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Analysis

Sustaining sustainability science: The role of established inter-disciplines

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ABSTRACT

The establishment of new interdisciplinary fields such as ecological economics, human ecology or technology assessment can be interpreted as a logical consequence of striving for new sustainability sciences that address current global, multi-dimensional and multi-scale challenges. These set out to bridge the gap between the natural and the social sphere, between scientific analysis and societal action. This paper aims at re-assessing the contribution of established inter-disciplines to sustainable development. Journal articles of ecological economics, technology assessment and science and technology studies are evaluated and compared along several proposed features of sustainability science. The results converge in two crucial aspects. (1) Concise societal or political recommendations are not part of present day 'normal science', be it a disciplinary or an explicitly interdisciplinary research context. (2) Participatory exercises are rarely applied as a socio-politically embedded practice, despite a high interest in such exercises as an object of study and discussion.

1. Introduction

The term sustainability science has been established to denote innovative, problem driven research that aims at understanding the dynamics of coupled social–ecological systems (Kates et al., 2001; Perrings, 2007). As a child of the early 21st century, it takes up challenges and exhibits characteristics that have been emphasized from the 1990s onwards under headers such as 'post-normal science' and 'mode 2' research (Gibbons et al., 1994; Nowotny et al., 2001): extended peer communities and participatory approaches, the acknowledgement of extended facts and a high level of systemic integration, interdisciplinary collaboration and normative sensitivity, as well as the production of societally robust and politically relevant knowledge via use-inspired basic research.[1]

As an 'umbrella term' (Rip and Voss, 2009), sustainability science delineates an 'array of increasingly vibrant movements' (Clark and Dickson, 2003), an emerging 'transdisciplinary effort' consisting 'of a plethora of ideas and perspectives' focussing on a joint goal (namely to obtain 'the much-needed symbiosis between nature and culture', Rapport, 2007:77), a 'vibrant' and 'maturing field' (Clark, 2007), a 'not yet mature, applied science' (Ostrom et al., 2007), a 'dynamic and evolving field of inquiry' or even an 'emerging discipline' (Komiyama and Takeuchi, 2006). The ambivalent relation between the existing (disciplinary) structures and sustainability science has been voiced frequently. Perrings (2007:15179) exemplarily notes that although "the development of discipline based science has been the source of almost all scientific advances in the last century it has also limited the capacity of science to address problems that span multiple disciplines."

Following this line of characterizing sustainability science, some research fields that emerged earlier onwards, in the 1970s and 1980s, can be seen as its forerunners. The then newly established inter-disciplines human ecology, social ecology, ecological economics, and technology assessment already aimed at providing answers to the formulated challenges. In their origins, they clearly set out to bridge the gap between the natural and the social sphere in the context of sustainable development goals. Other interdisciplinary fields such as science and technology studies are not yet perceived as prominent contributions to sustainability science, but might also be drawn upon more consciously in the future. In the light of the newly formulated paradigm of sustainability science it seems appropriate to (re-)assess the contribution of these (less elusive) inter-disciplines to sustainability science.[2]

The main aim of this paper therefore is to characterize established inter-disciplines along characteristics that have been put forward for sustainability science during the recent years and – upon this basis – to address their role within a comprehensive sustainability science agenda.

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[1] Recently, sustainability research has also been discussed via eco-technologies and hence characterized as a 'technoscience', evoking a more critical perspective (Schwarz and Nordmann, 2010).

[2] Kajikawa (2008) aims at directly analysing sustainability science via a study of three closely related journals. As a result, diverse definitions, ten different thematic research domains (forestry, climate, health, biodiversity, etc.) and seven basic research components (goal setting, indicator setting, indicator measurement, causal chain analysis, forecasting, backcasting, and problem–solution chain analysis) of sustainability science are identified and discussed. Other than in this paper, Kajikawa (2008) does not assess whether the prescriptive definitions and outlines are actually realized within the research activities presented.

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To achieve this goal, the more general characteristics ascribed to sustainability science are translated into concrete, observable parameters. Scientific papers stemming from three different established inter-disciplines, namely ecological economics, technology assessment and science and technology studies, are analysed along these parameters. The results are presented, implications for the status of the three fields as inter- and transdisciplinary endeavours are discussed and their role in the context of establishing a sustainable science is addressed.

2. The Cases of Three Established Inter-Disciplines

During the second half of the last century, especially during the 1970s and 1980s, a couple of new academic fields with a clearly interdisciplinary background and a more or less loose connection to societal issues and movements of this time emerged.[3] Some of these inter-disciplines represent established areas of research today. In the following section, three examples are introduced, including their interdisciplinary background, their issue-oriented character and their specific connection to the agenda of sustainable development.

2.1. Ecological Economics

Ecological Economics (EE) can be defined as the study of relationships between human housekeeping and nature's housekeeping (Common and Stagl, 2005). The general research focus of EE is to address the interdependence of societal economies and natural ecosystems over time and space (Costanza et al., 1997). Contrary to mainstream economics, in EE natural capital is added to the typical asset analysis of land, labour and financial capital (Røpke, 2004). EE emphasizes the fact that our physical world has a limited carrying capacity and that natural capital is finite. Contrary to environmental economics, EE treats the societal economy as a subsystem of the ecosystem and emphasizes the preservation of natural capital.

Seeking for commonly perceived roots of EE, two different origins can be detected: one pathway derives from natural sciences, especially from ecology, and the other one leads back to classical economics. Costanza (2003) dates back the first contemporary efforts in bridging the gap between economics and ecology to the 1960s when Kenneth E. Boulding published his essay: “The economics of the coming spaceship Earth” (Boulding, 1966) and Herman E. Daly made a contribution entitled: “On Economics as a life cycle” (Daly, 1968). Also the workings of Nicholas Georgescu-Roegen, which were coined as “Bioeconomics” by Gowdy and Mesner (1998), can be seen as direction giving.

From these beginnings it took quite a time until regular scientific activities in EE were initiated. In 1982 Ann-Mari Jansson organized the symposium entitled: “Integrating Ecology and Economics” in Sweden (Jansson, 1984). This event can be considered as one of the first opportunities where ecologists and environmental economists tried to find a common language (Costanza, 2003). In 1987, two participants of the Swedish meeting, Robert Costanza and Herman E. Daly, edited a special issue of the Journal *Ecological Modelling* on the topic of EE (Costanza and Daly, 1987). This special issue produced sufficiently enthusiastic responses (Costanza, 2003) and therefore encouraged further activities. In 1988 the *International Society for Ecological Economics* (ISEE) was founded and in February 1989 the first Volume of Ecological Economics, the “Transdisciplinary Journal of the ISEE”, was published.

Presently EE can be seen as a well established scientific community with all its characteristic activities. But the identity of EE as a field of research has been described as still rather diverse. No generally accepted theoretical framework and no clearly defined knowledge structure exist (Faber, 2008). According to Faber (2008), EE can be defined by its focus on nature, justice and time. Issues of EE like intergenerational equity, characteristics of environmental change and uncertainty of long-term processes can also be subsumed under the term sustainability science (Funtowicz and O'Connor, 1999). Both, EE and sustainability science can therefore be seen as reactions of the concerned scientific community to coupled economic and ecological challenges, which were increasingly framed as problems of an (un) sustainable development. Both approaches try to develop strategies to cope with the uncertainties of the dynamics of socio-ecological systems (Berkes et al., 2003; Anderies et al., 2007).

2.2. Technology Assessment

Technology Assessment (TA) was established in the 70s of the last century, a time when society was facing large technologies (nuclear power, space technology, etc.) and related new risks. It was the overarching aim of TA to comprehensively assess future impacts and options (benefits and risks) connected to (large) technologies in order to provide well balanced advice for policy makers. The US Congressional Office of Technology Assessment (1972–1995) was the first TA institute to be established and the only one to be closed down again. A predominantly expert driven TA, indirectly also involving stakeholders and interest groups especially in the beginning of research and in the review process was coined. Following the US example, European TA institutions such as the German Institute for Technology Assessment and Systems Analysis (founded 1976) were established. In the late 1980s, TA institutions with a close link to the parliaments were also founded.[4] Since 2004, the Network TA (NTA) provides a platform for the German speaking TA community including a biannual TA conference. Joint projects (as reported in TAMI 2004; Decker and Ladikas, 2004; and Joss and Bellucci, 2002) show a close collaboration of the European TA community as well as sustained work on a common understanding of TA itself and related core concepts and terms (Decker, 2008).

In the last decades, TA has extended its original goal of providing ex-ante assessments of technologies towards complex learning processes and providing an arena to broaden the knowledge base on which societal decisions are based (Rodemeyer, 2005). This goes along with the transition of TA as a “watchdog” in terms of an early alerter to contemporary TA as a “tracker” as Smits et al. (2008:3) put it.[5] Approaches like constructive TA (Rip et al., 1995) and real-time TA aim at directly integrating TA into technological research and development and strengthening its impact (Sarewitz, 2005; Guston and Sarewitz, 2002). In rapidly evolving areas such as converging technologies, TA is even attributed the role of an active player, contributing to processes of shaping the (emerging) technologies at stake. A shift from technology-driven approaches to problem-driven or sustainability-oriented approaches can also be observed. Technologies are no longer studied in isolation but as a part of social(–ecological) systems (Grunwald, 2002:247-265).

TA deploys the insights of diverse disciplines and involves a broad range of experts as well as actors. Participatory methods gained increasing importance since the 1990s to foster the democratization of technology policy and to facilitate public deliberation. “Upstream engagement” is, according to Wilsdon (2005), a promising way to provide arenas for the development of visions and the discussion of ends and purposes of science and technology, thereby overcoming a linear model of technology

[3] Interdisciplinarity takes different forms (for the U.S. context, see Klein, 1990). It is institutionalised temporarily in the form of interdisciplinary projects or, on a long-term basis, as interdisciplinary communities and centres. It is represented by multi- or interdisciplinary research teams or researchers with a multi- or interdisciplinary affiliation, aiming at interdisciplinary objectives and modes of research (based upon interdisciplinary research rationales, scopes, objects, ontologies, epistemologies, methodologies and methods). For a detailed literature review, an elaborate framework and empirical analysis of interdisciplinary research, see Huutoniemi et al. (2010). Unlike our study, Huutoniemi et al. (2010) analyse a broad range of (national) research proposals, not research papers within specific research fields.

[4] E.g. in Germany, the United Kingdom, Denmark, the Netherlands, France or at the European level.

[5] Referring to Smits et al. (1991).