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Pure science or policy involvement? Ambiguous boundary-work for Swedish carbon cycle science

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ABSTRACT

In theory, the interaction between the worlds of environmental science and policy may seem straightforward. From a realm outside politics and power, scientists provide relevant knowledge about nature upon which informed policy decisions could be based. However, in reality this linear model tends to be replaced by a much more complex relationship where the distinction between facts and values, knowledge and interests is less clear cut. In this paper, I explore links between science, policy and power through an interview study conducted with Swedish carbon cycle scientists and government negotiators to the UN Framework Convention on Climate Change. Drawing on a co-production model of science–policy interplay this paper addresses the implications of a mutually constitutive relationship between carbon cycle science and climate policy.

1. Introduction

International climate policy has developed in close connection to the achievements within climate science. Since the mid 1980s, when the anthropogenic greenhouse theory gained political credibility and saliency, science has formed the very basis for how to think about the climate problem and its consequences for human societies. Through the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988, scientific expertise has also become institutionalised in the multilateral setting and widely employed in the elaboration of mitigation strategies under the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto protocol. Hence, scholars have claimed that climate science and policy have become deeply intertwined both in practical and cognitive ways (Jasanoff and Wynne, 1998; Miller and Edwards, 2001). In this paper, I explore how this claim relates to basic carbon cycle research, conducted in traditional academic environments seemingly far away from the multilateral setting.

Ever since governments from North and South, East and West, agreed to include land use change and forestry activities in the Kyoto protocol in 1997, carbon cycle scientists have worked in tandem with government negotiators in order to come up with a politically and scientifically credible accounting system for carbon uptake in biomass and soils. The IPCC has played a central role in this process by producing reports that have helped the policy-making community to interpret and specify the vague and complex treaty text associated with the land use change and forestry articles in the Kyoto protocol (see Penman et al., 2003; Watson et al., 2000). Beyond these examples of direct policy driven carbon cycle science, the multilateral process has also spurred new research on the various components of the global carbon cycle and increased the funds available for work on regional carbon budgets for the land use sector (see for instance CCSP, 2005; CarboEurope, 2001). In this paper I explore how these basic research efforts are linked to the multilateral arena, and examine the extent to which these links challenge conventional conceptions of basic science as an autonomous and self-regulating arena insulated from questions of public policy (Sarewitz and Pielke, this issue). Is there such a thing as a 'pure' research arena, driven merely by curiosity and a will to extend knowledge for its own

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sake, or is all carbon cycle science, more or less, connected to international climate politics and policy-making? If the latter is the case, how is the fundamental understanding of land-atmosphere carbon exchange translated into policy action? And finally, how does this translation process implicate the boundary between carbon cycle science and policy?

I begin by letting these questions tie into the literature on science–policy interaction. I examine how the boundaries between basic and more user-oriented science are conceptualised by science and technology scholars, and whether a co-production model for science–policy interplay can offer new interpretations of the same boundaries. In the following sections of the paper I address my research questions empirically through a case-study of the Swedish carbon cycle research programme LUSTRA (Land Use Strategies to Reduce Greenhouse Gas Emissions). My study primarily builds upon fifteen semi-structured interviews (see Appendix A) that were recorded and transcribed during spring 2004. The interviews involved 60 min long conversations with seven senior LUSTRA scientists and eight Swedish government officials who, more or less actively, use LUSTRA research results in the Kyoto negotiations on land use change and forestry. Balancing between the funder's call for policy relevant knowledge and the participating scientists' commitment to good basic research, the LUSTRA programme illustrates the boundary work carried out in the interface between basic and regulatory science. It exemplifies the tension between conventional notions of scientific independence on the one hand, and the aim to attune science to the needs of society on the other.

Moreover, the LUSTRA example highlights how a strict demarcation between matters of science and policy can grant intermediary actors, or knowledge brokers in Litfin's terms (1994), a great deal of power in the multilateral arena. My study suggests that the reluctance among many LUSTRA participants to address the wider policy implications of their work, has given a limited number of officials in the Swedish government administration, with the expertise necessary to span the boundary between basic carbon cycle science and international climate policy, the mandate to translate primary findings into policy-relevant knowledge and thus determine what counts as useful facts in the decision process. This finding warrants a closer study of how fundamental research is framed and used, by whom and on behalf of what interests in the climate domain (Litfin, 1994, p. 198). It also prompts a reconsideration of basic science as an autonomous arena disconnected from matters of application. Although many carbon cycle scientists may have limited contact with the Kyoto negotiations on land use and forestry in their every-day research practices, I argue that their knowledge can function as an important resource for those making policy decisions and thus tie into the macro-political landscape of international climate policy.

2. From 'pure science' to policy involvement

No uniform or undisputed notion of science exists; on the contrary what constitutes 'science' is contested both in practice and epistemology. In every-day discourse a distinction is often made between basic science, driven by curiosity and a desire to expand knowledge for its own sake, and applied science that places scientific results in the service of society. Basic science rests upon the legacy of scientific independence and self-regulation, and has thus maintained peer review as the instrument by which the quality of reported result is guaranteed (Jasanoff, 1990). The credibility and integrity of the peer review system rests heavily upon the four social norms of science identified by Robert Merton in the early 1940s. These include universalism that secures that evidence is open to all and evaluated on the basis of impersonal criteria, communism that depicts knowledge as a cumulative and collective good, disinterestedness that ensures that research is conducted without personal motivations or prior wishes that the results should be one way or another, and finally, organised scepticism that guarantees that no beliefs or claims are immune from doubt (Bocking, 2004, p. 19; Merton, 1973, pp. 267–278). Together these institutional imperatives, known as Merton's 'ethos of science', have cultivated an idealised image of basic science as a disembodied search for knowledge free from social and political influence.

According to Nowotny et al. (2001, p. 53), applied science is a category that was invented in late 19th century to protect the 'purity' and independence of the fundamental research conducted in universities. Applied science has thus become the label for knowledge produced in industrial laboratories, agricultural experiment stations and other sites concerned with the use of scientific findings (Jasanoff, 2003, p. 228). In more recent years, science and technology scholars have identified yet another sphere of scientific work, that ties into the usability of applied science, but is more policy driven. This third category has been closely studied in relation to environmental regulation, and has been referred to as trans-science (Weinberg, 1972), mandated science (Salter, 1988), fiducial science (Hunt and Shackley, 1999) and regulatory science (Jasanoff, 1990). In contrast to both basic and applied science, all these labels signify a research arena where the primary audience are policy-makers and regulators rather than scientific peers.

According to Jasanoff (1990), regulatory science includes three types of scientific activities. Firstly, it involves studies that are sponsored by regulatory agencies to fill gaps in the knowledge base relevant to the policy-making process. These studies can be conducted in traditional academic environments, but, in contrast to basic science, they are evaluated not only on the basis of established scientific paradigms but also according to their usefulness in the policy-making process (Hunt and Shackley, 1999, p. 143; Salter, 1988, p. 2). Secondly, synthesising activities such as reviewing and assessing fundamental research play a much larger role in regulatory science than in traditional academic research (Jasanoff, 1990, p. 77). This type of science is seldom original enough to be published in academic journals. Instead, it offers translations of primary findings and interpretations of ambiguous research results that end up in the 'grey literature' (Salter, 1988, p. 4). Finally, Jasanoff (1990, p. 77) suggests that predictions of environmental risks constitute a substantial element in regulatory science. Since politicians tend to expect that research will offer unambiguous answers to complex and contested environmental policy problems (Sundqvist, 2000), the pursuit of certainty is a central task in science for policy. As

noted by Sarewitz (2004, p. 393), the general logic is that reduced uncertainty surrounding the relevant scientific facts will make the correct course of action more apparent.

While regulatory science appears as a unique realm in the boarder region between science and policy, it is fraught by a range of problems and paradoxes that stem from the idealistic image of scientific autonomy fostered by basic science. As pointed out by Salter (1988, p. 5), the appeal of science in public policy rests upon the assumption that scientific conclusions are value-free and thus independent of the use to which they are put. From a realm outside politics and power, scientists are expected to provide objective input to policy problems and act as neutral arbiters in political disputes. However, in order to be useful in the regulatory process, scientific experts are often asked to respond to questions they have not themselves chosen (Weinberg, 1972). This means that they are forced to transgress the boundaries of their disciplinary competence and supplement facts with a large measure of judgement (Jasanoff, 1990, p. 7; Nowotny, 2003). The political call for certainty and predictions also puts pressure on regulatory scientists to make oversimplifications and downplay, rather than reduce, uncertainties in their fields of knowledge (Sundqvist, 2000, p. 60). According to Nowotny (2003, p. 152), this inherent 'transgressiveness' of expertise increases its vulnerability to contestation and often results in a loss of scientific credibility. Hence, in order to maintain their status as scientists, expert advisors frequently speak as though they were speaking to other scientists and present their results without regard of political implications. When doing so regulatory science returns to the realm of more traditional academic research, and thereby becomes less useful in the policy arena (Salter, 1988, p. 9).

This deep paradox suggests that boundary-defining strategies, that demarcate science from non-science, facts from values, are central in science for policy (Gieryn, 1995; Jasanoff, 1990). However, the balancing-act between usability and scientific credibility also points to the arbitrariness of these boundaries and the problems associated with idealistic images of scientific purity. In order to re-conceptualise these boundaries, and free science from the 'objectivity trap' embedded in Merton's scientific ethos (Nowotny et al., 2001, p. 55), a growing STS-scholarship has introduced the concept of co-production to the study of science in environmental policy-making. Some have used the concept to refer to the institutionalised practices by which 'usable science' best is produced in interaction between scientists, policy-makers and the public (Hunt and Shackley, 1999; Lemos and Morehouse, 2005).[1] Others have taken the concept to an epistemological level, and let it signify the dynamic process by which science and society continually shape, constitute and validate one another (Jasanoff, 2004; Jasanoff and Wynne, 1998; Latour, 2004; Miller and Edwards, 2001).

In the latter meaning, co-production implies that the practices of science and policy are linked in a pattern of reciprocal influence that extends beyond the regulatory science arena. While policy criteria define understandings of usable science and thus shape, both directly and indirectly, scientists' formulation of research questions and choice of methods (Demeritt, 2001, p. 308), science will in turn affect what is understood as credible and rational ways of dealing with environmental problems and thus delimit the range of conceivable policy options. The cognitive understandings of the environment forwarded by science may later be picked up by a range of intermediary actors in the regulatory domain, who use 'scientific proof' to gain support for the validity of certain policy outcomes (Litfin, 1994). Although few scientists take on the role as expert advisors in environmental policy-making, their research can therefore still function as an important source of legitimation and power in environmental regulation (Litfin, 1994, p. 35). The outcomes of the policy process will eventually be transformed into institutional arrangements that shape the activities of people around the world, including scientists themselves (Miller, 2001, p. 249). Hence, the co-production model suggests that social and political commitments are built into scientific practice, even in its purest forms, although effective steps are taken to eliminate the social from scientific work (Jasanoff and Wynne, 1998, p. 16).

By forwarding an understanding of science as a situated and contingent social activity, co-production scholars have aimed to create an analytical space where simplistic demarcations between science and policy, facts and values, knowledge and power can be critically assessed and challenged (Jasanoff, 2004). In the following sections, I make use of this space in my study of the Swedish research programme LUSTRA. However, before turning to the Swedish context, I offer a brief background to the Kyoto negotiations on land use change and forestry and the growing international demand for carbon cycle expertise.

3. The LULUCF negotiations and the call for usable carbon cycle research

The idea to manage the world's forests in order to offset or sink atmospheric carbon was actively discussed in the academic community during the 1970s (Baes et al., 1977; Dyson, 1976; Whittaker and Likens, 1973), and rests upon achievements within the expanding field of carbon cycle research during more than 100 years. In the multilateral negotiations preceding the adoption of the UNFCCC in Rio de Janeiro in 1992, the idea was picked up in policy circles and proposed as an important strategy in the international attempt to combat anthropogenic climate change (see Bodansky, 1994; Noordwijk Declaration, 1988). When the Kyoto protocol was negotiated a few years later, a number industrialised countries with large forest areas argued for a 'comprehensive approach' to greenhouse gas accounting that would take into account all land-based sources and sinks. Since carbon reservoirs on land represent a significant part of the global carbon cycle, the United States, Canada, Australia and New Zealand claimed that it would be illogical not to include them in an agreement on quantitative reduction targets for greenhouse gas emissions (UNFCCC, 1997a). Accordingly, Article 3.3 in the Kyoto protocol commits signatory countries to account for net changes in greenhouse

[1] This use of the concept co-production should be differentiated from institutional economics, where scholars have let the concept refer to the process by which citizens play an active role in the production of public goods and services of consequence for them (see Ostrom, 1996, p. 1073).

gas emissions resulting from direct human-induced land-use change and forestry activities (LULUCF) (UNFCCC, 1997b).

However, due to the scientific difficulties to accurately measure and monitor land-based carbon uptake, and the political disagreement on the fairness of accounting for terrestrial sinks instead of reducing emissions, the comprehensive approach was restricted at the Kyoto meeting. Article 3.3 limits the eligible LULUCF activities to afforestation, reforestation and deforestation since 1990, and the original idea to account for carbon storage in all land-types was therefore turned into a matter of future negotiations through Article 3.4. Since COP 3 in Kyoto in 1997, the interpretation and specification of these two articles has been subject to intense and highly complex negotiations. In these negotiations, government representatives have relied heavily upon the expertise offered by carbon cycle scientists. The IPCC is the regulatory science body that has provided most of the policy-relevant advice on sinks. In 1998, the COP asked the IPCC to prepare a special report that would assess appropriate definitions and accounting methodologies for the land use change and forestry categories included in the Kyoto protocol. The 'IPCC Special Report on Land Use Change and Forestry' (Watson et al., 2000) was published 2 years later, and played a central role for the political agreement on sinks at the resumed COP 6 in Bonn in summer 2001. Many of the definitions and accounting practices proposed in this report can therefore be traced in the Marrakesh Accords adopted at COP 7 a few months later (UNFCCC, 2002).

At this meeting, the IPCC was also invited to develop methods to estimate, measure, monitor and report changes in terrestrial carbon stocks (see decision 11/CP.7). The assessment was presented at COP 9 in Milan 2003 (Penman et al., 2003), and after some years of continued negotiations, the IPCC 'Good Practice Guidance on Land Use Change and Forestry' now functions as the overarching methodological framework for the Kyoto land use change and forestry categories. While the IPCC advice has been produced in the regulatory domain, in the midst of conflicting country positions and political disputes (see Fogel, 2005), it builds upon an extensive body of primary findings produced by carbon cycle scientists located at universities and research institutes around the world (primarily in the Northern hemisphere). The CarboEurope cluster is one of the many academic networks that have benefited from the increased political interest in carbon cycle research during recent years. It was incepted by the EU in year 2000, and has since then coordinated carbon cycle and greenhouse gas research at 80 institutes in 20 countries in Europe. Although much of the work produced by CarboEurope ties into basic research portfolios, the overarching programme goal is to develop a carbon observation system that can quantify and verify the European carbon balance in view of the Kyoto protocol (CarboEurope, 2001). The Swedish LUSTRA research programme ties into this pan-European research effort.

4. The LUSTRA research programme—balancing between basic and regulatory science

The LUSTRA programme (Land Use Strategies to Reduce Greenhouse Gas Emissions) was incepted in 1999 by the Swedish Foundation for Strategic Environmental Research (MISTRA) in order to propose land-use strategies that can help reducing the Swedish net greenhouse gas emissions to the atmosphere (LUSTRA, 1999). Since then, LUSTRA has involved about 30 researchers, primarily located at the Swedish University of Agricultural Sciences (SLU), in carbon inventories and flux measurements at three field sites across Sweden. The 17 research projects included in this overarching programme all involve central elements of basic carbon cycle science. In contrast to the IPCCs reports on land use change and forestry, the LUSTRA projects have aimed for original and peer reviewed research published in academic journals. The work ties into the basic research portfolios of many of the participating scientists, and is thus targeted for the scientific community.

At the same time, the general programme objectives are highly user-oriented. As stated in the first programme report from 1999, LUSTRA is driven by the overarching aim to study and recommend how the Swedish land use and forestry sector can contribute to solutions to the climate problem. Hence, the programme aims to be of use to the domestic forestry sector and to Swedish government agencies responsible for the development of national forest management strategies (LUSTRA, 1999). Since the programme evaluation in 2002, the LUSTRA research portfolio has also become more aligned with international climate policy and the Kyoto negotiations on land use change and forestry (Olsson, 2003). While the work produced by LUSTRA scientists has contributed indirectly to the multilateral process by improving the understanding and quantification of changes in terrestrial carbon pools, the programme is since year 2002 expected to give more explicit advice on Kyoto-specific policy issues (e.g. the factoring out and permanence issue) (LUSTRA, 2004). International expert panels such as the IPCC, and Swedish government negotiators to the UNFCCC are therefore included among the programme's central user groups (LUSTRA, 2004).

In order to understand how the basic research practices of the LUSTRA participants tie into the regulatory aims of the programme, I interviewed seven senior LUSTRA scientists during spring 2004. The interviews were organised through a semi-structured interview guide including 15–20 open questions that addressed the links between the LUSTRA research practices and the Kyoto negotiations on land use change and forestry. A similar set of interviews was also conducted with eight Swedish officials from three government agencies (the Swedish Environmental Protection Agency, the National Board of Forestry and the Swedish Energy Agency) and two ministries (the Swedish Ministry of Environment and the Swedish Ministry of Industry, Employment and Education). With one exception, the interviewed government officials were, more or less, active members of the Swedish government delegation to the UNFCCC and thus closely familiar with the Kyoto negotiations on land use change and forestry. Two of the officials were also members of the LUSTRA programme board, and as negotiators on matters relating to sinks, several informants were direct users of Swedish carbon cycle expertise.

5. Curiosity versus usability

All of the seven LUSTRA scientists interviewed in this study reproduced the conventional image of basic science as an

independent research activity driven by curiosity and a desire to expand the understanding nature and environmental change. One respondent compared the fundamental research conducted in universities to a grass-root activity where interesting ideas emerge bottom-up and evolve over time independent from societal demands (I8). Whereas this unregulated research was perceived as necessary for the long-term build-up of new knowledge, many informants spoke of a shift in Swedish science policy from basic science to more user-oriented research. Many saw the LUSTRA programme as a typical example of this shift. Whereas most of the interviewed scientists acknowledged the responsibility of scientists to answer societal questions, some were also worried about the effects of the contemporary allocation of research funds:

> I believe that research in principle is more politically steered at present. Funds are today to a higher degree guided by political motives. The politicisation has increased. Fifty years ago most professors at this department focused on issues they found scientifically interesting. I think most would agree that current research is more homogenous and focused on the same issues. The EU is today allocating research funds to climate and carbon sinks. When EU has chosen this focus Swedish research foundations believe it must be important and thus go for the same. This results in very 'jerky' research. Suddenly it is nitrogen, heavy metals or carbon. Everyone runs in the same direction while the funds for basic science are decreasing. I think it is a dangerous development (I5, my translation).

> It is apparent that we, as researchers, must be prepared to answer important societal questions/. . ./There may be a need for urgent solutions to restricted problems. However we cannot let all science end up there. We also need a broad basis of research that is not regulated by urgent issues and instead contributes to the building of a stable knowledge basis for the future/. . ./It is a matter of finding a balance, but at present too much focus is on short-term questions that need answers today. We can barely answer them now, and in 25 years when new urgent questions arise we will have lost the scientific basis necessary to provide new answers (I6, my translation).

While most LUSTRA scientists asked for a better balance between long-term curiosity-driven science and research attuned to the short-term needs of society, the government negotiators interviewed in this study called for more regulatory research that will synthesise primary findings and translate them to policy-relevant knowledge. Although the IPCC reports on land use change and forestry have offered this type of highly policy driven science advice during the Kyoto-negotiations, several of the Swedish negotiators stressed the responsibility of scientists beyond the IPCC context to make their results available to the policy community:

> One wonders who is supposed to translate research results to us. It does not work that I as government official read and try to translate PhD dissertations, and then make policies. It would require a staff ten times larger than present, if that is enough. Well, it may be some sort of solution, but I don't believe in it. Someone else must make the syntheses, pull out conclusions and collect the results (I1, my translation).

> In this relatively new field of applied environmental research, we need scientists who can answer questions. The Swedish population is after all paying money for this type of research, and it is up to the researchers who accept these funds to deliver. It is a societal responsibility and therefore not research for its own sake. Knowledge that merely ends up in the researchers', colleagues' and professors' book shelves is in this context totally useless (I3, my translation).

Several government officials mentioned the LUSTRA programme as a good example of a more user-oriented research programme that is attuned to the needs of the policy community. Although only a restricted part of the results derived from the LUSTRA projects are directly relevant to the current LULUCF negotiations, several of the interviewees expressed hope that research programmes, such as LUSTRA, will contribute to the long-term build-up of a national competence in the carbon cycle field that can be useful in future negotiations. Few policy-makers saw any problems in a shift towards more user-oriented science. On the contrary, most agreed that it is necessary for policy-makers to steer scientists towards policy-relevant research areas.

6. Integrity versus policy-involvement

Presently the Swedish government delegation to the UNFCCC is updated on the achievements within carbon cycle research through the IPCC, Swedish consultancy reports and through hearings or direct contacts with Swedish scientists including the LUSTRA participants. A number of international seminars has also been organised in order to create a discussion forum for European climate scientists and negotiators. However, few Swedish carbon cycle scientists, and none of the LUSTRA members, have so far been directly involved as experts in the Kyoto negotiations on land use change and forestry. Most of the knowledge produced by the carbon cycle science community is instead interpreted and translated into policy-relevant knowledge by a limited number of knowledge brokers in the Swedish government administration. In accordance with Litfin's definition (1994, p. 36), these knowledge brokers are not active scientists themselves, but have the skills necessary to understand the work of academics and to frame it in a language accessible to decision-makers. As noted by one senior negotiator, it has been necessary to give these actors the mandate to negotiate the complex scientific aspects of Article 3.3 and 3.4 on behalf of the Swedish government. After the Kyoto meeting in 1997, the negotiations on land use change and forestry turned so complex that only those with adequate scientific expertise can follow the details (I10). However, in order to diversify the expertise in the field, this informant also asked for more informal meeting-places where policy-relevant questions can be addressed and elaborated in direct cooperation with scientists (I10).

Despite the translation problems invoked by the government officials interviewed in this study, many of the LUSTRA scientists were very optimistic about their ability to communicate their results to the policy community. Seminars, lectures, synthesised research reports and regular scientific publications were mentioned as central means in the transfer of information from science to policy. Some of the scientists also mentioned direct contacts with government officials as something fairly common in a small country like Sweden. While many informants agreed that the LUSTRA programme is more attuned to user needs than what traditionally is expected of scientific research, few of the LUSTRA scientists were familiar with the knowledge demands in the Kyoto process. Apart from the occasional updates provided by members of the LUSTRA board, the participating scientists had limited insight into the Kyoto negotiations on land use change and forestry and showed little interest in the policy implications of their work. Although some regretted their lack of information, most agreed that they have no time to get involved in the policy context of their research. Several informants also stressed the importance of a clear demarcation between the world of science and politics:

> Scientists should have a position from where they can maintain their credibility and not involve themselves too much [in politics]. It is tricky to remain neutral by standing outside, but as soon as they enter [the regulatory domain] they risk becoming politicised and accused of promoting certain interests. Scientists have a credibility system that involves internal criticism and scrutiny of scientific results. It is naturally important that scientists continue to have this internal scrutiny in order to maintain external credibility as a community (I7, my translation).

> Politics involves so many different issues and requires a balancing act between a range of needs, costs and other components in society. That is the role of the politician. I cannot do that from my perspective, and it is not my role. The role of LUSTRA is instead to clarify what happens [in nature] if society does this or that. To make political judgements is the role of the politician. If I were to make [political] judgements it would be wrong, in the same way as if the politician would make scientific judgements (I8, my translation).

As exemplified by these two quotes, the interviewed scientists reproduced the boundaries between matters of science and policy. Almost all of the LUSTRA members agreed that the primary role of science is to do high quality research and to communicate the findings to society in a transparent and apolitical manner. Several informants cautioned against an expert-driven society where climate scientists set the political agenda. From their perspective, scientists should merely provide a scientifically credible basis for decision-making, and not value how this information should be used. Interestingly enough, none of the interviewed government officials questioned this division of labour. Despite the call for a closer collaboration between the science and policy communities, they all seemed to take the demarcation between facts and values for granted. Two negotiators highlighted the political problems that can occur when scientific results are misinterpreted or deliberately misused in the policy process in order to promote certain political interests (I2; I11). Whereas this politicisation of science on several occasions has complicated the LULUCF negotiations, none of the interviewed government officials suggested that the widespread employment of scientific expertise in the political process challenges the demarcation between science, politics and power in any fundamental way.

7. Engagement beyond direct policy involvement

In theory, the interaction between the world of science and the world of politics and policy may seem straightforward and linear. As suggested by Skodvin and Underdal (2000, p. 22), knowledge about nature is here generated by truth-seeking scientists through the employment of stringent professional standards, and is communicated without distortion to decision-makers who use it as the basis for rational environmental decisions. However, in practice the relationship between the two worlds is seldom straightforward. Although most of the respondents in this interview study referred to the linear model outlined above when describing the ideal relationship between carbon cycle science and policy, the everyday experiences of Swedish government officials and LUSTRA scientists point to a more complex relationship that ties into the pattern of reciprocal influence invoked by co-production scholars. Through the LUSTRA programme seemingly independent university scientists, active within a traditional academic environment, have been engaged in the production of knowledge that is deemed useful in a very specific policy context. The knowledge demands in the Kyoto negotiations have shaped the research agenda of the programme and invited scientists to provide answers to questions they have not themselves chosen. Although many years of curiosity-driven basic research has created the knowledge basis and expertise necessary to provide these answers, the calls for Kyoto-specific knowledge has in turn influenced the choice of methods and empirical observations in a way that also implicates the fundamental research practices of LUSTRA scientists. In line with the co-production model, this feedback between scientific curiosity and usability challenges the existence of an independent realm of pure science, fully disconnected from matters of public policy.

At the same time, most of the interviewed scientists felt very distant from the multilateral setting and the political use of their results. Whereas many LUSTRA scientists believed that their research would inform the Kyoto negotiations on land use change and forestry, they all made a clear demarcation between the world of science and the practice of politics and power. This demarcation was also invoked by the interviewed negotiators who perceived much of the research in the carbon cycle science field as inaccessible and difficult to apply in the direct policy context. Their call for syntheses that can bridge the production and use of carbon cycle science highlights the different purposes and modus operandi of the two worlds. These physical boundaries between the every-day practices of LUSTRA scientists and Swedish government

officials do, however, not give support the legacy of scientific independence. In the absence of direct policy advice from the Swedish carbon cycle science community, my study suggests that the knowledge supplied by this community has been interpreted by a range of intermediary actors in the regulatory domain and hereby translated into a format that makes sense of the complex policy issues at stake in the multilateral setting. A central question is of course how these translations are made, and how the resulting knowledge is used in the policy process. Since the primary data coming out of research programmes such as LUSTRA are diverse and complex, they do not imply one single interpretation or use. As noted by the LUSTRA programme manager:

> I think their [policy-makers'] problem is to draw conclusions from a diverse science community. In LUSTRA we should have a unified message, but it is not easy. It is my goal to unite all of us around a common message. How we will succeed is too early to say. There are many diverging opinions within the scientific community about how to act. It is not obvious for many to provide an unambiguous message. Many would say that one has to tolerate plurality. On the other hand one can ask who should synthesise the various messages. Politicians are probably not the right people to do that. It should be the task of scientists, but the question is whether we will succeed (Olsson, 2004 my translation).

Several scientists involved in my study talked about the responsibility to communicate their results to the surrounding society. At the same time, the intra-scientific rules for quality control and self-regulation seemed to limit the time and resources available for such communication (I9). When scientists themselves do not have the time, interest or information necessary to address the policy-relevant aspects of their work, a great deal of power is transferred to the regulatory domain and a number of knowledge brokers ready to translate primary findings to a language accessible to decision-makers. In the carbon sequestration field, where both the science and policy arenas have turned highly complex and technical, the role of these intermediary actors seems to be very pronounced. The complex negotiations on Article 3.3 and 3.4 in the Kyoto protocol have not only restricted who is able determine what counts as useful facts among a diverse set of knowledge claims. One of the interviewed government officials also noted that the high entry barriers for who is qualified to speak has neutralised many of the value debates embedded in this previously contested policy option:

> There is a risk that science is exploited in a reductionistic and technocratic manner. One should not forget that this [carbon sink] issue involves politics and pure value judgements, a fact that tends to be concealed by scientific arguments/. . ./Had the [climate] debate only been about levels of carbon dioxide in the atmosphere, it would have been easy to explain and most people would have understood. However, through the introduction of carbon sinks we have lost the public, and that is partly because this issue goes against common sense. For those who try to reflect and understand this debate the sink issue must decrease the credibility [of climate policy] (I4, my translation).

To what extent does a technocratic framing of the sink issue implicate scientists active in research programmes such as LUSTRA? If we maintain idealised images of scientific purity and independence, the interpretation and use of primary findings in the regulatory domain appears to have little to do with the academic environments in which the knowledge is produced. As suggested by several government officials in my study, the misinterpretation and exploitation of scientific facts in the Kyoto negotiations on land use change and forestry is a problem of politics rather than science. However, if we approach science as a social and open-ended activity, it is no longer possible to fully separate the production of carbon cycle science from its use. While LUSTRA scientists may have limited contact with the regulatory arena, my study suggests that social relations shape their every-day research practices and influence how their findings are interpreted and used in the regulatory domain. Rather than reinforcing the boundaries that allow value judgements to be reduced into technical puzzles, Demeritt (2001, p. 309) has suggested that the proper response to the scientisation of climate politics is to develop a more reflexive understanding of science as situated and ongoing social activity. Only then is it possible to provide a balanced assessment of how its knowledge is tied to society. While this is one of the lessons learned from the LUSTRA experience, we need more empirical studies in order to fully assess the links between basic carbon cycle science and the making of international climate policy.

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Appendix A. List of interviews[2]

Berggren, D., 2004. Swedish University of Agricultural Sciences, Uppsala, 6 May.

Boström, B., 2004. Swedish Energy Agency, Stockholm, 24 April.

Eriksson, H., 2004. National Board of Forestry, Jönköping, 18 April.

Jansson, P.-E., 2004. Royal Institute of Technology, Stockholm, 19 April.

Johansson, M.-B., 2004. Swedish University of Agricultural Sciences, Uppsala, 6 May.

Kjellén, B., 2004. Swedish Ministry of Environment, Stockholm, 14 September.

[2] Please note: in order to secure the anonymity of the respondents, the order of the names does not correspond to the numbers in the text.

Lilliesköld, M., 2004. Swedish Environmental Protection Agency, Stockholm, 24 April.
Madji, H., 2004. Swedish University of Agricultural Sciences, Uppsala, 20 April.
Nilsagård, H., 2004. Swedish Ministry of Industry, Employment and Education, Stockholm, 5 May.
Olsson, M., 2004. Swedish University of Agricultural Sciences, Uppsala, 11 March.
Persson, T., 2004. Swedish University of Agricultural Sciences, Uppsala, 20 April.
Rosenqvist, R., 2004. Swedish Ministry of Environment, Stockholm, 4 May.
Wallin, B., 2004. National Board of Forestry, Jönköping, 18 March.
Ågren, G., 2004. Swedish University of Agricultural Sciences, Uppsala, 11 March.
Österberg, K., 2004. Swedish Environmental Protection Agency, Stockholm, 21 April.

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