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Bias in peer review of organic farming grant applications

Jesper Rasmussen,[1] Vibeke Langer,[1] and Hugo Fjelsted Alrøe[2]
[1]*Department of Agricultural Sciences, The Royal Veterinary and Agricultural University, Copenhagen, Denmark;* [2]*Danish Research Center for Organic Food and Farming, Tjele, Denmark*

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Abstract. Peer reviews of 84 organic farming grant applications from Sweden were analyzed to determine whether the reviewers' affiliation to one of two types of agriculture (i.e., organic and conventional) influenced their reviews. Fifteen reviewers were divided into three groups: (1) scientists with experience in organic farming research; (2) scientists with no experience in organic farming research; and (3) users of organic farming research. The two groups of scientists assessed the societal relevance and scientific quality of the grant applications based on three criteria (i.e., presentation, methodology, qualifications), whereas the user group only assessed societal relevance. The analysis showed that the two groups of scientists provided very different reviews. Scientist reviewers with experience in organic farming research agreed more with the user group on research relevance than did scientist reviewers without such experience, and the assessment of relevance was closely correlated to the assessment of scientific quality within both scientific groups. As both scientific groups did not clearly distinguish between societal relevance and scientific quality, the idea of an objective science is challenged. The contextual values associated with the norms of good agriculture were not clearly distinguished from the constitutive values of science associated with the traditional norms of good science. This raises the question of whether organic and conventional grant applications should be mixed for review regardless of the reviewers.

Key words: Conventional agriculture, Objective science, Organic agriculture, Peer review process, Scientific paradigms, Scientific quality, Societal relevance, Sweden

Jesper Rasmussen *is an Associate Professor in the Department of Agricultural Sciences, The Royal Veterinary and Agricultural University, Denmark. He teaches organic farming, plant production, and physical weed control. His research interests include non-chemical weed management, soil tillage in organic farming systems, and the role of values in teaching and research.*

Vibeke Langer *is an Associate Professor in the Department of Agricultural Sciences, The Royal Veterinary and Agricultural University, Denmark. She teaches organic farming, farming systems, and pest management in organic agriculture. Her research interests include land use, production, and nature management on organic farms.*

Hugo Fjelsted Alrøe *is a Senior Scientist at the Danish Research Center for Organic Food and Farming (DARCOF). His research interests are in the philosophy of research and science, with a focus on systemic and transdisciplinary research, systems theory and the role of values in science, and ethics and value inquiry in relation to sustainability, precaution, sustainable agriculture, and organic farming. He also works with communication technologies as tools for research.*

Introduction

Organic and conventional agriculture are rooted in paradigms often referred to respectively as alternative and dominant. Depending on context, the dominant paradigm may also be called conventional or mainstream, but all of these terms refer to the same basic understanding (Beus and Dunlap, 1990; Christensen, 1998; Harding, 1998).

In the alternative paradigm, human beings are seen as an inseparable part of nature, which imposes intrinsic limits on our manipulative powers and creates an inherent tension between present economic growth and sustainability. The alternative paradigm is linked to a counter social movement critical of industrial modernism.

In the dominant paradigm, nature is seen as a resource for humans without intrinsic worth or limits to our manipulative powers. The limits, such as they are, are seen to stem from our current ignorance of natural processes. Continually increasing economic growth is considered to be necessary to provide the financial and technological resources needed to address problems of unsustainability. Within this context, the alternative paradigm is regarded as extreme and unnecessary.

The two paradigms represent different understandings of sustainability (Neumayer, 1999; Ayres et al., 2001), farming practices (Beus and Dunlap, 1990), and agricultural science (Perkins, 1982; Miller, 1985). Strong sustainability is linked to the alternative paradigm, while weak sustainability is linked to the dominant paradigm.

Paradigms are coherent frameworks of knowledge, values, and beliefs within which experiences are interpreted and made meaningful. Rationality is created within paradigmatic frameworks, which makes it difficult to resolve extra-paradigmatic disagreements. Neumayer (1999) investigated the paradigmatic characteristics of strong and weak sustainability and concluded that there exists no scientific answer to which of the two paradigms is "correct." Support for one or the other depends on basic values and beliefs.

Even if organic agriculture is closely linked to the alternative paradigm and conventional agriculture is linked to the dominant paradigm, individuals associated with one or the other may hold inconsistent or unexpected paradigmatic positions. Some organic farmers, for example, may hold even more conventional positions than conventional farmers (Beus and Dunlap, 1991), because pragmatism may uncouple ideals and actions, and farming methods may be adopted even though farmers do not share the philosophy behind them.

A number of papers deal with the relationship between farmers' paradigmatic attitudes and their actions (Beus and Dunlap, 1991; Egri, 1999), but it is unknown whether paradigmatic positions influence the core values of science, and thereby the peer review process, in the scientific community.

Research and teaching are both knowledge and learning systems (Alrøe, 2000), and alternative and dominant paradigms represent different positions with respect to knowledge and learning (Huckle and Sterling, 1996; Harding, 1998). In the dominant paradigm, objectivity and facts are opposed to subjectivity and values. The role of the scientist is assumed to be unbiased and impersonal, and progress is based on rationality and advancements in science and technology. The alternative paradigm recognizes limits to conventional science and stresses the necessity of integrating values and beliefs into the learning processes (Francis and King, 1997; Alrøe and Kristensen, 2002; Packham and Sriskandarajah, 2005). Personal involvement and bias are considered unavoidable, and paradigmatic transformations are considered necessary (Huckle and Sterling, 1996; Lieblein et al., 2000; Francis et al., 2001). Key elements in this transformation are changes from (1) objective to participatory approaches; (2) reductionistic to holistic approaches; (3) discipline-directed to problem-directed approaches; (4) universal principles to site-specific conditions; and (5) individual learning to interdisciplinary team learning.

Acknowledging these differing views on knowledge and learning can lead to the question of whether scientists holding different paradigmatic positions will evaluate scientific quality differently. This is an important question with respect to the peer review process of scientific manuscripts and grant applications.

This paper asks whether the evaluation of grant applications is influenced by the peer reviewer's affiliation to one of two very different types of agronomy (i.e., organic and conventional) and by the degree to which peer reviewers distinguish between scientific quality and societal relevance.

Materials and methods

In spring 2001, the Swedish government allocated 69 million Swedish crones (US$9.3 million) for research in organic agriculture and horticulture over the period 2001–2003. Funds were allocated by the Swedish Research Council for Environment, Agricultural Sciences, and Spatial Planning (FORMAS) to 23 projects in the following areas: the ecology of production systems (7 projects), plant nutrient cycling (6 projects), animal husbandry (3 projects), technique (1 project), economics (1 project), and miscellaneous (5 projects). Projects were chosen from over 100 grant applications. Two committees were appointed to evaluate the grant applications – a scientific committee and a user committee.

The scientific committee consisted of seven scientists from Denmark and three from Sweden. The Danish scientists were specifically chosen for this particular research program because of their experiences as leaders of research projects in organic farming. They were associated with the Danish Research Center for Organic Food and Farming Research (DARCOF), a "research center without walls" where research is performed in interdisciplinary collaboration with participating research groups. It was decided to use Danish scientists with qualifications within the research area of organic farming because the number of Swedish scientists in this area was limited and because it was feared that they would not be "objective" reviewers.

The three Swedish scientists, by contrast, were affiliated with FORMAS and had no formal experience with organic farming research. They were chosen because they were considered to be highly qualified scientists who held views on scientific quality and relevance that corresponded to those of the Swedish scientific establishment.

FORMAS decided to use these two complementary groups of scientists to ensure balance and broadness of perspective. Thus, two scientific groupings were recognized – scientists who had an affiliation with organic farming research (ORG+) and scientists without such an affiliation (ORG−).

A third group, the user group (USER), consisted of five people representing different organizations that had a clear affiliation with the organic farming sector (e.g., farmers, traders, and consumers). It was assumed that the user group would benefit from the research program.

The scientific committee used four criteria in the peer review process. Three of these criteria were meant to reflect scientific quality and one was meant to reflect the relevance regarding society and the organic sector. Each criterion was described in detail in written instructions given to all committee members before the peer review.

The scientific criteria were presentation (P), methodology (M), and qualifications (Q). "Presentation of the problem" referred to the scientific content, novelty value, and coherence between research objectives, hypotheses, and theoretical context. "Methodology" referred to the appropriateness of methods, time schedules, and costs. "Qualifications" referred to the likelihood that the applicant would be able to carry through the project and obtain the expected results.

The relevance criterion reflected the degree to which the project contributed to the development of organic agriculture and horticulture and to the society as a whole. Each criterion was graded on a six part marking scale, with "6" being highest or best and "1" being lowest or worst. The user committee assessed only the relevance of all grant applications whereas the scientific committee assessed all criteria. In the general description of the research program, it was stated that research should be multidisciplinary, there should be close links between theoretical and applied aspects, and participatory research was encouraged.

All grant applications that were reviewed by more than two reviewers were included in the analysis, resulting in a total of 84 applications. On average, five reviewers (a minimum of three and a maximum of seven) reviewed each grant application. The number was determined by how well the reviewer's scientific competence fit the content of the application. For each grant application the most competent expert was appointed as chairman. The funding decision was made through discussions among all reviewers. Funding, however, was not solely based on the reviews. It was a precondition that a specific number of research topics should be covered, which meant that the number of projects within each topic was restricted. Therefore, the competition for funding was influenced by the number and quality of grant applications in each specific topic.

In order to investigate whether peer reviews were influenced by the reviewers' affiliation to organic farming, reviewers were categorized into three groups: (1) users (USER); (2) scientific reviewers affiliated with organic farming research (ORG+); and (3) scientific reviewers with no affiliation to organic farming research (ORG−). Before peer reviews were analyzed, ratings were averaged within each group.

Statistics

The present study may be seen as a review reliability study in which multiple, but not all reviewers evaluated each grant application. The reviewers evaluating each application typically differed and the number of ratings given to each application also differed. In review reliability studies, reliability is expressed as the agreement between two sets of independent ratings for a large number of submissions (Marsh and Bazeley, 1999). In this study, data were analyzed on the basis of how the three types of reviewers (ORG+, ORG−, USER) reviewed each grant application. Although there is a variety of statistics used for estimating the reliability of ratings, the most highly recommended are the Kappa and Pearson correlation coefficients, which are equivalent under appropriate conditions (Cicchetti, 1991b). Kappa statistics are appropriate for testing whether agreement exceeds chance levels for binary ratings. The value of Kappa is an index of agreement, often referred to as reproducibility or reliability (Thompson and Walter, 1998). Because rank-ordered evaluative scales were used and not dichotomous scales such as "good" or "poor," weighted Kappa statistics were applied (Cicchetti, 1991a). In Kappa statistics only integers are used to create graded levels in the range 1–6. According to Cicchetti (1991a), correlation coefficients and Kappa values less than 0.4 indicate poor agreement of peer reviews, 0.40–0.59 fair agreement, 0.60–0.75 good agreement, and 0.75–1.00 excellent agreement. Cicchetti's terminology is used throughout the paper. To test differences between the rating levels of groups, an analysis of variance was performed.

Results

Scientific reviewers affiliated with organic farming research (ORG+) rated the average scientific quality higher than reviewers without this affiliation (ORG−) ($P < 0.01$), and the 16 funded projects were generally rated higher than the unfunded projects (Table 1). The user group (USER) rated relevance significantly lower than did both scientific groups ($P < 0.001$) and differentiated its ratings more (Tables 2 and 3).

Table 1. Average ratings (standard deviation in parentheses) of scientific quality (P+M+Q) and relevance of grant applications reviewed by scientists with (ORG+) and without (ORG−) affiliation to organic farming research and the user group (USER).

Category of grant application		N	Rating[a]		
			Scientific quality (P+M+Q)[b]	Relevance	Total rating (scientific quality + relevance)
All	ORG−	84	3.48 (0.90)	3.50 (0.81)	3.47 (0.81)
	ORG+	84	3.78 (0.81)	3.71 (0.79)	3.72 (0.74)
	USER	84	–	3.07 (1.58)	
Funded	ORG−	16	4.20 (0.81)	4.01 (0.61)	4.15 (0.67)
	ORG+	16	4.31 (0.76)	3.96 (0.82)	4.23 (0.74)
	USER	16	–	4.07 (1.23)	

[a] Rating 1 is poor and 6 is excellent;
[b] P denotes the presentation of problem, M denotes methodology, and Q denotes qualifications of the applicant(s).

Table 2. Frequencies of ratings of relevance of grant applications assessed by scientists without affiliation to organic farming research (ORG−) and the user group (USER). Statistics showed "poor agreement."

	USER							
	Rating groups[a]	1	2	3	4	5	6	Total
ORG−	1	1	0	0	0	0	0	1
	2	4	1	1	1	1	0	8
	3	6	4	6	3	6	0	25
	4	7	6	13	8	6	3	43
	5	2	0	1	1	1	2	7
	6	0	0	0	0	0	0	0
	Total	20	11	21	13	14	5	84

[a] Rating 1 is poor and 6 is excellent.

Table 3. Frequencies of ratings of relevance of grant applications assessed by scientists with affiliation to organic farming research (ORG+) and the user group (USER). Statistics showed "fair agreement."

	USER							
	Rating groups[a]	1	2	3	4	5	6	Total
ORG+	1	0	0	0	0	0	0	0
	2	2	0	1	0	0	0	3
	3	11	2	7	2	1	0	23
	4	4	8	9	7	10	3	41
	5	3	1	4	4	2	2	16
	6	0	0	0	0	1	0	1
	Total	20	11	21	13	14	5	84

[a] Rating 1 is poor and 6 is excellent.

Statistical analyses showed a total lack of agreement between the two scientific groups with respect to the assessment of relevance and presentation of problem (P). These two groups also showed poor agreement on methodology (M) and fair agreement on the applicants' qualifications (Figure 1). Scientists affiliated with organic farming (ORG+) showed much higher agreement with the user group on relevance ($r = 0.46$, $P < 0.001$) than did scientists without this affiliation ($r = 0.28$, $P < 0.05$) (Tables 2 and 3). Some projects, however, were assessed as highly relevant by scientists with or without affiliations to organic farming but not relevant by users, and vice versa (Tables 2 and 3). If the assessments of relevance made by the two scientific groups were substituted for total quality ratings (scientific quality + relevance), Tables 2 and 3 would remain more or less unchanged. This is because the assessments of relevance and scientific quality were highly correlated within each scientific group ($P < 0.001$) (Tables 4 and 5). The varying degrees of agreement on the scientific quality criteria and the total lack of agreement on relevance resulted in a poor but statistically significant agreement on the total quality ratings (scientific quality + relevance) (Figure 1).

At a common meeting among all the reviewer groups, it appeared that the user group viewed the relevance of grant applications as a measure of overall quality. The user group seemed not to be specific about the demarcation between relevance and scientific quality. It was, however, not possible to test whether the user group rated the societal relevance of grant applications independent of scientific quality, because the user group was only asked to evaluate relevance. In the scientific committee, however, data clearly showed that both scientific groups did not clearly discriminate between scientific quality and societal relevance (Tables 4 and 5). Strong correlations existed between ratings of scientific quality and relevance in both groups. The ratings of the individual scientific quality criteria (P, M, Q) also appeared to be highly inter-correlated. The total ratings (scientific quality+relevance) within each scientific group more or less equaled the ratings of scientific quality, indicating that the assessment of

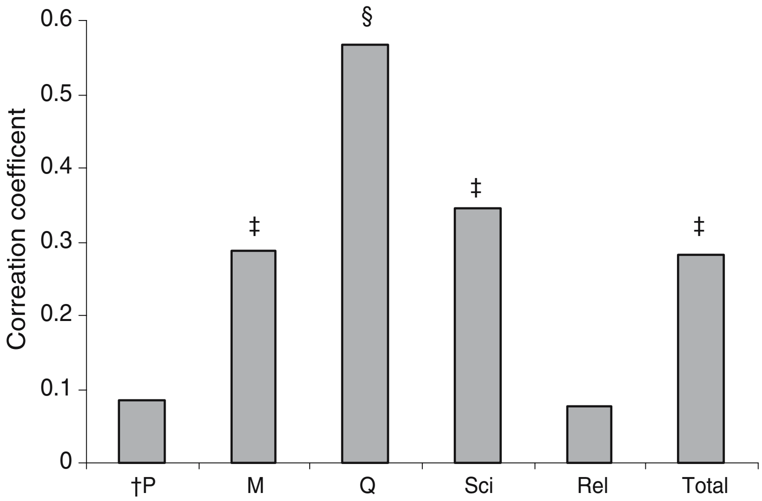

Figure 1. Correlation of ratings from scientists with (ORG+) and without (ORG−) affiliation to organic farming research ($n = 84$). † P denotes the presentation of problem; M denotes methodology; Q denotes the qualifications of the applicant(s). Sci is the sum of P, M, and Q. Rel is the societal relevance, and Total is the sum of all quality criteria. ‡Significant at $P < 0.001$. §Significant at $P < 0.01$.

Table 4. Correlations between scientific quality criteria (P, M, and Q), relevance, and total rating for all 84 grant applications peer reviewed by scientists with an affiliation to organic farming research (ORG+).

	M[a]	Q	Scientific quality (P + M + Q)	Relevance	Total
P	0.575[b]	0.502	0.802	0.624	0.837
M		0.710	0.875	0.397	0.833
Q			0.869	0.347[c]	0.811
Scientific quality (P + M + Q)				0.515	0.969
Relevance					0.707

[a] Denotes the presentation of problem, M denotes methodology, and Q denotes qualifications of the applicant(s).
[b] All correlations are significant at $P < 0.001$ unless otherwise noted[c].
[c] Significant at $P < 0.01$.

Table 5. Correlations between scientific quality criteria (P, M, and Q), relevance, and total rating for all 84 grant applications peer reviewed by scientists without affiliation to organic farming research (ORG−).

	M[a]	Q	Scientific quality (P + M + Q)	Relevance	Total
P	0.861[b]	0.640	0.895	0.666	0.888
M		0.671	0.910	0.529	0.875
Q			0.861	0.359	0.811
Scientific quality (P + M + Q)				0.549	0.976
Relevance					0.701

[a] P denotes the presentation of problem, M denotes methodology, Q denotes the qualifications of the applicant(s). Total is the sum of scientific quality and relevance.
[b] All correlations are significant at $P < 0.001$.

relevance did not add much to the scientific quality assessments in the total quality assessment.

Poor agreement or even disagreement between the scientific groups was obvious for the projects that were funded ($n = 16$). For these projects, correlation analysis showed that the ratings of the user group for relevance and those of scientists unaffiliated with organic farming (ORG−) for scientific quality plus relevance were negatively correlated ($r = -0.519$, $P < 0.05$). By contrast, the user groups' ratings were positively correlated with the ratings of scientists affiliated with organic farming ($r = 0.597$, $P < 0.05$). There was no correlation between the ratings of the two scientist groups ($r = 0.04$, $P > 0.05$).

Analysis of the ratings of individual reviewers showed that there was good agreement between the total ratings of leading experts and those of the remaining reviewers ($r = 0.643$, $P < 0.001$) (data not shown). Leading experts, however, gave "high rated" projects higher scores and "low rated" projects lower scores than did the remaining reviewers. Hence, leading experts were more positive to high quality projects and more negative to low quality projects than the remaining reviewers.

Discussion

This study showed poor agreement among reviewer group ratings of all criteria except the applicants' qualifications, which showed fair agreement (Figure 1). Other studies concur that it is easier to agree on scientific qualifications than on application content (Marsh and Bazeley, 1999). Scientific qualifications seemed to be evaluated in a more objective and reproducible way than other quality criteria. Scientific qualifications were first of all evaluated on the basis of the scientists' track records (e.g., published output and academic status). While some peer review studies show that publication output and academic status (e.g., level of appointment and institutional base) are higher for successful grant applicants than for unsuccessful ones (Bazeley, 1998), other studies disagree (Cole et al., 1981).

In general, peer review studies show substantial reviewer variance and thereby poor agreement among different reviewers of grant applications and manuscripts (Cole et al., 1981; Cicchetti, 1991a; Rothwell and Martyn, 2000). Cole et al. (1981) found that roughly half the fate of a particular grant application was determined by characteristics of the application and the applicant. The other half was determined by apparently random elements, which they called the "luck of the reviewer draw." As an aside, and in keeping with these findings, Rothwell and Martyn (2000) found that agreement among reviewers of manuscripts to accept, revise, or reject was not significantly greater than that expected by chance. Given the significant importance of chance in the peer review of grant applications, Cole et al., (1981) confirmed that the more applications a researcher submits, the higher the probability of being funded. This means that the probability of getting a research grant is highly dependent on the number of submitted applications.

Poor agreement among reviewers may originate from random or systematic disagreement. If there is substantial random disagreement, then it would be possible for unbiased groups of reviewers to differ in their mean rating simply by chance (Cole et al., 1981). Systematic biases, however, may originate from disagreements among scientific schools of thought, societal discourses, or from disagreements based on personal knowledge, issues of gender, nationality, and personal preferences.

Bias in peer review and in the selection of reviewers has been debated within a number of research disciplines (Travis and Collins, 1991). The most common complaint concerns the bias against lesser known institutions and unorthodox research, particularly from the so-called "old-boys network." This is called cognitive cronyism or "old boyism" (Travis and Collins, 1991). It is uncertain how widespread it is, but interdisciplinary research and areas of controversy are more likely to suffer from cronyism than mainstream research (Travis and Collins, 1991; Luukkonen, 1995). The result is that unorthodox projects are less likely to be funded and that applicants will try to play down the novel aspects of their applications, or even change their research intentions (Travis and Collins, 1991). This may support conservatism and undermine the culture of risk taking.

In highly competitive research environments, however, jealousy rather than cronyism may be the problem (Wessely, 1998; Wilson, 2002). Top-rated research groups seem not to favor applications from similarly prestigious groups; there is even reason to suspect that they are viewed with disfavor (Wessely, 1998).

It is evident that non-rational aspects may influence the review process. One study clearly showed that female applicants for postdoctoral fellowships received lower review scores than their male counterparts even when they were equally qualified (Wennerås and Wold, 1997). Gender bias has been intensively debated, and the literature is still ambiguous on this issue (Bazeley, 1998; Wessely, 1998).

There are no published studies on the reproducibility and systematic biases of peer reviews of organic grant applications or scientific manuscripts. In this study, the way reviewers were selected influenced peer reviews. Reviewers affiliated with organic farming (ORG+) reviewed grant applications differently than those reviewers without this affiliation (ORG−). Whether this bias is linked to the alternative and dominant paradigms cannot be determined on the basis of the present investigation. It is, however, likely that reviewers with comprehensive research experience in organic farming were more oriented towards the alternative paradigm than reviewers without this experience. People, in general, strive for harmony between their paradigmatic positions and actions. Rasmussen and Kaltoft (2003), for example, showed that the attitudes of university staff were reflected in their professional engagement in organic farming.

The present study was not able to explain why reviewers affiliated with organic farming agreed more with the organic farming sector about research relevance than the reviewers without this affiliation (Tables 2 and 3). Lockeretz (2000) concluded that the main difference between organic and conventional farming research is what gets studied, not how one studies it. This could be an argument for separating quality criteria in the review process into two categories – relevance (what gets studied) and scientific quality (how one studies it) – as was the case in the present research. This study, however, showed that the two categories of quality were indeed very difficult to distinguish in practice. Ratings of scientific quality and relevance were highly correlated.

There was even a surprisingly high correlation between the ratings for the qualification of applicants and those for the societal relevance of the grant applications (Tables 4 and 5). It might be expected that less qualified scientists could propose relevant research projects and vice versa, and that these ratings would be uncorrelated, but this was not clearly reflected in the data. Actually, the relevance rankings did not seem to add anything substantial to the scientific quality assessments due to the inter-correlations among all assessment criteria. This, however, does not mean that relevance is unimportant. Most likely, it is very important; it can be hypothesized that the perception of relevance influences the scientific quality assessment. However, it is not possible to reveal causality in the present study.

This study challenged the idea of an objective science. The contextual values, which are associated with the traditional norms of good agriculture, were not distinguished from the constitutive values of science, which are associated with the norms of good science (Longino, 1990: 4). In the dominant knowledge and learning paradigm, the constitutive values of science are assumed to be unaffected by the contextual values, which are excluded from the research process. In the alternative knowledge and learning paradigm, contextual values are believed to enter into the very process of science. Therefore, Alrøe and Kristensen (2002) have suggested "reflexive objectivity"[1] as a new criterion for doing good research. This criterion includes and exposes the role of value-laden aspects in research. It assumes both an involved actor stance in which contextual values influence specific research processes and a detached observer stance in which normative and empirical aspects of science remain distinct and in which there is a scientific communication of the value-laden context. In their philosophical analysis, Alrøe and Kristensen (2002) linked relevance of science to contextual values and reflexive objectivity to constitutive values.

If the constitutive values of science are unaffected by contextual values (the dominant position), the assessment of scientific quality should be independent of the reviewers' paradigmatic positions, and it should be unimportant whether research is directed towards organic or conventional agriculture. The norms of good science should transcend value-laden contexts. On the other hand, if the value-laden contexts influence the constitutive values of science (the alternative position), the demarcation between science and its value-laden contexts is complex, and the concept of reflexive objectivity as proposed by Alrøe and Kristensen (2002) would be valuable. If the reviewers' paradigmatic position influences the assessment of scientific quality, then an open communication of value-laden intentions to expose the role of value-laden aspects in research is needed. Scientists with positive attitudes towards conventional mainstream agriculture may hold scientific quality norms different from scientists with positive attitudes towards organic farming, as this study indicates.

This empirical study supported the alternative paradigmatic position, that the norms of good science may be linked to societal relevance (i.e., contextual values). From this perspective, contextual values should not be excluded from the peer review process but should be subjected to open communication within the scientific community. A reviewer's affiliation with organic farming may affect the review process, and the best way to handle this "problem" is with the open communication of value-laden intentions and different views on scientific quality.

The decision taken by FORMAS to have two complementary groups of scientists in the committee to ensure balance and broadness in research perspectives appears sound. The research program should respond to the scientific establishment – both scientists unaffiliated with organic farming (ORG−) and those affiliated with organic farming (ORG+). It could, however, be debated whether this balance is required if the scientists affiliated with organic farming are just as scientifically qualified as those from the scientific establishment. If this requirement is fulfilled, it could be argued that there is no need for additional representatives from the scientific establishment. This, however, is a debate that should be taken up in research councils.

In conclusion, this study showed that reviewers affiliated with different farming systems may exercise systematic biases when reviewing organic grant applications. In this study, reviewers who were experienced in organic farming research were in greater agreement with the users of the research concerning the relevance of grant applications than were reviewers without this experience. Regardless of their affiliation to organic farming, reviewers did not clearly distinguish between the societal relevance and the scientific quality of the grant applications. Contextual values seemed to enter into the very process of science.

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Note

1. Reflexive objectivity implies that the communication of science must include the cognitive context, which comprises the societal, intentional, and observational context. The concept is suggested as a criterion for doing good science, along with the criterion of relevance.

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Address for correspondence: Jesper Rasmussen, Department of Agricultural Sciences, The Royal Veterinary and Agricultural University, Højbakkegård Alle, DK-2630, Taastrup, Denmark
Phone: +45-3528-3456; Fax: +45-3528-2175;
E-mail: Jesper.Rasmussen@agsci.kvl.dk