

# Limitations to Interdisciplinarity in Problem Oriented Social Science Research<sup>1</sup>

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**Abstract:** *This paper describes and evaluates the feasibility of, and limitations to, the interdisciplinarity of two comparative international, multidisciplinary, problem and policy oriented social science research projects. These projects, entitled „Alternative uses for land and the new farm worker: segregation versus integration“ (1985 – 1987) and „Successful environmental management in European companies“ (1992 –1995), involving 6-7 person years, were carried out for the EU Commission.*

*After conceptually clarifying some key theoretical terms, the empirical analysis investigates both projects with respect to their degree of interdisciplinarity. The analysis concerns the integration of natural and social sciences, their resulting interpretative, conceptual framework, and the theoretical basis of their policy recommendations.*

*It is found that although the projects clearly acknowledged the multidimensional (and multidisciplinary) character of research which involved questions and problems relating to both nature and society, neither project strove to become, nor achieved true interdisciplinarity in terms of frames of reference. Furthermore, neither project developed dynamic interactive conceptual models which could be used to provide an adequate explanation of successful environmental management, as was the original intention.*

**Key Words:** Disciplinarity, interdisciplinarity, multidisciplinary, problem oriented research, sustainability.

## 1. Introduction

Clear concepts are a necessity when trying to find viable solutions to the problems that arise with interdisciplinarity in problem oriented research relating to sustainability. Key terms would include: science, problem oriented research, interdisciplinarity, sustainability. However, this paper does not attempt to elucidate them and their corresponding theoretical frameworks, or discuss the relevant debates within the philosophy of science, sociology of science, and policy analysis.<sup>2</sup> Instead, an analytical framework which takes into account crucial insights of social studies of science is presented. Then the paper describes the empirical pathway concerning how questions of interdisciplinarity have been actually addressed in two international comparative, multidisciplinary, problem, and policy oriented social science re-

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<sup>1</sup> This is a revised Version of a paper presented at the First European Dialogue Conference on Science for a Sustainable Society - Integrating Natural and Social Sciences, Roskilde University, 1997.

<sup>2</sup> As a consequence, only a small amount of literature is referred to.

search projects.<sup>3</sup> Finally, conclusions concerning the limitations of the interdisciplinary research concepts and design in (sustainability oriented) research projects are drawn, without answering, in substance, the question of how to actually realize truly interdisciplinary research projects.

## 2. Analytical framework

A differentiated perspective of the basic, underlying, key concepts is needed in order to arrive at an appropriate and clear idea of the viability of interdisciplinarity in problem oriented research.

### 2.1 Science as a social system

Modern science can be seen as a social system which is a differentiated primary societal subsystem with a functionally specified orientation to search for generalized truths, is differentiated internally with respect to disciplines and themes, provides specific outputs for the rest of modern society, which can be conceived of as being divided into subsystems in which specific social norms and ways of communication dominate, - and in which people work professionally as scientists.

As a system, science has its own boundaries and relative autonomy with a partial decoupling of internal and external driving mechanisms. The necessity to do research internally, following scientific methods, to use and to refer to existing scientific theories and to observe applicability, gives science *external* freedom and autonomy, and results in *internal* restrictions (cf. Luhmann 1977, 1990).

Science presupposes super-paradigmatic structures (e.g. nature shows regularities), and science is relieved of action (difference between theory and practice).

The importance of science can be assumed to increase as long as development trends of functional differentiation, generalization, specialization, rationalization, and increase of complexity dominate and grow in modern societies. However, the scientification of society also necessarily implies an inherent reciprocal tendency of socialization („Vergesellschaftung“) of science which orients its own regulative problems, knowledge and theory production, organizational structures and so on increasingly towards social, mainly ruling interests. As an agent of change, science becomes deeply immersed in the dynamics of society. This will change science. However, it will not dissolve the boundaries that differentiate science from politics or the economy.

Once science becomes embedded in the process of innovation, it becomes intimately linked to the non-scientific institutions of political choice, of economic calculus, of legal and moral assessment. However, this does not render science a mixture of all rationalities. Quite the contrary, the more science is submitted to economic and political criteria, the more

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<sup>3</sup> Two further multidisciplinary and partly internationally comparative problem oriented projects, namely on „Technological risks and social conflicts. Political risk strategies in the field of nuclear energy“ (Conrad/Krebsbach-Gnath 1980) and on „Ecologicalization of agricultural policy. The case of nitrate pollution“ (Conrad 1990, 1992), carried out in 1976 to 81 and in 1982 to 91 which were headed by me, too, have not been included in this analysis because - in spite of similar characteristics - the first one is already more than 20 years old and lacks international comparison, though the truly most multidisciplinary, but not interdisciplinary project among the four listed, and the second one was mainly an international comparative policy analysis, supplemented by economic, sociological and natural science aspects mainly undertaken by myself.

likely it is that scientists will be confined to the functional role associated with research competence (Krohn/van den Daele 1998).

## 2.2 Disciplinary and problem oriented research

*Disciplinary research* can be characterized as following the guidelines of the cognitive theoretical core of a discipline, deciding what questions make sense, what kind of problems can arise and can be solved, what methods of investigation are available, and implying the orientation of research according to *theoretically* interesting problems. The dominance of the disciplinary perspective in (academic) research is institutionalized both at the cognitive and the social level. Substantial interdisciplinary *theory* does not exist.

The advantages of differentiation and specialization in productivity and efficiency can only be utilized when the different areas are, at least somehow, integrated again. Practical (social) problems rarely are in accordance with disciplinary boundaries. Therefore scientific knowledge, if superior at all, has to be taken from different fields and combined. So open questions have to be investigated in a problem oriented manner, when external, non-theoretical purposes tend to dominate. *Problem oriented research*, as opposed to basic research, is less interested in gaining new general scientific findings, but more concerned with the utilization of general knowledge for practical (social) problems which are not structured according to disciplinary categories and delimitations. This implies inherent uncertainties and the necessity of (problem oriented) interlinkage of disciplinary knowledge. Problem oriented research differs from applied research. The latter is oriented towards the specification and application of available scientific knowledge (analytical models, conceptual schemes, techniques, instruments) for relatively clearly specified purposes. In contrast problem oriented research must, in principle, deal with uncertainties related to prognosis, complexity and contingency in order to legitimize decisions which have no certain foundations, but typically cannot wait until basic questions of a scientific field have been solved.

The central problem of problem oriented science is to find the right balance between sufficient theoretical orientation and sufficient problem concern. On the one hand, problem oriented research often lacks an appropriate theoretical framework, maturity, effectiveness, persistency, consensus concerning concepts and methods.<sup>4</sup> On the other hand, theoretical orientation, which (in principle at least) is also technically superior in the longer run, may again reduce problem orientation to questions of a newly developed disciplinary matrix.

In particular, problem oriented research, addressing questions of sustainability<sup>5</sup>, implies an (explicit) normative orientation in addition to the orientations which relate to its focus on a (social) problem. Formally, however, this makes no difference compared with other problem oriented research with its (implicit) normative objectives. So, the aim of science for a sustainable society implies, for the corresponding research, specific substantive orientations. However, in principle, there is no difference to the formal characteristics of finalized science in general (cf. Böhme et al. 1978).

*Multidisciplinary* problem oriented research (projects) are characterized by the (creative) selection and combination of different scientific theories and disciplines in order to produce

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<sup>4</sup>Therefore „when an immature field takes on the task of expanding its research effort for the solution of some urgent practical problem, there will be a tendency for the outcome of its labours to be a weighty argument establishing the conclusions that its sponsors and its public wanted all long.“ (Ravetz 1971:399)

<sup>5</sup>For the unavoidable vagueness of and the possibility to operationalize the concept of sustainable development as a social *leitmotiv* see Conrad 1993, 1997, 2000, Lélé 1991.

a reasonable understanding, and to deal with (technically), or even solve, a (social) problem. In this kind of research, the individual disciplinary and theory-specific contributions work harmoniously together in a common conceptual model without renouncing their independent treatment of specific (disciplinary) problems with the help of their genuine methods and instruments. These efforts may also lead to a new cognitively demarcated scientific specialty, but hardly to a (new) general, and thus truly *interdisciplinary theory*. Significantly, corresponding (complex) dynamic models representing the interaction of the various relevant influencing factors within a uniform theory are frequently postulated as an appropriate scientific requirement, but such models are hardly ever developed in practice. So a problem oriented common conceptual framework appears quite possible, which would lead to a rather far reaching formal combination and integration of different relevant scientific perspectives and concepts. Complex differentiated (multidimensional and multilevel) explanations of social processes (paying due attention to understanding the specific characteristics of individual social phenomena) imply that the regularities and causal connections explaining a specific case may well differ from case to case. As a consequence, the understanding and explanation of certain social facts and processes will tend to be a unique combination of various explanatory modules which may well claim general validity but need not play a significant role in many cases (cf. Mayntz 1996). Due to the usually case-specific interaction of influencing variables, substantive generalized and thus theoretical models of underlying interaction dynamics are therefore hardly feasible. This tendency is also further emphasized by the importance of hermeneutic understanding and reconstruction when investigating human action always determined by (subjective) meaning and intention. Thus, one should usually not expect generalized theory building in problem oriented research.

### 2.3 Interdisciplinarity

Interdisciplinarity may well be considered a valuable ideal of integrating (theoretical) concepts and methods in a common framework, but rarely a realistic aim in terms of developing a new common theory. Perhaps a common new context is all that can be hoped for. Typically, this would be at the level of system building within an integrated (and reflexive) theory.

In this paper, interdisciplinarity is conceived as necessarily including the cognitive level of common theory building which is contributed to by different scientific disciplines. This differs from the frequently imprecise debate, where any collaboration of scientists from different disciplines is seen as interdisciplinary research. Without at least serious attempts at research in this direction, one should only speak of multidisciplinary collaboration, but not of interdisciplinarity. Even the use of common methods in a multidisciplinary research project is not sufficient to guarantee interdisciplinarity.<sup>6</sup>

Certainly, the well-founded theoretical, methodological and organizational reasons for multidisciplinary scientific cooperation also apply to interdisciplinary research. They require mutual social acceptance and the capacity of collaborating scientists to communicate. Furthermore, they require the analytical and possibly theoretical links between different scientific disciplines; common problem definitions, conceptual frameworks and methodical standards; and organizational preconditions allowing for a suitable working basis. The latter would include sufficient resources, information exchange, enough time, dispassionate cost-benefit analysis, adequate composition of the research group (see Bechmann et al. 1996, Bowden 1999, Gräfrath et al. 1991, Kaufmann 1987, Kocka 1987, Parthey/Schreiber 1983).

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<sup>6</sup> Similarly, Leroy (1997:7) summarizes in his broader terms of interdisciplinarity: „Interdisciplinarity so far seems primarily a question of the transfer and integration of methods, rather than the forging of substantive theories.“

<sup>7</sup> A more recent example may be detected in the corresponding joint efforts of the various neurosciences.

If one distinguishes the social and cognitive levels of *common* organization, attitude, problem definition, methodology, and theory building in scientific cooperation, one may reasonably conclude that genuine interdisciplinarity only occurs if all these criteria are satisfied, which can rarely be expected to happen.<sup>7</sup> In addition, on the cognitive plane of a common conceptual framework, one has to distinguish between different levels, namely the formal (meta-)level of shared basic assumptions and orientations, the level of a common analytical framework for the problem area under investigation, the level of agreed upon methodology, and the level of theory integration. Of all these levels, only the level of, at least partial, joint theory formation is considered as truly interdisciplinary in this paper.

One may well question the usefulness of attempts to develop truly interdisciplinary theory, as problem oriented research is a main feature of scientific research today, apart from disciplinary research. One may also question it because a grand (super) theory, –(beyond, for example, a unified theory of different types of interaction in physics) can hardly be expected for reasons indicated above. For most practical purposes, well organized multidisciplinary projects which share a common problem definition, a common analytical model and a common case-specific focus<sup>8</sup> appear to be sufficient. That such multidisciplinary projects still are hardly actual practice demonstrates the considerable efforts already necessary in this latter respect, whereas interdisciplinary theory building may well remain a valuable background ideal, at best.

Since problem oriented research is almost by definition not oriented towards theory building, it can hardly involve interdisciplinarity. Thus, corresponding empirical analysis of problem oriented research should evaluate how far it satisfied the various criteria of competent multidisciplinary scientific cooperation indicated above but not its genuine interdisciplinarity.

## 2.4 Integrating natural and social sciences?

The attempt to even integrate *natural* and *social* sciences in problem oriented research turns out to be even more difficult than to connect, conceptually, different disciplines within the natural sciences or within the social sciences. This is partly due to the parallelism of the two central traditions of (quantitative) analytical explanation, and (qualitative) hermeneutic understanding in the social sciences (cf. Kieser 1993), leaving aside common issues such as critical data analysis, comparability of data, representative selection of samples and cases, etc.

Analytical explanation and hermeneutic understanding are not mutually exclusive but complementary, since analytical explanations always contain elements of understanding, and since quantitative representative studies indicate regularities in behaviour and structure pointing to potentially typical patterns of action, and the corresponding underlying intentions. In the actual practice of social science research, the dispute about explanation and understanding does not play an important role, and the partial compatibility of the two approaches is acknowledged and employed.

So, formally, there are no reasons, in principle, to combine natural and social science concepts in a common theoretical framework. However, integration, in substantial theoretical terms, remains particularly difficult due to the hermeneutic dimension of the social sciences.

Thus, in multidisciplinary (problem oriented) research projects natural science based knowledge typically plays the role of (physical) boundary conditions to be taken into account in social science investigations and theories, and social science based knowledge is taken to specify boundary conditions of natural (physical) processes investigated by natural sciences. There exist no unequivocal, but only socially variable relations, between non-social (physical)

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<sup>8</sup> This allows a common language and common interpretations of positions of the actors involved.

<sup>9</sup> Human ecology with its corresponding methodological debates and quite limited theoretically satisfying results provides a significant example in this respect.

configurations, though these may well be socially moulded, too, and social constellations. Whereas one may well use models and methods of one discipline in others (cf. Mayntz 1991), joint (interdisciplinary) theories trying to integrate both natural science and social science findings in a common theoretical frame (and not only in a problem oriented analytical framework) are hardly to be expected except at a very abstract and formal level.<sup>9</sup>

### **3. Description of the projects**

After this clarification of crucial analytical concepts and related conclusions, the following sections describe the set-up, objectives, and results of the two research projects under consideration in this paper.

#### **3.1 The project „Alternative uses for land and the new farmworker“**

The study „Alternative uses for land and the new farmworker: segregation versus integration“ (Conrad 1987) was, as part of the FAST-programme, largely funded by the EU-Commission and, in addition, by the German ministry for research and technology. The study was carried out in 1985 to 86 and benefited considerably from neighbouring, more techno-economically oriented studies within the EU FAST-programme. These provided relevant data on technical, geographical, and economic boundary conditions.

The purposes of the study were fourfold, namely to analyse the socio-economic and political circumstances and conditions that may lead to major changes in land use in the EU countries, to develop some scenarios for land use change, to study the consequences for the farmer, and to derive policy options and recommendations for the EU-Commission.

Since the study was oriented towards policy analysis, it focused on the policies and politics that might determine the future patterns of land use and farm work. Therefore, the debate and the conflict surrounding various forms of land use were seen as policy games in which a number of actors will pursue their vested interests in one or more policy arenas. The analysis took into account the existing power relations, institutional arrangements, and the goals and strategies of other actors. Technical and economic determinants taken from the results of other investigations were treated as boundary conditions in this study. Furthermore, the focus of the study on the analysis of patterns of, and changes in, land use in rural areas necessarily implied certain limitations for policy conclusions.

According to the aims of the investigation, the primary subjects of analysis were:

- the present state of, and future trends in, food production and forestry as major land-use activities;
- the inventory and assessment of non-food related land uses such as energy, fibres, or chemicals production from biomass, or the allocation of land for recreational amenities, tourism, or conservation;
- the present state of, and probable future trends in, farm work;
- the socio-economic and political conditions and forces underlying changes in land use and farm work;
- the policy options with respect to new forms of farm work and alternative uses for land.

Since the results of this analysis may vary for different countries or regions, these subjects were investigated not only at the EU level, but also at the macro-regional level in the four geographic areas selected, namely, England and Wales, the Federal Republic of Germany, southern France, and northern Italy. These regions cover a considerable range of agricultural structures and differ in their regulatory frameworks, their policy styles, their economic positions within the EU, and in their approaches to alternative land use.

Table 1: Prospects for different land-use options

Indicators	Land used for:					
	Increased food export	Import substitution of animal feedstock	Increased forestry	Bio fuels	Biomass for chemicals	Nature protection
Prevention of land degradation	neutral?	neutral? limited	yes, limited	neutral?	neutral?	yes
, Technical' maturity	available	availability	availability	low	differently	moderate
Competitiveness with non-biomass substitutes	—	—	mostly, if they exist	no	rarely	—
Competitiveness with other agrarian products	hardly, because of missing markets	limited	very limited	no	limited	no (if competing demands for land use)
Competitiveness with imports/ other countries	rarely	differently, limited	medium	low	limited	—
Economic viability	low	medium	medium	no	differently	low
Constituency, vested interests	strong	moderate	moderate	considerable	considerable	low
Degree of organisation and institutionalisation of Interest in	high	low	medium	considerable	medium	limited
Public pressure in favour of	high indirectly in disfavour (against subsidies) factual acceptance,	weak	weak	more in disfavour	missing	differently among countries
Political acceptability of subsidies	expansion doubtful	limited availability	limited availability	limited availability	hardly	exists
Internal conflict potential <sup>a</sup>	low	considerable	moderate	low	low	partly high
External conflict potential, <sup>b</sup>						considerable
Strong competing interests	high	high	low	exists	exists	(tourism)
Possibility for interest coupling <sup>c</sup>	limited	exists	exists	exists	limited	limited
Political viability	medium	medium	yes	medium	medium	medium
Compatibility with socio-structural development trends	partly more no	relatively neutral	yes	more no	relatively neutral	yes
Prospects <sup>d</sup>	—	0	+	—	0	0

Notes:

- <sup>a</sup> e.g., rich against poor farmers, farmers against the food industry, regional/national conflicts of interest between different branches of agriculture production (cereal production *versus* milk production).
- <sup>b</sup> e.g., agriculture *versus* other industries; EC countries *versus* the United States.
- <sup>c</sup> i.e., increased viability through coalition building between parallel-oriented substantial or formal interests.
- <sup>d</sup> overall assessment, taking into account increased land use on a larger-scale. +: positive, 0: neutral/ambiguous, and — : negative prospects

The analysis was not sufficiently concise for comparative testing of specific public policy theories. Rather, the study provided a problem-oriented, descriptive analysis that points to some general features of land use and farm work under given political, economic, and social conditions.

Formally, the study consisted of a thorough problem analysis, an impact analysis, a presentation of scenarios, and a policy analysis. Essential sources of information included statistical materials, bibliographical data, and interviews conducted with knowledgeable persons and experts. Since the investigation was mainly carried out at the macro-level, detailed local conditions and specifications were hardly taken into account. Nevertheless, a few in-depth analyses of specific subjects were conducted. For purposes of clarity, the analysis was divided into two parts: an evaluation of the rigor and validity of lines of argument concerning alternative uses for land, and an analysis of vested interests and structural rigidities related to policy and politics concerning agriculture and land use. In a nutshell, the conclusions of the project strongly support attempts to shift the focus of EU policy from agriculture to regional and environmental policy. Table 1 provides an overview of the main results of the study.

As the investigation progressed, its emphasis and orientation shifted several times, as described in Conrad 1987.

### **3.2 The project „Environmental management in European companies“**

The study „Environmental management in European companies: success stories and evaluation“ (Conrad 1998a) was carried out from 1992 to 95 and was mostly funded by the EU Commission within its research programme on environmental policy instruments.

The study investigated exemplary cases of successful environmental management in West European companies with the aim of discovering the reasons and dynamics underlying them, and the role environmental policy did and could play. On the one hand, nine empirical case studies concerned various Danish, Dutch, German and Swiss companies of different sizes and from different industrial branches within the social context of relatively advanced western industrialized countries. On the other hand, six case studies traced environmental improvements in Polish and Latvian companies under quite different socio-political conditions of eastern European societies in transition.

The case studies describe the social processes leading to substantive environmental achievements and corresponding environmental management systems. They point out the variety of specific formal, organizational, economic and political mechanisms which may lead to such improvements. They also show the interaction among in-house and external determinants, and the general (necessary) characteristics of these development processes, as far as they can be deduced from these and similar case studies. The case studies were carried out in 1993/94 on the basis of a common analytical framework with the help of extensive interviews with the main actors involved in the respective success story and of related documents and literature.

In the comparative evaluation of the nine western European case studies, which point out typical as well as varying actors and structures behind the success stories investigated, an analytical framework connecting five different perspectives was utilized to trace the interaction dynamics leading to successful environmental management. These are an extended two-dimensional model of the sociosphere, a set of various classes of environmental management determinants, Porter's (1985) five different competitive forces determining industry competition, analytically distinct primary (performative) and secondary (supportive) environmental management activities/fields of a company, and an ecological stress matrix indicating different environmental impacts of the whole cradle-to-grave value chain.

Altogether, in spite of quite interesting characteristics of the case-specific success stories,



Table 2: *Main features of companies studies*

Company	Amecke Fruchtsaft	Diessner	ABC Coating	Glasuld	Hertie	Kunert	NedCar	GEP Europe	Ciba
<b>Feature</b>									
<b>type of evaluative analysis</b>	outcome	outcome	outcome	process	process	process	institutional	institutional	institutional
<b>company size</b>	medium	medium	medium	medium	large	medium/large	medium/large	medium/large	large
<b>turnover/year (Mio DM)</b>	30		5	90	6000	700	1700	2000	26500
<b>independent company</b>	(yes)	yes	no	no	(yes)	yes	no	no	yes
<b>industry branche</b>	beverage	chemistry	surface refinment	construction material	retail trade	textile	automobile	chemistry	chemistry
<b>environmental management strategy existent</b>	no	(no)	no	in progress	in progress	in progress	partly	yes	yes
<b>internally/externally determined mind project</b>	cooperative	internal	cooperative	cooperativ	cooperative	internal and consultancy	cooperative	mainly internal	mainly internal
<b>favourable economics</b>	yes	yes and no	yes	yes	yes and no	yes	yes and no	yes	yes and no
<b>public environmental policy significant</b>	no	partly	yes	yes	partly	no	hardly	partly	partly
<b>diffusion of environmental improvements</b>	yes	no	small	yes	partly	no	small	small	small
<b>controversy important</b>	no	no	in the beginning	in the beginning	partly	partly	no	in the beginning	hardly
<b>many actors involved</b>	no	no	yes	yes	no	no	no	medium	medium

the case studies show features of successful, innovative environmental management which are to be expected by those familiar with investigations and theories of innovation, organization, political economics, and environmental management. Table 2 provides an overview of the main results of the western European case studies.

Environmental policy recommendations are essentially concerned with providing adequate framework conditions that facilitate rather than hinder corporate environmental management.

Altogether, actual project performance only partly accorded with the project design and procedures, as described in Conrad 1998a.

#### **4. Project evaluation concerning interdisciplinarity**

In the following the degree and pattern of conceptual integration achieved in both research projects is summarized in various respects.

##### **4.1 Procedural process selecting the conceptual approach**

Despite being two quite different projects they nevertheless exhibit rather similar features concerning the question of interdisciplinarity in problem oriented research, and can thus be largely dealt with on a common basis.

Apart from the provisions made in the project proposals of meeting the requirements of an EU research programme within which they have been funded, the relatively detailed project design and concept were essentially elaborated by the project leader. These were discussed and agreed upon by all participating researchers in joint project meetings during the first months of the projects. Whereas the other participating researchers/(national) research teams followed the overall (formal) project design, they typically pursued their own (varying) conceptual ideas, too, which partly differed from those (theoretically more ambitious) ones of the project leader. Consequently, the further elaborated and partly modified, definite conceptual approach was finally developed by the project leader when writing the final report, which was then circulated for critical comments and discussion.

To achieve a common detailed theoretical-analytical framework which was shared by all project participants obviously would have required much more time for debate and reflection than was actually available.

The conceptual approach in both research projects has the following common characteristics: analytically clear project design; presentation of underlying (basic) assumptions; pointing out the study's methodology as well as its limitations and those of its policy recommendations; contextual embedding of the study (agricultural (policy) structures and development/evolution of environmental policy and environmental management; results of neighbouring research projects); presentation of the main analytical reasoning and/or analytical framework; carrying out empirical (in-depth) case studies; discussion of various (disciplinary) arguments and concepts considered relevant for the project topics; discussion of future development trends/scenarios; policy-analysis oriented investigation of the research subject; presentation, elaboration and contextualization of policy recommendations.

##### **4.2 Degree of theoretical integration**

If one now asks about the degree of theoretical integration achieved by the conceptual approach of the projects, one may conclude the following:

1. Seen from the perspective of their underlying problem orientation (alternative uses for land/successful environmental management) the projects strove to attain a rather comprehensive investigation and discussion of relevant (physical, ecological, technical, economic, political, social and historical) dimensions and concepts.
2. The presentation of corresponding (analytical as well as empirical) reasoning is integrated via the conceptual design/perspective of the studies, but dealt with in a sequential order without the further theoretical integration of most arguments.
3. The explicit aim of the second project of developing a general (formal) pattern of interaction dynamics of company internal and external determinants of environmental management was not attained for two reasons: there was no serious attempt to develop such a dynamic model, nor could such a *general* pattern be discovered empirically by comparing the various case studies.
4. The five-dimensional analytical framework applied in the second project allowed for the placing and thus, to assess a company's specific environmental management activities, strategies and system in a broad, multidimensional setting. However, no attempt was made to integrate these analytical dimensions further into a uniform theoretical framework which would go beyond such a taxonomic assessment.
5. In accordance with the main purpose of problem oriented research, the projects explicitly neither attempted to pursue their analysis in terms of (one) specified theoretical concept/theory, nor tested specific theoretical hypotheses by corresponding project design. Therefore, the deeper goal of theory integration, which would indicate genuine interdisciplinarity, could be addressed even less.
6. The level of theoretical-methodological self-reflection and evaluation of the projects was relatively high compared to similar investigations. This allowed for the adequate embedding of project design and approach at a conceptual level, but not, at this stage, to integrate project results in a uniform theoretical context.
7. This is especially obvious for the policy recommendations made. On the basis of the project results, they can claim considerable plausibility (significance of EU regional policy/providing favourable boundary conditions for environmental management), but what cannot be derived as the only possible (stringent) conclusions to be followed anyway. And this is also clearly spelled out in the study reports despite supporting arguments and contextualization provided in favour of the policy recommendations made.

### **4.3 Disciplinary attributability of the research results**

Looking at the tables which partly summarize the project results, it seems reasonable to conclude that they largely consist of evaluative assessments concerning various aspects of different land-use options or company policies. These refer to different (disciplinary) questions/concepts and thus provide a taxonomy which possibly results in an overall assessment of the prospects of different land-use options or of corporate environmental management strategies.

These major project results, and, even more so, further results elaborated in more detail in the studies, are partly descriptive taxonomies with no need of disciplinary attribution, and partly can well be attributed to either disciplinary or specialty concepts (e.g. technical maturity, political acceptability of subsidies, favourable economics). So, the selection and listing of indicators and (summarizing) assessments can neither deny their disciplinary origin nor their problem orientation. They provide, however, hardly any integration in terms of substantive theory.

As already indicated above, the project results particularly refer to (theoretical) concepts in the disciplines of macro- and micro-economy, political science/policy analysis, political sociology, macro-sociology, and environmental sciences.

#### **4.4 Separation of natural and social sciences' perspectives?**

Both projects followed a conceptual approach in their problem orientation. Due to their emphasis on social science, the results and perspectives of natural science are treated as significant (physical/ecological) boundary conditions. These clearly restrict and influence the viability of different social strategies and design options (of land use or environmental management). As boundary conditions, however, natural sciences' perspectives enter the analysis as necessary, supplementary, knowledge which clearly has no theoretical interference with the social sciences' concepts which predominate in the studies.

When biofuel production has ecologically detrimental side-effects, this is an argument against this land-use option, but it is only a socially relevant one if this ecological fact gains normative importance in (environmental) policy (strategies).

When environmental management efforts - *ceteris paribus* - lead to energy savings, this is an argument in favour of these efforts, but usually only of social significance if these savings entail economic savings.

So, natural and social sciences' perspectives are clearly combined in problem oriented research (addressing sustainability questions), but are mostly separated in the substantive terms of scientific theory. This is in agreement with the methodological arguments presented above, which support the idea of relatively strict boundaries of, for instance, environmental sociology (Conrad 1998b).

#### **4.5 Feasibility of a common conceptual framework**

This question has to be answered in a differentiated manner.

First, one has to distinguish between the actual practice of the projects analysed, their potential feasibility, and the general feasibility of a common conceptual framework for problem oriented research. Second, these modes of assessment should refer to the above mentioned (section 2.3) different (theoretical) levels of a common conceptual framework (shared basic assumptions and orientations, common analytical framework, agreed-upon methodology, theory integration).

Concerning the level of shared basic assumptions, it seems reasonable to conclude that a common conceptual framework was not only feasible in principle but was also developed to a considerable degree in actual practice for both research projects. I see, in principle, no theoretical reason to deny the framework's general feasibility for problem oriented research, its actual elaboration being dependent on the time reserved for debating and implementing it within the research group.

A common analytical framework for the problem area under investigation may or may not be developed over time, both for (social) practical reasons, or for (cognitive) theoretical reasons. For the project on alternative uses for land one cannot yet speak of such a substantive framework having been developed, and for the project on successful environmental management it is, at best, of only a rudimentary form.

An overall methodology was agreed upon in both projects and was followed to a considerable degree.

The integration of theory, may occasionally be observed in problem oriented research, but this was not the case either in practice or in theory in the two projects investigated.

So a common conceptual framework and methodology is well feasible in (multidisciplinary) problem oriented research and was partly elaborated in both research projects. However, this objective may even not be intended and will not lead to truly interdisciplinary theory building.

#### 4.6 Interdisciplinary problem oriented research for sustainable development?

Sustainable (industrial) development was not a central issue of both research projects, although they discussed environmentally compatible modes of industrial production and of land use. Therefore, it is hard to derive any corresponding unequivocal conclusions from them. However, as far as *ecological* compatibility (and sustainability) are concerned, the projects do not indicate that this (normative) criterion imposes any additional *formal* restrictions/requirements on multidisciplinary problem oriented research.

In general, multidisciplinary problem oriented research concerning sustainable development appears to be a worthwhile and a viable goal. However, this attempt remains within the strong, genuine, limitations of truly interdisciplinary theory development addressed above, and the additional method(ological) limitations of operationalizing a general abstract-multidimensional societal ideal or leitmotiv such as sustainable development (Conrad 1993, 1997). So one should probably expect less than more substantive interdisciplinary connotations in multidisciplinary problem oriented research which addresses sustainable development if we compare it to this type of research in other fields and for other purposes.

### 5. Conclusions

This final section summarizes the analysis of the viability of interdisciplinarity in problem oriented research by indicating some conclusions, applying the analytical categories denominated and described in section 2 above.

1. In a practical, though not in a formal sense, posing and (empirically) analysing questions of the viability of interdisciplinarity and theory integration in (problem oriented) research presupposes science to be a (functionally differentiated) social system within (modern) society because of its specified orientation to search for generalized truths.<sup>10</sup>
2. A problem oriented common conceptual framework appears quite possible leading to rather far reaching formal combination and integration of different relevant scientific perspectives and concepts. However, one should usually not expect generalized theory building in problem oriented research.
3. Sufficient time, which is usually lacking, should be provided to acquire and to utilize a common conceptual (theoretical) framework in multidisciplinary problem oriented research. This is because a project team's substantial (i.e. emotional) internalization, and the subsequent implementation/utilization of such a (newly developed) conceptual framework is undoubtedly a time-consuming process which requires repeated feed-back loops of (social) learning.
4. Apart from basic disciplinary premises, problem oriented research will mainly combine theoretical concepts from different scientific specialties or research areas (e.g. innovation theory, organizational learning, theory of policy games, theory of economic structural change in the social sciences), and not from scientific disciplines in general. This combination of theory modules in a problem oriented, common conceptual framework will tend to involve diverse scientific disciplines. Although theory modules from different disciplines may tend to be less compatible than those from just one or from two neighbouring disciplines, in the last resort the theoretical-analytical viability of these combinations will be determined by the mutual 'fit' of the theory modules selected, and less of the underlying disciplines.
5. As far as concerns the overall conceptual framework and not special scientific aspects within problem oriented research projects, the main level of scientific explanation is (qualitative) description and assessment on the basis of appropriate taxonomies. Since substantive technology development as well as policy recommendations assume the

- feasibility of intentional (strategic) intervention, problem oriented research projects require at least some functional explanation and concept of systems control, as can be found in the projects investigated in this paper. Frequently, one will also observe elements of causal explanation and construction in most problem oriented research projects though rarely in a comprehensive integrated manner. Beyond abstract formal schemes integrated (reflexive) theories and system building, including dynamic interaction models of the problem area can be seldom found in (multidisciplinary) problem oriented research.
6. Finding the right balance between sufficient theoretical orientation and sufficient problem-concern in problem oriented research usually requires practical solutions specific to each case so that substantive general statements concerning interdisciplinarity are hardly feasible in this respect. Furthermore, one has to bear in mind that the adequacy of the chosen combination and framework of specified theoretical models may well vary in principle and not only because of prevailing norms and interests underlying this choice, although it is by no means arbitrary.
  7. In the end, interdisciplinary theory development and problem oriented research typically remain separate activities, whereas multidisciplinary and problem oriented research usually go well together.

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