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Integrated assessment and energy analysis: Quality assurance in multi-criteria analysis of sustainability

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Abstract

Science for sustainability policy requires the handling of multi-dimensional and multi-scale analyses. Integrated assessment is about generating information relevant for decision-making. This generates a divide between two scientific paradigms: (1) 'Post-Normal Science' acknowledges the unavoidable existence of non-equivalent perceptions and representations of the reality; legitimate but contrasting perspectives found among social actors; heavy levels of uncertainty. (2) 'Normal Science', believes that it is possible to handle in a rigorous and rational way these challenges and that therefore it is possible to define in substantive terms 'the best course of action' for society. This paper is written to explain the reasons and the tools developed by scientists working within the Post-Normal Science paradigm.

1. Introduction

1.1. The context of this paper

The conclusions of the second Biennial International Workshop Advances in Energy Studies include, among other recommendations, a call for the scientific community to reframe quantitative analyses within an ecological economics perspective and to develop more effective tools for decision makers [1]. In relation to this point, one of the technical sessions of that workshop—entitled 'Energy and Governance'—was dedicated to the development of policy and management tools for energy analysis to

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deal with the need of considering simultaneously different dimensions (economic, ecological, social) in decision making.

This article is an attempt to blend together the content of two papers which were presented in that session. The two papers were both dedicated to *Integrated Assessment** [*terms written in bold and with a star are defined in the glossary*]. The original two papers were focusing on two issues: (i) the technical problems associated with the handling of integrated packages of indicators referring to different scales and dimensions of analysis; (ii) an overview of policy challenges and available tools for dealing with the obvious fact that different *stakeholders** will carry different legitimate definitions of what should be considered as an 'improvement' or a 'worsening' of an existing situation.

In the rest of this paper, we deal with these two issues and their relevance for energy analysis. In particular, in this introduction we provide a general discussion of science for governance and implications for the use of quantitative analyses in this field. We raise several issues related to the operationalization of basic ideas of Post-Normal Science in relation to science for governance. In Section 2 we provide an example of the problematic quantification of energy flows when perceived and represented within a system organized in hierarchical levels on multiple scales (a critical appraisal of the energetics of human labor). In Section 3 we provide typologies of difficulties faced when attempting a characterization of the performance of electricity generation in a country on a *multi-criteria space**. Finally, in Section 4, we deal with the obvious but often neglected fact that any process which is generating scientific inputs used for governance should include an explicit task of 'quality assurance'. Such a task is required to guarantee transparency and accountability in relation to the integrity and competence adopted in the process. This is a crucial requisite to obtain, later on, legitimization and social acceptance for the consequent process of decision making.

1.2. The epistemological challenge implied by 'science for governance'

In the year 2000, a group of students in economics operating in France established a web site whose content was against *autism** in academic economics [http://www.paecon.net/]. They were against: (i) economics' 'uncontrolled use' and treatment of mathematics as 'an end in itself', and the resulting in 'autistic science'; (ii) the repressive domination of neoclassical theory and derivative approaches in the curriculum; (iii) the dogmatic teaching style, which leaves no place for critical and reflective thought. An excessive hegemonization of a given scientific paradigm carries the risk of determining a strong 'normalization' and 'lock-in' of the scientific characterization of any problem structuring in that field.

More or less in the same period the same set of issues popped out in other scientific fields. For example, several discussions can be found in the field of conservation ecology about the risk of using excessive formalization in analytical models used to assist decision making [2]. In relation to this topic, Anderson [3] lists three main related points: (1) quantitative analysis is 'essentially worthless if it is not translated into effective policy' [4]; (2) very complicated models are much more difficult to communicate and this can imply the loss of important information in the interaction between scientists and decision makers [5,6]; (3) quantitative analyses must be relevant to decision makers. This requires a pre-analytical agreement between scientists and decision-makers about an appropriate definition of the problem structuring [7,8].

Within the field of *epistemology** such a discussion is a very old one and has been carried out in relation to 'science for governance' for decades [9]. The debate in this field is about how to define and guarantee 'quality' for science. It should be noted that this discussion deals with one