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Decision strategies for policy decisions under uncertainties: The case of mitigation measures addressing methane emissions from ruminants

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ABSTRACT

Decision strategies aim at enabling reasonable decisions in cases of uncertain policy decision problems which do not meet the conditions for applying standard decision theory. This paper focuses on decision strategies that account for uncertainties by deciding whether a proposed list of policy options should be accepted or revised (scope strategies) and whether to decide now or later (timing strategies). They can be used in participatory approaches to structure the decision process. As a basis, we propose to classify the broad range of uncertainties affecting policy decision problems along two dimensions, source of uncertainty (incomplete information, inherent indeterminacy and unreliable information) and location of uncertainty (information about policy options, outcomes and values). Decision strategies encompass multiple and vague criteria to be deliberated in application. As an example, we discuss which decision strategies may account for the uncertainties related to nutritive technologies that aim at reducing methane (CH_4) emissions from ruminants as a means of mitigating climate change, limiting our discussion to published scientific information. These considerations not only speak in favour of revising rather than accepting the discussed list of options, but also in favour of active postponement or semi-closure of decision-making rather than closure or passive postponement.

1. Introduction

Policy options concerning the environment and sustainable development raise problems for decision-makers if the options, their outcomes and possible trade-offs are contested or unclear. In such cases, options cannot simply be ranked according to the value of their outcomes to determine which one would be rational to choose. As an alternative to taking arbitrary decisions or eschewing the decision problem (Kellon

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and Arvai, 2010), we suggest using decision strategies. A decision strategy is a plan for structuring the decision process. The potential of decision strategies will be shown with reference to the case of mitigating methane (CH_4) emissions from ruminants to abate global warming.

Among all long-lived greenhouse gases (GHGs), CH_4 has the second largest radiative forcing (+0.48 Wm^{-2}) after CO_2 (+1.66 Wm^{-2}), on a per-unit base, $CH_4$is about 25 times more powerful at warming the atmosphere than CO_2 (Forster et al., 2007). Globally, CH_4 accounts for about 15% of the radiative forcing caused by all anthropogenic GHG emissions, with ruminants being responsible for about 28% of anthropogenic CH_4 emissions (Beauchemin et al., 2008: 21). In the absence of mitigation measures, there is expected to be a continued increase in global emissions from agriculture in the future due to expected increases in food demand and diet changes as the world's population continues to grow.

Many natural and human environments are already being affected by the warmer climate and are expected to be further affected in the future. There is consensus among the parties of the United Nations Framework Convention on Climate Change (UNFCCC) that strong reductions in global GHG emissions are required in order to keep the global temperature increase below 2 °C, thus preventing dangerous anthropogenic interference with the climate system (UNFCCC, 2010).

Methane emissions from livestock are subject to national emission reduction targets for UNFCCC Annex 1 countries. Nutritive technologies have been proposed to reduce GHG emissions from livestock (UNFCCC, 2008), but ''implementation of mitigation measures in practice is still in its infancy'' (Van Groenigen et al., 2008: 47). Given the high global warming potential and its relatively short lifetime (around 12 years compared to more than 100 years for CO_2), CH_4 is a promising candidate for mitigating global warming in the near future. Various uncertainties related to nutritive technologies, their possible outcomes and the values related to these outcomes make nutritive technologies for ruminants a good showcase for the potential of decision strategies.

Decision strategies structure the decision process, e.g. regarding who should take part in the decision process (''participatory strategies''), what to decide on (''scope strategies''), or when to decide (''timing strategies''). Decision strategies alone do not solve a decision problem but enable reasonable, i.e. justified decisions by providing a systematic basis for deliberation and learning about uncertainties in the process of decision-making (Hansson, 1996; Korthals and Komoduur, 2010). Reasonable decisions differ from robust policy strategies, i.e. policy options that are insensitive to uncertainty about the future (Lempert et al., 2004).

Since the 1990s, a range of participatory strategies has been developed, which are frequently used today (for an overview see Rowe and Frewer, 2005). Participatory strategies may profit from systematically rethinking the scope of the decision problem and the timing of decision-making. Conversely, the application of scope and timing strategies needs deliberation since these strategies come along with multiple and vague criteria that have to be weighted in application. Policy sciences, for instance, take participation of social groups in public policy decisions as a fundamental requirement. They suggest factoring large decision problems such as global ones into multiple problems of small scope to be addressed in community-based approaches. They propose reconsidering decisions after implementation of options, which is a temporal strategy called ''adaptive governance'' (Brunner, 2010). So policy sciences use a specific scope and timing strategy for structuring participatory decision processes.

Since there are various scope and timing strategies that lack systematic analysis as a means for learning about and accounting for uncertainties in decision-making, they are the focus of our paper. We exemplify their potential by relating to published scientific information on nutritive technologies to mitigate CH_4 emissions from ruminants. We have to leave for further work considerations about the integration of scope and timing strategies with participatory strategies as well as their empirical application to real-world decision processes.

Decision strategies must account for the broad range of uncertainties associated with policy decision problems because being unclear about uncertainties can distort the decision process and lead to unreasonable results. We propose a matrix for the classification of uncertainties based on a distinction between ''location'' and ''source''. The former refers to whether uncertainties are associated with information about options, outcomes or values; the latter concerns the distinction between incomplete information, inherent indeterminacy and unreliable information (Section 2.1). We describe the nutritive options to address CH_4 emission from ruminants referring to data from UNFCCC (2008), and we classify uncertainties of information using the uncertainty matrix (Section 2.2).

Regarding the decision strategies, we systematize ideas from the literature and propose two scope strategies (Section 3.1) as well as four timing strategies (Section 3.2). Criteria speaking for or against a specific decision strategy are discussed in relation to the classified uncertainties of deciding on CH_4 emissions from ruminants (Section 3.3).

Section 4 summarizes how decision strategies allow for learning systematically about uncertainties and how they might help making reasonable decisions concerning messy real-world problems.

2. Uncertainties

A policy decision problem consists of three basic components: the policy options (''options'' for short), their possible outcomes and the value of these outcomes (Hansson, 1996). In standard decision theory, ''decision under uncertainty'' refers to decisions with a well-defined and known set of options and values of outcomes, while the probability of outcomes is unknown or known with insufficient precision. ''Decision under risk'' requires known probabilities of outcomes (Luce and Raiffa, 1957: 13). Contrary to that, decision analysis does not distinguish between ''risk'' and ''uncertainty'', but proposes to elicit subjective probabilities, if objective probabilities are not available (Eisenführ et al., 2010). This is questionable as a general practice. Regarding e.g. future climate, assigning subjective probabilities based on experts' estimates has been questioned, because probabilities cannot be reasonably assigned to future human behaviour (Dessai and Hulme, 2004).