Rationale for Taking Precautions: Normative Choices and Commitments in the Implementation of the Precautionary Principle

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Abstract. The precautionary principle states that serious environmental threats and health hazards should be anticipated and that they ought to be forestalled before the realisation of damage even if scientific understanding of the risks is inadequate. Although the principle is a subject of intense debate and academic scrutiny, its normative underpinnings have received surprisingly exiguous attention. In this paper, the precautionary principle is explicated, which is followed by an introduction of a framework which both illuminates different normative commitments and choices related to the implementation of the principle, and enables ethical evaluation of specific understandings of the principle.

1. Introduction

The precautionary principle – if in doubt, decide in favour of the environment – plays a significant role in the current environmental (and health) law and policy. It is explicitly mentioned, for instance, in biotechnology law, both at national (e.g. GEA 2004/847) and international (e.g. CPB 2000) level.[1] At the same time, the principle is a subject of intense debate and academic scrutiny. On the one hand, independent research institutes and a number of academics have emphasised the necessity of the precautionary principle in well-founded environmental risk governance (e.g. EEA 2001). The principle has also been endorsed by several environmental organisations such as Greenpeace and the Science and Environment Health Network (SEHN). On the other hand, the precautionary principle and its inclusion in environmental risk governance have been subjected to substantial criticism (e.g. Holm & Harris 1999; Starr 2003; Wildavsky 1996).

Notwithstanding this, normative underpinnings of the precautionary principle have received surprisingly exiguous attention. Although the importance of the ethical discussion has been underlined in several occasions, there are only a few brief – and alone unsatisfactory – published papers on the issue. Susan Carr (2002), for instance, has criticised the European Union's negligence of the value-based aspects of the principle. Jenneth Parker (1998) shortly considers ethical assumptions of the precautionary principle in an introductory article on the principle included in *Encyclopedia of Applied Ethics* (see also Jensen 2002). Marc A. Saner (2002) relates the precautionary principle to main approaches in the Western ethical traditions, in particular to those of virtue ethics, deontology and utilitarianism. An interesting analysis can be found in René von Schomberg (2006) who discusses the normative basis of the precautionary principle in a recent article. Although Schomberg's analysis is certainly a laudable explication of the different normative choices related to the precautionary decision-making, it lacks an ethical analysis of these choices. In policymaking, in its turn, the precautionary principle has been invoked to justify a wide range of policies – sometimes even mutually contradictory ones (see e.g. Levidow et al. 2005). Furthermore, this has often been done without an explicitly stated normative framework. The Commission of the European Communities, for instance, has emphasised the scientific aspects of the precautionary decision-making and ignored almost totally the justification of its basic values.[2]

The application of the precautionary principle is fundamentally a normative choice. The degree to which we are prepared to take precautions is related to the values which we attach to the nature, society, human well-being, and social equality. Indeed, taking precautions seems to be instinctive for human beings, and it is certainly in accordance with common sense. Nonetheless, the influential role of the precautionary principle in environmental law and policy cannot be based upon mere hunches or gut feelings, but upon the fact that the taken precautions are consistent with certain values shared in a society.[3] When the principle is invoked in societal risk decision-making, evaluative and normative underpinnings should be taken into account, explicated and justified. Exactly this is the subject of the present paper. Specifically, following an explication of the precautionary principle, I will introduce a framework which both illuminates different normative commitments and choices related to the implementation of the principle, and enables ethical evaluation of specific understandings of the principle.

2. The Precautionary Principle

The precautionary principle is a principle of practical decision-making which may be justified on the basis of ethical and socio-political grounds and/or as a form of rational action. In general, the principle states that serious environmental threats and health hazards should be anticipated and that they ought to be forestalled before the realisation of damage even if scientific understanding of the risks is inadequate. Despite this commonly agreed (and non-specific) core idea, the precautionary principle has various forms. A number of formulations of the principle can be found in official documents such as international environmental treaties (see e.g. Trouwborst 2002), and several definitions have been proposed in the academic literature (Sandin 1999). Nevertheless, two particular formulations may be considered paradigm examples of the principle. The first one was adopted at the United Nations conference on environment and development in Rio de Janeiro.

> Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation (UNCED 1992, Principle 15).

This formulation is typically referred to when the principle is invoked or discussed. It is explicitly mentioned in most of the academic articles on the principle; and, it is usually presented as a basic example of the principle (e.g. Manson 2002; Myers 2002, 211; VanderZwaag 2002, 167). Furthermore, the formulation (or its equivalents) is included in several other official documents. The *Cartagena Protocol on Biosafety* (CPB 2000, Article 1), for instance, reaffirms the formulation.

The second standard formulation was introduced at a conference organised by the SEHN. According to it,

> [w]hen an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically (*Wingspread Statement on the Precautionary Principle* 1998).

The *Wingspread Statement* is also mentioned in a number of academic articles on the precautionary principle as a basic example of it (Myers 2002, 211). According to Derek

Turner and Lauren Hartzell, this formulation is "[t]he closest thing to a canonical version of the precautionary principle" (Turner & Hartzell 2004, 451). Environmentalists have typically endorsed the formulation (e.g. the SEHN).

It is obvious that these two formulations above differ. The former says only that uncertainty will (or should) not be used as a reason not to take cost-effective precautionary measures, but the latter states an obligation to take precautions with no reference to cost-effectiveness. Furthermore, the following paragraphs of the *Wingspread Statement* also say that the burden of proof should be shifted from the public (governments and NGOs) to industry (and scientific community). Whilst in the *Rio Declaration* the term 'the precautionary approach' is employed, the *Wingspread Statement* mentions 'the precautionary principle'.

In addition to the identification of the paradigm examples, the precautionary principle can be further explicated by abstracting its basic structure as a decision-making principle.[4] Specifically, every formulation of the principle is a function of two variables, namely that of trigger condition and precautionary response. When a situation fulfils the prerequisites described by (1) the trigger condition, the stated (2) precautionary response should be taken.[5]

The trigger is two-fold. It consists of (a) damage and (b) knowledge thresholds that define the necessary and jointly sufficient preconditions for the application of precaution. The damage threshold concerns harmful or otherwise undesirable outcomes.[6] It determines relevant types of threats and hazards which form a prerequisite for the application of the principle. It is specified variously in official formulations of the precautionary principle as well as in different definitions found in the relevant academic literature. Examples of this include formulations such as

> "possibly damaging effects of the most dangerous substances" (*Second International Conference on the Protection of the North Sea* 1987, Preamble, Paragraph 7);
>
> "potential adverse effects" (*World Charter for Nature* 1982, Principle 11b);
>
> "threats of serious or irreversible damage" (UNCED 1992, Principle 15);
>
> "threats to the environment or human health" (*Wingspread Statement on the Precautionary Principle* 1998);
>
> "the potential adverse effects of a living modified organism on the conservation and sustainable use of biological diversity (…), taking also into account risks to human health" (CPB 2000, Article 10).

The second part of the trigger is the knowledge threshold that determines the level of the required scientific understanding of an identified threat at which precautionary response is well-founded. Also the knowledge threshold has been specified variously. Interesting case example of this is found in the Ministerial Declarations of the *Second* and *Third International Conference on the Protection of the North Sea*.

> "even before a causal link has been established by absolutely clear scientific evidence" (*Second International Conference on the Protection of the North Sea* 1987, Preamble, Paragraph 7);

> "even when there is no scientific evidence to prove a causal link between emissions and effects" (*Third International Conference on the Protection of the North Sea* 1990, Preamble).

Other examples in official documents include, for instance,

> "effects are not fully understood" (*World Charter for Nature* 1982, Principle 11b);
>
> "lack of full scientific certainty" (UNCED 1992, Principle 15);
>
> "even if some cause-and-effect relationships are not fully established scientifically" (*Wingspread Statement on the Precautionary Principle* 1998);
>
> "[l]ack of scientific certainty due to insufficient relevant scientific information and knowledge" (CPB 2000, Article 10).

The second structural part of the precautionary principle is the prescribed action. Examples of its definition found in the official formulations of the principle encompass,

> "activities should not proceed" (*World Charter for Nature* 1982, Principle 11b);
>
> "cost-effective measures" (UNCED 1992, Principle 15);
>
> "action to control inputs of such substances" (*Second International Conference on the Protection of the North Sea* 1987, Preamble, Paragraph 7);
>
> "precautionary measures" (*Wingspread Statement on the Precautionary Principle* 1998);
>
> "taking a decision, as appropriate, with regard to the import of the living modified organism in question (…), in order to avoid or minimize such potential adverse effects" (CPB 2000, Article 10).

In sum, the basic structure of the precautionary principle can be stated as follows:

> (1) *Trigger condition*
> (a) *Damage threshold*
> (b) *Knowledge threshold*
> (2) *Precautionary response*

One reservation needs to be made here. The structure abstracted is not purported to present the ultimate formulation of the precautionary principle, but an illuminating schema under which specific formulations of the principle can be subsumed. Besides the illuminative function, this schema can be employed to evaluate different understandings of the principle.

3. Normative Underpinnings of the Precautionary Principle

As a principle of practical decision-making, the precautionary principle implies a conduct-guiding norm. In what follows, the aim is to point out the main normative commitments and choices present – but typically not explicit – in the implementation of the precautionary principle.

To begin with, it is useful to distinguish between extrinsic and intrinsic normative components of precautionary decision-making.[7] (This distinction has not been explicated nor emphasised in the discussion, however.) First, the most basic choice of the former kind is the introduction of the precautionary principle to a particular regulatory context. This choice cannot be derived from the principle itself. At the time of invocation, the precautionary principle is not a part of the regulatory tools of a certain context. The choice is socio-political and ethical in nature, and it should be based upon commonly accepted and relevant reasons.

Second extrinsic choice is the determination of the general level of protection or of the agreed acceptable level of risk. These threshold levels are set independently (and chronologically before) of the introduction of the precautionary principle to a regulatory framework. They ultimately determine the interpretation of the damage threshold. Accordingly, in societies with varying levels of protection,[8] the application of the precautionary principle has different actual consequences. It should be borne in mind, however, that the chosen level of protection is typically expressed in general and qualitative terms. Thus, there is much space for judgement and different readings of it in practice. For instance, the European Union has defined its level of protection as *high* and *context-dependent*.[9]

Finally, extrinsic normative choices are also made when the principle is interpreted and implemented. This springs ultimately from the fact that (decision-making) principles such as the precautionary principle do not imply a context specific guidance. Thus, their application into a concrete situation presupposes deliberation and interpretation (see e.g. Beauchamp & Childress 1994, 15; Dworkin 1976; Gardiner 2006, 58; Nollkaemper 1996, 80-81).

Intrinsic normative commitments, in their turn, can be further grouped into two subcategories. On the one hand, all the understandings of the precautionary principle imply three general substantive propositions explicated below. Even if the exact meaning (or right definition) of the principle is a matter of disagreement (see e.g. Adams 2002; Kaiser 1997; Sandin 1999; VanderZwaag 2002), general core idea(s) which leaves space for different interpretations of the key concepts can be identified. Ethically speaking, three normative propositions are implied by the precautionary principle.

First, severe environmental damage (such as loss of biodiversity) and health hazards (e.g. increased allergies) should be anticipated before they actually take place.[10] This normative demand reflects a plea to narrow the scope of our ignorance and oversight. Concrete risk research and the active development of its methods can certainly increase our ability to identify and assess environmental threats and health hazards, and also tell us about what we do not know. However, there may always remain possible and unexpected outcomes that we do not know that we do not know about. It would be highly impractical (i.e. costly and resource-demanding) and also partly impossible in principle to attempt to avoid these outcomes. Surprisingly, to date, this first substantial proposition implied by the precautionary principle has not received much direct attention in the academic literature of the principle.

Second, the precautionary principle implies a norm to take pre-emptive actions in order to protect the environment and human health. This *proactive* view may be contrasted with the *reactive* approach which states an obligation to remedy or compensate damage after its realisation. (Of course, one possible position would also be not to care about these kinds of harms at all.) Similar account of the second normative proposition implied by the principle can be found in Edward Soule who emphasises "a commitment to risk avoidance in terms of some environmental risks" (Soule 2002, 21). In his view,

> *sometimes* regulators should prohibit (or constrain) the commercialization of environmentally risky technology, even though the science that identifies the risk is uncertain and even though economic or other factors might recommend otherwise (Soule 2002, 21).

In the concrete, pre-emptive measures may take the form of outright bans or phase-outs, moratoria, pre-market testing, labelling, and requests for extra scientific information before proceeding. Other kind of precautionary response would be the establishment and implementation of new precautionary risk assessment methodologies. The last mentioned reflects a heavy emphasis upon the first normative proposition of the principle – the focus is not only on how to deal with the identified threats, but also on the methods to anticipate and assess threats at the first place.[11]

The third normative proposition which is flowed from the precautionary principle concerns the right role of scientific knowledge in the environmental and health decision-making. According to the principle, adequate scientific understanding of an identified threat is not a necessary condition for taking precautions (see Soule 2002, 21). This feature distinguishes the principle (or the precautionary approach) from earlier institutionalised risk governance approaches. Following Neil A. Manson,

> [t]his idea is supposed to run counter to standard decision-making procedures (e.g., cost-benefit analysis), in which possible but unproven causal connections do not count (Manson 2002, 264).

Arie Trouwborst (2002) also distinguishes between the precautionary thinking and the traditional model of environmental decision-making:

> The main feature of this [traditional] model, which is founded upon the assumption that science can to a sufficient extent foretell the outcome in terms of environmental impacts of any given human activity, is that action to protect the environment is solely justified when conclusive evidence shows that such an activity *will* cause (substantial) damage in the absence of preventative and abatement measures. (Trouwborst 2002, 11; see also ibid. 11-12,18-19.)

With the help of critical analysis, the third proposition can be further specified. The proposition does not imply that any suspicions of risks, educated guesses or results of junk science are sufficient to trigger precautions, but that we "should act based on the best available science, albeit tentative, inconclusive, or in dispute" (Soule 2002, 21; see also Ahteensuu 2007b).

More specifically, a narrow view based upon a decision-theoretic classification suggests that the principle can be applied when (1) the (objective) probability of a risk cannot be

established, i.e. in the state of scientific uncertainty,[12] or when (2) the magnitude of a risk is uncertain or contested, that is, in the state of ambiguity. It has also been argued that the precautionary principle can be applied in the state of ignorance, viz. when neither the probability nor the magnitude of a threat can be assigned.[13] A broader view that rests upon the level of scientific understanding states that taking precautions is well-founded when a threat is poorly understood in scientific terms, or when there are scientific discrepancies and disagreements on the nature of a risk.[14]

On the other hand – and as is seen above – particular formulations of the precautionary principle typically include specific (extra) qualifications (i) for the damage threshold (e.g. irrevocable effects); (ii) for the knowledge threshold (lack of full scientific certainty), and (iii) for the prescribed precautionary response (cost-effectiveness) (cf. UNCED 1992, Principle 15).[15] As pointed out by Per Sandin (1999, 895-898), these qualifications differ with regard to two variables: stringency and precision. Ethically speaking, it is important to notice, however, that not all the differences in specific formulations (or in definitions) are actually morally relevant. An example of a morally significant distinction is that between *anthropogenic* and *non-anthropogenic* threats (e.g. Shrader-Frechette 1985). Whilst technological risks, such as the risks of modern agri-biotechnology, are examples of the first-mentioned; natural disasters which are due to asteroid impacts, earthquakes, typhoons, plagues and so on can be subsumed under the latter category.[16] The *Wingspread Statement* (1998), for instance, emphasises human-caused harms and seem to restrict the damage threshold to human activities. Normatively speaking, because an anthropogenic threat comprises a human contribution by definition, the ethical responsibility to prevent these disasters from taking place is strengthened. As noted by Sandin (1999, 891-892), the precautionary principle is typically – although not always – considered in the context of anthropogenic threats.

In sum, normative underpinnings present in the implementation of the precautionary principle have been classified above as follows:

(1) *Extrinsic normative choices*
- (i) *Introduction of the precautionary principle to a regulatory context*
- (ii) *Determination of the general level of protection*
- (iii) *Normative deliberation related to the interpretation and implementation of the principle*

(2) *Intrinsic normative commitments*
- (a) *General*
  - (i) *Severe environmental damage and health hazards should be anticipated before they actually take place*
  - (ii) *Pre-emptive actions should be taken in order to protect the environment and human health*
  - (iii) *Adequate scientific understanding of an identified threat is not a necessary condition for taking precautions*
- (b) *Specific*
  - (i) *Extra qualifications for the damage threshold found in a particular formulation (or definition) of the principle*
  - (ii) *Extra qualifications for the knowledge threshold found in a particular formulation (or definition) of the principle*
  - (iii) *Extra qualifications for the prescribed precautionary response found in a particular formulation (or definition) of the principle*

4. Discussion

In this paper, the structure of the precautionary principle was illuminated, and the normative commitments and choices related to the implementation of the principle were mapped. In my previous work, I have argued that the specific understandings of the precautionary principle may only be correctly evaluated one by one and in relation to the relevant regulatory context(s) (Ahteensuu 2007a). The framework introduced above provides a fruitful conceptual tool for that analysis. However, it needs to be completed with an evaluation of ethical justifications for taking precautions, which sets an agenda for subsequent study.[17]

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[1] It should be emphasised that the relevance of the precautionary principle is not limited to a single regulatory context, but it plays a role in several of them. The principle has been invoked in various fields of risk debates as well as of actual policymaking. It is mentioned in a number of official documents within different regulatory contexts. The relevance encompasses, for instance, marine and fisheries protection (see e.g. VanderZwaag 2002, 171-173); climate change and global warming debate; the protection of the ozone layer (e.g. *Montreal Protocol* 1987, Preamble, Paragraphs 6 and 8); *Vienna Convention* 1985, Preamble, Paragraph 5); the nuclear power risk; the risks of radio frequency electromagnetic fields of power lines, and of cellular telephones and cellular telephone base stations (see e.g. Balzano & Sheppard 2002; Foster et al. 2000); and the conservation of our natural environment (see e.g. The Precautionary Principle Project: Sustainable Development, Natural Resource Management and Biodiversity Conservation (in <URL: http://www.pprinciple.net/ [12.7.2006]).

[2] For a discussion, see Carr 2002.

[3] Because the precautionary principle is employed in a public policy, views about it and especially the chosen mode of implementation affect the whole society. First, the application of the precautionary principle in a regulatory framework has influential effects on the rights and freedoms of individuals, companies, and scientific community (e.g. on the limits of acceptable scientific research). Second, since the use of the precautionary principle also implies redistributing costs, the way in which the principle is interpreted and implemented has further social impacts. It is certainly worth – ethically speaking even necessary – to consider as to whether the implied redistributions of risks, rights, costs, and benefits are just and democratic.

[4] Common elements or dimensions of the precautionary principle have been proposed. Stephen M. Gardiner, for instance, distinguishes three important components of the principle: threat of harm, uncertainty and precautionary response (Gardiner 2006, 36; see also CEC 2000, 13-16; Tickner et al. 1998). More elaborated study can be found in Per Sandin who considers the dimensions of the principle and provides the following formal definition in his article "Dimensions of the Precautionary Principle".

> *If* there is (1) a threat, which is (2) uncertain, *then* (3) some kind of action (4) is mandatory (Sandin 1999, 891).

Accordingly, Sandin distinguishes between four basic dimensions (or common elements) of the principle:

> (1) the *threat dimension* that refers to "one or other undesired possible state of the world";
> (2) the *uncertainty dimension* that "expresses our (lack of) knowledge of these possible states of the world";
> (3) the *action dimension* that "concerns what response to the threat is prescribed";

(4) the *command dimension* that "states what the *status* of the action is" (Sandin 1999, 890-895).

All disputes concerning the exact meaning of the precautionary principle should be interpreted as disagreements on the proper range of the variables (1)-(4) in this structural schema. According to Sandin, the variables may vary in strength (or stringency) and precision (Sandin 1999, 895-898).

Another – and strikingly similar – formalisation is found in Neil A. Manson (2002) who tries to identify the core logical structure of the precautionary principle in his article "Formulating the Precautionary Principle". Manson proposes three shared elements. The *damage condition* specifies the characteristics of an e-effect (i.e. an effect on the environment) "in virtue of which precautionary measures should be considered". The second part, the *knowledge condition*, describes "the status of knowledge regarding the causal connections between the e-activity and the e-effect". The third element determines the *e-remedy* which decision-makers should take in response to the e-activity. (Manson 2002, 265.)

Manson argues that this three-part structure is shared by all versions of the precautionary principle. The logical form of the principle is neatly put into the following conditional statement:

> if the e-activity meets the damage condition and if the link between the e-activity and the e-effect meets the knowledge condition, then decision makers ought to enact the specified e-remedy (Manson 2002, 265).

The proposed elements, dimensions and logical core structure(s) of the precautionary principle are certainly laudable in their own, and they may provide us with a better grasp of the principle. Sandin's structural schema can, for example, be employed to explicate, compare, and evaluate different formulations of the precautionary principle. However, the chosen terms, such as 'dimension', are not illuminative. As the precautionary principle is a decision-making principle, it would be in order to speak about thresholds and prescribed actions, not about dimensions or elements whose status and interrelationships are not explicated.

Another problem shared by Sandin and Manson's structural schemata is that they seem not to exhaust all the understandings of the precautionary principle.To be fair, Sandin softens the claim about applicability of the structural schema in his later writings. According to him, "there are, however, other versions of the precautionary principle which cannot be interpreted with the aid of the four dimensional if-clause" (Sandin 2004, 470). As an example of this, Sandin considers the formulation of the precautionary principle in the *Rio Declaration* (UNCED 1992, Principle 15).

[5] As explicated by Per Sandin (1999, 895), the formulations of the precautionary principle often differ with regard to the normative status of the precautionary response. As an example of this, the application of precautionary measures may be stated as justified or obligatory (see also Cameron & Wide-Gery 1995, 100,135).

[6] Although the term 'risk' has multiple definitions and uses, generally speaking it means exposure to the chance of loss. More precisely, a risk denotes an undesirable state of affairs which may or may not occur as a result of human activities and/or natural events. For an analysis of different risk concepts, see Renn 1992; see also Stirling 2004.

[7] I do not claim that the classification introduced covers all the normative choices related to the precautionary principle and its use. This is because, in the end, every choice can be thought to include an evaluative statement or a norm to act in a certain way (see e.g. Longino 1983). Risk research upon which the precautionary decision-making is based, for instance, encompasses several normative choices of different levels (see e.g. Lemons 1997, 218). Nonetheless, the classification introduced seems to elucidate the most relevant normative choices and commitments.

[8] Every country has a sovereign right to choose its own level of protection.

[9] "Community policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Community" (The EC Treaty 1992, Article 174, Paragraph 2).

[10] On the basis of a review of official documents and the related academic literature, the relevant types of harms include (i) environmental damage, e.g. loss of biodiversity; (ii) human deaths and health hazards such as increased allergies; and (iii) harm to other sentient beings. Other kinds of risks such as economic ones – if taken into account at all (see Nollkaemper 1996) – are considered at most indirectly. Different theories of ethics (e.g. anthropocentric and ecocentric approaches) assign different emphasis upon (i)-(iii).

[11] As an example of precautionary risk assessment methodologies, see Tickner 2003. For an analysis of the implemented (narrow and broad) precautionary policies within the European Union, see Levidow et al. 2005.

[12] It should be emphasised that, despite the fact that the precautionary principle is pre-eminently a principle of law, the uncertainty that triggers its application is related to limitations on scientific understanding of a risk, not to legal uncertainty and/or proof.

[13] For a more detailed discussion about different risk decision-making situations, see e.g. Stirling 2002, 77-82.

[14] In the abstract, the sources of limited scientific understanding (of a risk) can be divided into three classes. First, uncertainty and disagreements arise from incomplete analyses which are due to such factors as gaps of data and/or poor quality data. Second, the analysis methods employed may be invalid. This may take place, for example, in the forms of faulty models, assumptions, and extrapolations from evidence. The relevant actual causal pathways might not correspond the identified and tested ones. Third, our knowledge can also be limited by the high complexity and indeterminacy of some natural systems. Human factor (i.e. decisions in the future), for instance, can significantly reduce the accuracy of our predictions.

It should be noted that the level (or quality) of science and risk assessment directly affects the implementation of the precautionary principle. Roughly, the more developed risk assessment techniques the less uncertainties, and accordingly, the less are there possibilities to invoke the precautionary principle.

[15] Obviously, the choice of a specific formulation (or a definition) of the precautionary principle is a choice itself – and also a normatively relevant one. However, in legal praxis the particular formulation applied is typically determined by the regulatory context.

[16] However, it should be borne in mind that human action may contribute to several natural catastrophes. The global climate change provides an example in which the categories have become blurred.

[17] I am grateful to Jukka Varelius, Susanne Uusitalo and Lassi Kauttonen for valuable comments on an earlier version of this paper.

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