Limits to growth: the 30-year update**. Vermont: Chelsea Green Publishing Company, 2004.

NIMA – NÚCLEO INTERDISCIPLINAR DE MEIO AMBIENTE. **Um fruto brasileiro**. Available at: <<http://www.nima.puc-rio.br/index.php/pt/todas-as-notas/4115-lancamento-do-projeto-frente-projucara>>. Accessed on: 30 May 2013.

OLIVEIRA, B. **Química analítica verde: proposições para a Agenda Ambiental PUC-Rio**. 2012. Dissertação (Mestrado em Metrologia)– Programa de Pós-Graduação em Metrologia, Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro, 2012.

PUC-RIO – PONTIFÍCIA UNIVERSIDADE CATÓLICA DO RIO DE JANEIRO. **Marco Referencial, Estatuto, Regimento, Constituição Apostólica, Ex Corde Ecclesiae**. Rio de Janeiro: Editora LibraryThing, 2001.

PUC-RIO/NIMA – PONTIFÍCIA UNIVERSIDADE CATÓLICA DO RIO DE JANEIRO/NÚCLEO INTERDISCIPLINAR DE MEIO AMBIENTE. **Agenda ambiental-PUC-Rio**. Rio de Janeiro: PUC/Núcleo Interdisciplinar de Meio Ambiente, 2009. Available at: <<http://www.nima.puc-rio.br>>. Accessed on: 21 January 2012.

_____. **Sobre o NIMA**. 2012. Available at: <<http://www.nima.pucRio.br>>. Accessed on: 21 January 2012.

SIQUEIRA, J. C. **Ética sócio ambiental**. Rio de Janeiro: Editora PUC-Rio, 2009.

_____. Rio +20 – **Reflexões sobre a sustentabilidade socioambiental**. Rio de Janeiro: Editora PUC-Rio, 2012.

SOHN, L. B. **The Stockholm Declaration on the human environment**. Harvard International Law Journal, v. 14, n. 3, p. 423-515, 1973.

THE TBILISI DECLARATION. **Intergovernmental Conference on Environmental Education**. Final Report. USSR: 1977. Available at: <<http://unesdoc.unesco.org/images/0003/000327/032763eo.pdf>>. Accessed on: 29 August 2012.

THE TALLOIRES DECLARATION. **Association of University Leaders for a Sustainable Future**. 1990. Available at: <http://www.ulsf.org/talloires_declaration.html>. Accessed on: 29 August 2012.

THE HALIFAX DECLARATION. **Creating a common future: university action for sustainable development**. 1991. Available at: <www.iauiau.net/content/rtf/sd_dhalifax.rtf>. Accessed on: 29 August 2012.

THE KYOTO DECLARATION. **Ninth International Association of Universities Round**. 1993. Available at: <<http://www.iisd.org/educate/declarat/kyoto.htm>>. Accessed on: 29 August 2012.

THE THESSALONIKI DECLARATION. **International Conference Environment and Society: Education and Public Awareness for Sustainability**. 1997. Available at: <<http://resources.spaces3.com/f49d326a-5930-45cfa9ef-4d23a0670a6d.pdf>>. Accessed on: 29 August 2012.

THE SWANSEA DECLARATION. **Association of Commonwealth Universities' Fifteenth Quinquennial Conference**. 1993. Available at: <<http://www.iisd.org/educate/declarat/swansea.htm>>. Accessed on: 29 August 2012.

THE UBUNTU DECLARATION. **Ubuntu Declaration on Education, Science and Technology for Sustainable Development**. 2002. Available at: <http://www.ias.unu.edu/sub_page.aspx?catID=108&ddIID=304>. Accessed on: 29 August 2012.

UNCSD/RIO+20. **The future we want**. 2012. Available at: <<http://www.rio20.gov.br>>. Accessed on: 30 August 2012.

WORLD declaration on higher education for the twenty-first century: vision and action. 1993. Available at: <http://www.unesco.org/education/educprog/wche/declaration_eng.htm>. Accessed on: 29 August 2012.