Multiperspectival science and stakeholder involvement: Beyond transdisciplinary integration and consensus

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Abstract: *Science is perspectival and crossdisciplinary cooperation cannot, in general, rely on an actual (re-)integration of science – second order perspectives are needed. On this background we focus on stakeholder involvement in multiperspectival science, with biomass for energy as a concrete case. Our thesis is that scientific intervention in a complex problem field should not strive for consensus on problems and goals. In such a situation there will be many different stakeholders, and the heterogeneity of stakeholder perspectives and their relation to different scientific perspectives should be exposed and coordinated through a separate second order research process. A process that involves polyocular, contextual communication based on second order observations of scientific and stakeholder perspectives, and which can maintain a dynamic, multidimensional space of understanding as a basis for research and stakeholder cooperation throughout the intervention process. The first problem is not problem solving but problem forming.*

Keywords: *complexity, crossdisciplinary, multiperspectival, heterogeneity, stakeholders, biomass.*

Introduction

Functional differentiation is a sine qua non of modern science. The complexity of the world is rapidly increasing in co-evolution with the growing complexity of science, and there is a continuing differentiation of functions and perspectives. Over time, science has differentiated from the unspecialized science or natural philosophy of the past into specialized fields of observation like biology, sociology and psychology (Stichweh 1992, 1996, Luhmann 1990, 446ff).

Disciplinary specialisation and sophistication is the basis for the strength of science in technological development and problem solving. Yet the functional differentiation of science and society is also a contributing cause of the systemic problems of today, which are becoming manifest in form of systems crises centred on climate, energy, food, public health, environment, ecosystems and biodiversity. Though they may contribute to the causes, specialised disciplines are insufficient means to handle systemic problems and guide complex development processes.

Hence, there has been a call for multi-, inter- and transdisciplinary science as answers to the problem of increasing complexity and differentiation. The promise of multi-, inter- and transdisciplinarity is that helpful solutions can be gained from the use of several disciplines on the same problem (in multidisciplinary work); perhaps with a shared framework for cooperation between the disciplines (in interdisciplinary work); and perhaps with a real integration of the involved disciplinary and stakeholder perspectives (in transdisciplinary work).

But crossdisciplinary cooperation is not a trivial problem. Involving more than one discipline is necessary to address complex problem fields, but there are fundamental problems in communicating between different scientific perspectives, in particular where there is no common theoretical framework, and the answers gained are often fragmented or dominated by one hegemonic perspective at the cost of the others (e.g. Dewulf et al. 2007, Evely et al. 2008, Miller et al. 2008, Pennington 2008). The more ambitious the collaboration is, in terms of using and integrating very different scientific perspectives in solving real, complex problems, the more difficult the task.

Based on earlier work on the problems and possibilities of crossdisciplinary science (Noe et al. 2008, Alrøe and Noe 2010), we claim that, as a general approach, the move beyond disciplines towards an integrated, holistic science is impossible and that there is no way back to the undifferentiated natural philosophy of the past. Science is perspectival, and the way forward for crossdisciplinary cooperation and for how to use the fragmented sciences to help solve complex problems for society, lies in a third direction. The form of integration we need in crossdisciplinary research is not integration proper, but an orchestrated use of different scientific perspectives as instruments of observation. Specifically, we have suggested the need for separate research processes based on second order observations of the different specialised scientific perspectives involved; processes of polyocular communication that produce multidimensional spaces of understanding as a basis for research cooperation and for the use of specialised scientific knowledge.

Based on this perspectivist understanding of crossdisciplinary research as necessarily multi-perspectival, we in this paper focus on the related, non-trivial problem of how stakeholders can be involved in multiperspectival science, with biomass for energy as a concrete case. In this practical and complex case there are many stakeholders with valid interests and very different perspectives.

Our basic thesis is that the intervention of science into a complex problem field should start not from processes of consensus and integration, but from increased awareness of the heterogeneity of different stakeholder perspectives and their relations to different scientific perspectives. The first problem is not problem solving but problem forming. The different perspectives involved should be exposed and coordinated through a dynamic process of polyocular observation and communication, which can provide a multidimensional space for problem forming and problem solving.

In the following we will first explain the perspectivist approach to science in more detail, outlining the framework that it provides for crossdisciplinary research. Then we will present the case of biomass for energy and finally we will discuss how our perspectivist approach to stakeholder involvement in multiperspectival science compares to other approaches to transdisciplinary research.

A perspectivist framework for crossdisciplinary research

The perceived problems of crossdisciplinary science are not exceptions, but symptoms of a fundamental structural problem in crossdisciplinary science, which can be analyzed philosophically by gaining a deeper understanding of the perspectival nature of science. The first step in the analysis is to investigate science as a cognitive process and look at the 'instruments of observation,' broadly construed. The differentiation of science is not only a differentiation of social systems, but also a cognitive differentiation and specialization of scientific perspectives. Differentiation increases the complexity that science can handle overall, by reducing the observational complexity that each perspective must handle, through selection and delimitation. This makes differentiation a very powerful mechanism in science. And this is the reason why a genuine reintegration that 'undifferentiates' scientific perspectives, in general, is neither possible nor desirable. The strength of independent scientific perspectives is needed. But the same differentiation mechanism is also the reason why truly crossdisciplinary science is a non-trivial problem.

In this section we outline how a thoroughly perspectivist approach can help us understand the persistent problems in crossdisciplinary science. We want to expose the perspectival causes of communication failures and disagreements in crossdisciplinary science and provide tools for how to understand and handle scientific perspectives. The practical aspiration is that this pluralist and perspectivist, but not relativist, framework can serve as a better basis for truly crossdisciplinary research and for the crossdisciplinary use of very different kinds of science in society.

There is a growing recognition that the context established by scientific disciplines, schools and methodological approaches is decisive for the focus and the kind of observations that can be made by science. This contextual and pluralist conception of science has been nurtured by the ideas about the incommensurability of successive scientific theories launched by Paul Feyerabend and Thomas Kuhn. In recent years there has been a rising interest in cognitive approaches within philosophy of science, where the focus is on scientific models and representation rather than theories and truth. Lately, Ronald Giere (2006a, 2006b) has developed this cognitive understanding of science into a 'scientific perspectivism' proper, and Alrøe and Noe (2010) has explored the structure of scientific perspectives in crossdisciplinary science.

The perspectivist view of science is quite radical compared to much present philosophy of science, but it can be characterized plainly in a few sentences. In our own words: "There is no outside perspective on the world. All knowledge comes from a certain perspective. All learning happens in concrete perspectives on the world, which are part of the world, and which can themselves be made objects of observation." This fairly banal insight contains strong implications for how we think about scientific expertise, scientific disagreement and the role of science in society, and for our ideas about scientific norms.

A scientific discipline is a specialized perspective for observation of a field with specific instruments, concepts, logics and examples. The perspective is reproduced and refined through internal processes. It delimits and focuses the field of observation, and makes possible the observation of certain phenomena and aspects. This view of science implies that there are many scientific truths about any complex problem, and that the question for philosophy of science is not how to select the correct one, but how to appreciate and use the nonunifiable plurality of partial knowledges (Longino 2006). All ontological claims are interwoven with the epistemological conditions for observation that apply in the perspective where it is grounded.

However, this does not imply that any truth can be as good as any other, or that there is no difference between expertise and taste. The distinct, collective character of science is manifest in the foundational methodological ideas, open inquiry, systematic observation, and testable truths, which establish its excellence in the production of knowledge.

Building on the idea of second order cybernetics (Foerster 1984), we suggest that the problems that arise in crossdisciplinary science due to the perspectival nature of science need to be handled through separate second order perspectives. Using a term first used by Magoroh Maruyama, these second order learning processes can be called polyocular observation and communication. The second order perspectives do not directly observe the research object, they are second order observations of first order scientific perspectives (see Fig. 1 for an example).

The need for second order perspectives and polyocular communication is a reaction to the difficulties of communicating directly across different perspectives with, possibly, different immediate objects in form of theories, models and entities, different delimitations of the shared (dynamic) research object, different understandings of common concepts, different logics and rationales, different criteria of science and different societal and intentional contexts in form of values and interests. In the (obviously simplified) example of the farm, agronomy is concerned with food production and observes yields, biology is concerned with nature and observes biodiversity, economy is concerned with markets and observes commodities, and sociology is concerned with culture and observes human interactions. In a concrete crossdisciplinary investigation of, say, nature quality in a farmed landscape, these disciplinary perspectives represent different interests in nature quality with very different ideas about what nature quality means, they have different methods for how nature quality is best investigated, different boundaries of the farm, and in the end they draw different conclusions based on different rationales.

It is sometimes stated as a goal that the scientific disciplines that are applied in crossdisciplinary research should undergo a disciplinary integration proper, often using the term transdisciplinary science. This may be a relevant target if the objective is, for instance, to create an integrated perspective on a technological field such as nanotechnology. If the integration succeeds, a new, separate perspective is established, where specific theories, models, values, logic and exemplars are selected and the research field determined. There are strong internal mechanisms in science that favour the formation of specialized perspectives, which offer consistent, effective and accurate knowledge in the context of their particular, delimited research world and refined tools of observation.

On the other hand, the idea of transdisciplinarity of a first order, without the selections and delimitations inherent in the formation of a single scientific perspective, is incongruous. The specialized disciplines are generally not able to both reproduce and refine their own perspective and carry out second order observations of the different perspectives (including their own) that are employed in crossdisciplinary work. It is fine to utilize and extend the interactional expertise present, but there is a need for separate resources to perform such second order learning processes in scientific practice. Concretely, this could mean that a separate work package with its own money and human resources is included as part of large crossdisciplinary projects, with the aim to establish a reflexive, polyocular communication based on observations of the disciplinary perspectives, their cognitive context and their results.

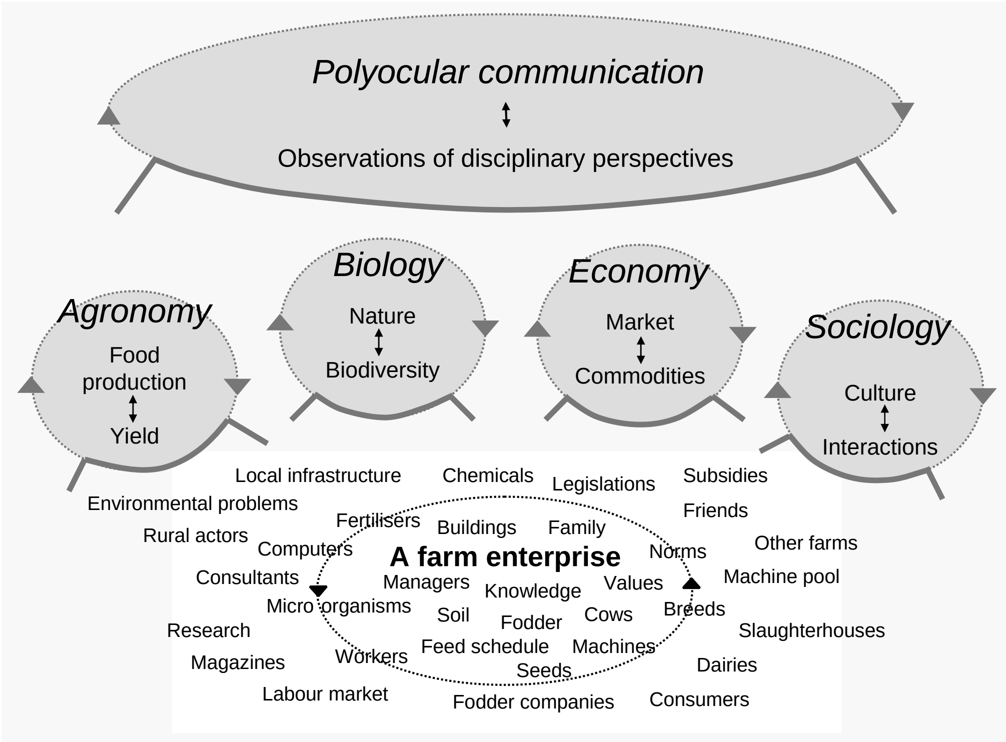

Figure 1. An example of polyocular communication based on second order observations of specialized disciplinary perspectives on a farm enterprise (Modified from Noe et al. 2008).

Broadening the scope, we think there is a need for such second order observations, polyocular learning processes and reflexive expertise not only to handle the problems of practical crossdisciplinary research, but also wherever science is used in society and in particular when different specialized scientific perspectives are used in connection with stakeholder involvement to address a complex problem field and development process.

The case of biomass for energy

Biomass for energy production is an example of a problem field where research needs to involve not only a range of scientific perspectives but also a range of different stakeholders in order to assist the development processes in a fruitful way.

Biomass for energy is essentially multifunctional (e.g. Berndes and Börjesson 2007). It is the coupling of many different considerations and functions that makes the use of biomass for energy production a good idea, e.g.:

- Greenhouse gas reduction
- Renewable energy production
- Environmental targets
- Nature quality and biodiversity
- Landscape and qualities of experience and recreation
- Economic activity and job creation

For a range of these considerations and functions bioenergy production can have both a positive and a negative effect. For example, biomass for energy may be a more environmentally friendly production, it reduces the need for fossil fuel and helps reduce greenhouse gases, and it may help establish new jobs and economic activity in the rural areas. But it may also promote monoculture production, threaten nature areas and biodiversity, impoverish landscapes, supplant food production and displace it to other areas where it may have additional adverse effects. Biomass for energy production thus has a host of built-in potentials, but it is not necessarily all good.

Development and dissemination of bioenergy production requires the involvement of a range of scientific disciplines including biology, agronomy, engineering and social sciences.

However, due to the multifunctional nature of biomass for energy, the development and dissemination of the production must be investigated in the context of the areas where it takes place and the conditions that apply there. In a certain area, the potentials and problems of biomass for energy will be connected to the specific conditions for the production provided by the natural, technological, socioeconomic and cultural conditions, as well as to the different interests and functions that are present in that area, such as groundwater protection, recreation, business opportunities etc.

The development and dissemination of biomass for energy therefore requires the involvement of a long range of stakeholders including farmers, residents, artisans, entrepreneurs, consultants, investors, authorities, NGOs, etc. The question that we ask here is how this heterogeneous group of stakeholders can be involved in the multiperspectival research in biomass for energy in a fruitful way that will assist the development processes.

The concrete case where this question is to be pursued is the EU FP7 project "Biomass Mobilisation" (BioMob) that seeks to mobilise biomass resources for regional development. The overall concept of the project is the development of research-driven clusters for biomass-mobilisation to support the sustainable use of biomass. At a time of intense demand for renewable energy, real possibilities exist for the transformation of regional economies through the commercialisation of applied research in the mobilisation of biomass. The challenge is to identify appropriate biomass synergies between regions, research themes and enterprise opportunity.

Discussion of stakeholder involvement in multiperspectival science

The purpose of science, and in particular applied or problem-oriented science, is often thought to be problem solving (e.g. Laudan 1981). However, in highly complex problem fields and development processes, such as the biomass for energy case, the problem is not given or easily determined. Before any problem-solving can be done, there must be a process of problem-making or problem-forming.

Our basic thesis in this paper is that the intervention of science into a complex problem field like biomass for energy should start not from processes of consensus and integration, but from increased awareness of the heterogeneity of the problem field. Evidently, stakeholders play a key role in determining what is problematic, but in highly complex cases the process of problem forming cannot take place without the use of science. *The key characteristic of complexity, in the sense used here, is that it is necessary to use a number of different perspectives to observe it*. And a problem, an immediate problem as it is perceived and represented, belong to a certain perspective.

Problem forming in a complex problemfield therefore has to be in essence pluralist and perspectivist and therefore both crossdisciplinary and participatory. The different perspectives involved should be exposed and coordinated through a dynamic process of polyocular observation and communication; a second order process that can support multidimensional problem forming and multidimensional understanding as a basis for research and stakeholder cooperation throughout the intervention process.

In the biomass for energy case, the purpose of involving all the different stakeholders in the research and development process is therefore not that they are to reach a consensus on the problems and goals to pursue, but that they are to take part in a dynamic and multidimensional research and development process. The farmer does not have to share a concern for the environment or for climate change in order to play an active role in the development of biomass for energy production, as long as this production can be brought into agreement with the production values and other values that characterize the farm enterprise.

As a tool to stakeholder involvement in multiperspectival science (such as the biomass for energy case), we propose that it would be helpful to undertake a closer analysis of the three different kinds of perspectives involved: stakeholder interest, societal function and scientific observation, and how they may be coupled with or decoupled from each other. For instance, the differentiation of scientific perspectives may be coupled with certain interests and functions, but the scientific perspective may also be decoupled later and continue as an independently reproduced perspective (discipline or school).

We agree with the common conception that the key challenge of transdisciplinarity is that it requires adequate addressing of the complexity of problem fields and the diversity of perspectives involved. But the perspectivist approach that we promote here is different from other approaches to transdisciplinary research that focus on integration as a means to meet this methodological challenge (Pohl and Hirsch Hadorn 2008; Pohl et al. 2008).

There are different possible forms of integration, but we claim that a genuine reintegration of the differentiated scientific perspectives is, in general, neither possible nor desirable (Alrøe and Noe 2010). It is not that disciplinary integration proper is not possible. In some cases different disciplines have been integrated to address specific types of complex problems and development processes, but only to form new, specialised disciplines (e.g. biotech, IT, nanotech). Since such integration proper requires considerable effort and leads to a new disciplinary closure that observes and deals with a certain type of problems, and which cannot be applied to other problem fields, it does not provide a general solution for how to do transdisciplinary work on complex problems.

Shared, integrating frameworks in form of different systems approaches have also been developed to provide general tools to create an integrated understanding of complex problems, and Pohl and Hirsch Hadorn (2008) consider systems thinking a contribution to the transdisciplinary challenge of integration. But the choice of systems framework is not innocent – each system theory has its own perspective on complexity that observes certain types of problems, and the different system theories will leave different imprints on the answers gained.

Pohl et al. (2008) consider integration of the diverse scientific and societal views of the problems to be a core task of transdisciplinary research. The frame for integration is the transdisciplinary research team, where integration may take place as a learning process of the whole group, as an exchange among the experts or undertaken by a specific sub-group or individual. "In transdisciplinary research, scientific disciplines (represented by individual researchers) and sectors of the life-world (represented by individual actors) are getting interrelated and transformed through a problem field" (Pohl and Hirsch Hadorn 2008:113). But we don't believe disciplines are generally getting transformed by the activities of transdisciplinary research teams - the self-reproducing mechanisms of scientific disciplines are far too strong. Nor do we believe they should be.

Disciplinary transformation may indeed happen to some degree; disciplines do evolve and undergo differentiation and integration in some cases. But in general, scientific disciplines and 'schools of thought' are instruments of observation that are fine-tuned to provide a certain perspective on the world. The functional differentiation of science and the connected disciplinary specialisation and sophistication is the basis for the strength of science in technological development and problem solving. The question is what status and function the integration of local transdisciplinary research teams can have in the larger framework of science.

However, the strength of disciplines and schools brings with it the weakness of a narrow focus, and the specialised disciplines are surely insufficient means to handle systemic problems and complex problem fields and development processes. We just don't think integration proper of disciplines and schools is a generally possible or desirable solution.

We suggest (1) that this key conundrum of transdisciplinary science can only be solved through the use of second order observations, which observe how the different specialised perspectives observe the complex problem field, and polyocular communication processes on these contextual observations; (2) that such transdisciplinary processes do not depend on, and only to a limited degree lead to disciplinary integration proper; (3) that stakeholder involvement in such multiperspectival science cannot be considered independently of the scientific perspectives since problem forming in complex problem fields cannot take place without the powers of scientific observation; and (4) that a closer analysis of the relations between stakeholder interests, societal functions and scientific perspectives could prove helpful in this regard.

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