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IN DUBIO PRO NATURA?

**A Philosophical Analysis of the Precautionary Principle
in Environmental and Health Risk Governance**

by

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For my sister

who has shown incredible strength and positive attitude
in fighting a serious illness

ABSTRACT

In this book, I apply a philosophical approach to study the precautionary principle in environmental (and health) risk decision-making. The principle says that unacceptable environmental and health risks should be anticipated, and they ought to be forestalled before the damage comes to fruition even if scientific understanding of the risks is inadequate. The study consists of introductory chapters, summary and seven original publications which aim at explicating the principle, critically analysing the debate on the principle, and constructing a basis for the well-founded use of the principle. Papers I-V present the main thesis of this research. In the two last papers, the discussion is widened to new directions.

The starting question is how well the currently embraced precautionary principle stands up to critical philosophical scrutiny. The approach employed is analytical: mainly conceptual, argumentative and ethical. The study draws upon Anglo-American style philosophy on the one hand, and upon sources of law as well as concrete cases and decision-making practices at the European Union level and in its member countries on the other. The framework is environmental (and health) risk governance, including the related law and policy.

The main thesis of this study is that the debate on the precautionary principle needs to be shifted from the question of whether the principle (or its weak or strong interpretation) is well-grounded in general to questions about the theoretical plausibility and ethical and socio-political justifiability of specific understandings of the principle. The real picture of the precautionary principle is more complex than that found (i.e. presumed) in much of the current academic, political and public debate surrounding it. While certain presumptions and interpretations of the principle are found to be sound, others are theoretically flawed or include serious practical problems.

The analysis discloses conceptual and ethical presumptions and elementary understandings of the precautionary principle, critically assesses current practices invoked in the name of the precautionary principle and public participation, and seeks to build bridges between precaution, engagement and philosophical ethics. Hence, it is intended to provide a sound basis upon which subsequent academic scrutiny can build.

Key words: environmental risk governance, precautionary principle, interpretations, public engagement, prohibitions, applied ethics

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LIST OF ORIGINAL PUBLICATIONS

This thesis is based upon the following original publications, which are referred to in the text by Roman numerals (I-VII).

- I Ahteensuu, M. (2004), “The Precautionary Principle in the Risk Management of Modern Biotechnology”, *Science Studies: An Interdisciplinary Journal for Science and Technology* 17(1): 57-65.
- II Ahteensuu, M. (2007), “Defending the Precautionary Principle against Three Criticisms”, *Trames: A Journal of the Humanities and Social Sciences* 11(4): 366-381.
- III Ahteensuu, M. (2007), “Rationale for Taking Precautions: Normative Choices and Commitments in the Implementation of the Precautionary Principle”, *Risk & Rationalities* [Conference Proceedings], Queens’ College, Cambridge, UK. (URL:<http://www.kent.ac.uk/scarr/events/ah-teensuu.pdf>.)
- IV Ahteensuu, M. (2008), “The Precautionary Principle and the Risks of Modern Agri-Biotechnology”, in (eds. Launis, V. & Rääkkä, J.) *Genetic Democracy: Philosophical Perspectives*, Springer (Series: International Library of Ethics, Law, and the New Medicine 37): 75-92.
- V Ahteensuu, M., “On the Distinction between the Weak Interpretation and Strong Interpretation of the Precautionary Principle”, a manuscript (in the referee process of *Journal of Medicine & Philosophy*).
- VI Ahteensuu, M.* & Siipi, H., “A Critical Assessment of Public Consultations on GMOs in the European Union”, accepted for publication in *Environmental Values* (on 29th November 2007).
- VII Rääkkä, J.* & Ahteensuu, M. (2005), “The Role of Prohibitions in Ethics”, *The Journal of Value Inquiry* 39(1): 27-35.

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* Contribution of the first-mentioned author is more than 50%.

1. INTRODUCTION

1.1. Description and Aim

In the present thesis, I will apply a philosophical approach to study the so-called precautionary principle¹ in environmental (and health) risk decision-making. Generally speaking, the precautionary principle says that *in dubio pro natura*. If in doubt, decide in favour of the environment. It may be described as a plea to foresee and forestall or to “strive for trials without an error” in environmental risk governance.² More concretely, the precautionary principle is typically presumed to provide guidance when scientific knowledge about (the possible) causal relationship between detrimental environmental and/or health effects and an activity is significantly incomplete or in dispute. Lack of adequate scientific knowledge on the probability or magnitude of specific environmental threats (and health hazards) should be decided for the benefit of the environment, not the other way around.

Presumably the most noted formulation of the principle is that 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).

Another well-known formulation was introduced at a conference organised by the Science and Environment Health Network (SEHN) in 1998. 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

¹ *Ennaltavarautumisen periaate* or *varovaisuusperiaate* (in Finnish), *försiktighetsprincip* (in Swedish), *Vorsorgeprinzip* (in German), *principe de précaution* (in French), *principio de precaución* (in Spanish). For a discussion on the terminology see Section 2.2.

² As a general approach (or idea), the precautionary principle is typically contrasted with the traditional “trial and error” risk management approach – to use Aaron Wildavsky’s terms – which required that the causal relationship between an action and the presumed damage to the environment had to be scientifically proven before taking anticipatory and preventive actions was justified (Wildavsky 2000; see also Section 2.3.).

and effect relationships are not fully established scientifically (*Wingspread Statement on the Precautionary Principle* 1998).

These two formulations are commonly considered standard examples of the precautionary principle (II; IV; V). Nonetheless, as will come clear in what follows, they are insufficient to embody the subtleties of its different forms.

The principal aim of this study is to assess how well the precautionary principle stands up to critical philosophical scrutiny. Does the principle present a well-founded policymaking tool in the decision-making of environmental threats and health hazards? In particular, the objectives of the study are

to *explicate* the precautionary principle

- 1 to clarify its origin
- 2 to elucidate terminological issues
- 3 to identify the core of the principle
- 4 to identify normative choices and commitments made in the implementation of the principle
- 5 to distinguish the principle from other principles, approaches and concepts;

to *critically analyse* the academic (and non-academic) debate on the precautionary principle

- 6 to identify focal problems and debated issues on the principle and the possible need for further scrutiny
- 7 to reconstruct and critically evaluate the main arguments presented for and against the principle
- 8 to expose conceptual presuppositions and flaws in the argumentation;

to *construct and propose* a basis for the well-founded use of the precautionary principle

- 9 to introduce conceptual distinctions and frameworks in order to improve the conceptual foundation of the discussion and policy, and ethical tools to facilitate the understanding and evaluation of the different interpretations of the principle
- 10 to establish a set of plausible interpretations of the principle by narrowing down its possible readings on the basis of theoretical and practical grounds;

to *assess* public engagement and the current public consultation practices related to risk assessment of genetically modified organisms (GMOs) in the European Union (EU)

- 11 to evaluate whether current GMO consultation practices meet the aims and objectives on which their introduction is typically justified

- 12 to discuss the ethical and socio-political foundation of public engagement;

to *discuss* the role of negative norms (i.e. moral restrictions on action which are prohibitive in nature) in the light of traditional moral philosophical debates

- 13 to consider the question of whether acting against moral prohibitions is, ethically speaking, worse than acting against some other moral norms in the light of three classical distinctions in ethics.

Philosophically speaking, I try to explicate and systematically analyse the academic argumentation related to the precautionary principle as well as the actual policymaking within which it is employed. The objective is to expose conceptual and ethical presuppositions – which are inherent, but often not explicit – in the discussion and application, to offer conceptual and ethical tools for using the principle in (the) environmental and health risk governance (of GMOs), and to propose new directions for subsequent research.

The thesis consists of three chapters – Introduction, The Precautionary Principle, Summary – followed by seven original papers. The introduction specifies the objectives, relevance, approach and framework of the study. It answers the questions of what is done, why, and how. Chapter 2. considers the origin and development of the precautionary principle, terminological issues, the core of the principle, and related concepts, principles and approaches. The summary states the main conclusions of the study.

The original papers were written as independent contributions but they constitute a coherent whole when taken together. My views have, however, evolved during the years of writing these papers, and this has admittedly resulted in some minor tensions between them. Although there is some overlap and iteration in themes and discussions, each paper has its own original arguments.

Papers I-V focus directly on the precautionary principle and present the main thesis of this study. In the last two papers, the discussion is widened to new, exploratory directions. These papers concern public engagement and GMO consultation practices, and the role of prohibitions in ethics. Their relevance for the debate on the precautionary principle may be indirect, but they offer valuable insights to it.

“The Precautionary Principle in the Risk Management of Modern Biotechnology” identifies and discusses problems and debated issues related

to the precautionary principle. This paper forms a basis for the subsequent papers as the ideas discussed in it will be subjected to further scrutiny as well as to critical revision in the following papers. Including this first contribution on the precautionary principle in the study also makes transparent the research process and the development of my thoughts during the past few years.

“Defending the Precautionary Principle against Three Criticisms” critically evaluates three criticisms which have been levelled at the precautionary principle in academic discourses, political arenas, and also in public discussions in order to reject the principle altogether. The criticisms are labelled as the argument from vagueness, the argument from incoherence, and the argument from adverse effects.

“Rationale for Taking Precautions: Normative Choices and Commitments in the Implementation of the Precautionary Principle” introduces 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.

In “The Precautionary Principle and the Risks of Modern Agri-Biotechnology”, the precautionary principle is considered in relation to the current dispute over the well-founded risk governance of modern biotechnology. The risks of modern agri-biotechnology are briefly discussed, after which the principle is explicated. Two opposite views on the right role of the precautionary principle in agri-biotech risk governance are critically analysed.

“On the Distinction between the Weak Interpretation and Strong Interpretation of the Precautionary Principle” points out problems in the current usage of the traditional distinction between the weak form and strong form of the precautionary principle upon which the ongoing debate has been centred. The analysis also discloses elementary understandings of the principle.

“A Critical Assessment of Public Consultations on GMOs in the European Union” highlights shortcomings in GMO consultation practices. The aims of public engagement and GMO consultation – in particular, serving democracy, informing the public, reaching consensus, enabling better decisions to be made, and establishing trust – are considered.

“The Role of Prohibitions in Ethics” discusses the question of whether acting against moral prohibitions is worse than acting against other moral

norms in the light of three classical distinctions in ethics. The prohibition thesis, that is, the claim that on a moral scale prohibitions are weightier than other norms is related to the distinction between negative and positive rights, that between acts and omissions, and that between duties and supererogatory acts.

1.2. Relevance and Background

Although the precautionary principle is increasingly subjected to academic scrutiny and remains a matter of intense debate, its ideological and ethical underpinnings – as well as the interrelations between precaution, public engagement, and basic concepts in moral philosophy – have received surprisingly exiguous attention. In general, ethical and other philosophical aspects of the precautionary principle have not been studied much. (This is especially the case in Finland.) The need for an ethical analysis and conceptual clarification has been stressed on several occasions (e.g. Foster et al. 2000; Manson 2002, 263; see also Carr 2002).

The value of this study is two-fold. On the one hand, the present thesis may have *theoretical significance*. There are plain reasons to undertake the research tasks explicated above. First, the precautionary principle is conceptually slippery and elusive. According to David VanderZwaag (2002, 175), “it is difficult to get a firm conceptual grip” of the principle. Hence, clarification of the basic concepts and distinctions related to the principle, such as explicating the way in which its strong interpretation differs from the weak one (V), is worth studying on pure theoretical grounds and valuable in its own right.

The second source of theoretical importance springs from the fact that the precautionary principle is a matter of ongoing debate (see e.g. I; II; IV). Academic scholars (such as risk analysts, legal theorists, economists, decision theorists, philosophers and sociologists), decision-makers, representatives of environmental organisations and the lay people continuously argue about the principle. Despite academic efforts to clarify the principle and the established policy documents (such as the CEC 2000), the principle has remained controversial.

In the discussion on the precautionary principle, disagreements and confusion touch upon almost all the relevant questions, even the most basic

theoretical ones.³ For instance, whilst most authors speak about one definite principle (e.g. Rogers 2001), others use the indefinite plural form (e.g. Löfstedt et al. 2002). Second, several phrases, such as “precaution” (Levidow et al. 2005) and “precautionary approach” (UNCED 1992), have been employed both in the academic literature and in official documents. It is debated whether a difference in terminology implies a difference in the meaning of the principle.⁴ Furthermore, whether it is rational to act according to the principle is unclear. Is the precautionary principle a principle of rational decision-making? Some authors are convinced that it is not (e.g. Morris 2000, esp. 19; Holm & Harris 1999), whereas David B. Resnik (2003, esp. 342), for instance, holds that at least some of the formulations of the principle are examples of a rational decision-making principle. Given these evident examples of confusion and disagreement, clarification and in-depth analysis of the principle are clearly needed.

Third, another source of theoretical significance is that the dispute over the precautionary principle readdresses traditional philosophical dilemmas. These include ontological and epistemological questions on risk, and issues related to the philosophy of science and to the ethics of risk governance. What kind of entities are risks, and what can be known about them? Who should bear the burden of proof in risk policy? What is the right role of scientific knowledge in practical (or societal) decision-making? How should we respond to the known risks in an ethically sound manner? What is the

³ Disagreements on practical decision-making principles, such as the precautionary principle, can be about theoretical issues and/or issues of application. Theoretical questions of a decision-making principle concern, for example, the definition of the principle and its right status. Mutually exclusive answers to these questions present instances of theoretical disagreements. On the other hand, the questions of application concern the right interpretation and well-grounded implementation of a principle. What preconditions justify the application of the principle? What kind of an action (e.g. a precautionary measure) is justified in a particular case? Opposite answers to these questions are disagreements of application.

(Decision-making) principles do not imply a context specific guidance, and thus their application to a concrete situation presupposes deliberation and interpretation (see e.g. Beauchamp & Childress 1994, 15; Dworkin 1976; Gardiner 2006, 58; Nollkaemper 1996, 80-81). As a consequence, an agreement upon the theoretical questions of a principle does not imply an agreement upon the issues of its application.

⁴ While the terms “principle of precautionary action” and “precautionary principle” have been used synonymously, it is not clear whether there is a difference in meaning between “precautionary principle” and “precautionary approach” (see e.g. Conco 2003, 642-643; Trouwborst 2002, 3-5; VanderZwaag 2002, 166-167).

right scope of precaution?⁵ The discussion on the precautionary principle brings philosophical questions related to risk and precaution to a new framework. Although there seems to be a growing interest in the field, only quite a limited amount of peer-reviewed philosophical studies on the principle is available to date.⁶

On the other hand, the possible *practical value* (or social significance) of the study derives from the fact that the precautionary principle is used in the decision-making of environmental threats and health hazards. The principle has an influential role in societal risk governance, especially in the EU. Specifically, besides being an organising concept (i.e. so-called umbrella term) for the preservation of the environment and protection of human health and other sentient beings in general (see e.g. Jordan & O’Riordan 1999, 16,18; Parker 1998, 633-634), the precautionary principle is pre-eminently a legal principle (or approach) that has been invoked above all in environmental law. It plays a role both at national and international levels.

The precautionary principle is explicitly mentioned in many national (environmental) laws, and several governments have accepted the principle as a basis for policymaking.⁷ The GMO context provides a topical example of this. In Finland, the reformed *Gene Technology Act* (GTA 2004/847) mentions the principle in the first paragraph. The EU has adopted the principle in its modern biotechnology risk governance (see 2001/18/EC; CEC 2000). In international law, the *Cartagena Protocol on Biosafety to the Convention on Biological Diversity* (CPB 2000), which regulates the transfer, handling and use of living modified organisms (LMOs), refers to the principle in its key objectives. Finally, the precautionary principle has been included in virtually every established international environmental treaty, declaration and other policy document over the past decade (Freestone & Hey 1996, 3; VanderZwaag 1999, 356-357).

⁵ Other questions include: How much precaution a virtuous person should take? How safe is safe enough? How much uncertainty are we forced/willing to accept?

⁶ For studies on the precautionary principle which may be correctly characterised as philosophical see e.g. Gardiner 2006; Manson 2002; Parker 1998; Resnik 2003; Sandin et al. 2002; Sandin 1999; Saner 2002. See also issue 1 of *Journal of Agricultural and Environmental Ethics* 15 (2002), and issue 3 of *Journal of Medicine and Philosophy* 29 (2004).

⁷ An interesting example of the latter can be found in Austrian biotechnology policies. The Austrian standard of GMO risk assessment goes beyond the strict scientific understanding of risk, and thus it has been seen as precautionary in nature (Torgersen & Seifert 2000; see also Ahteensuu 2007).

Beyond doubt, clarification of the confusion and disagreements related to the principle has not only theoretical significance but definite practical value as well. This becomes evident when considering two further points on the precautionary principle. First, many definitions of the principle have been proposed in the academic literature, and a number of formulations of the principle can be found in official documents (for instance, in international treaties) (see e.g. Trouwborst 2002). In his article on the dimensions of the precautionary principle, Per Sandin (1999) identifies 19 different formulations of the principle. In addition to the obvious surface differences (see e.g. Manson 2002, 263), there are significant differences in the content of the formulations (see III). Consensus has not been established concerning the exact meaning or the right definition of the principle (e.g. Adams 2002, 302; Lemons et al. 1997, 210; Kaiser 1997, 203).⁸ Second, there are no commonly accepted guidelines for the implementation of the principle. For instance, in spite of the *Communication on the Precautionary Principle* (CEC 2000), which was introduced by the Commission of the European Communities in order to standardise the use of the principle, the adopted national “precautionary policies” within the EU have varied in a wide range (see Levidow et al. 2005). Accordingly, there is a plain, practically motivated, need for theoretical studies on these issues.

Because the precautionary principle is used in public policy in several countries, views about it and especially the mode of implementation chosen affect the whole society. First, implementing the principle in a regulatory framework redistributes risks. Second, applying the principle has influential effects on the rights and freedoms of individuals, companies and scientific community (for instance, on the limits of acceptable scientific research). Third, since the use of the precautionary principle also implies redistributing costs, the way in which the principle is applied has further social impacts. It is certainly worth – ethically speaking even necessary – to consider whether these redistributions of risks, rights, costs and benefits are just and democratic.

That the application of the precautionary principle is fundamentally a normative choice should be emphasised. The degree to which we are prepared to take precautions is related to the value(s) which we attach to

⁸ There are several interpretations (or understandings) of the precautionary principle. The principle leaves much space for variability and discretion owing to its numerous different formulations in the official documents, and because of the general nature of the terms employed in them. Partially, this has led to disagreements in the application of the principle in concrete situations.

nature, society, human well-being, and social equality. In general, societal decision-making should be based upon the premise that actions taken are consistent with certain shared values of a society. Thus, in an acceptable application of the precautionary principle, evaluative and normative presuppositions are taken into account, explicated and justified.

In the commentary literature, however, the normative dimensions of the precautionary principle have been largely neglected.⁹ In policymaking, the principle is often used to justify a wide range of policies (even mutually contradictory ones) (see e.g. Levidow et al. 2005); this is usually done without any explicitly stated normative framework. For instance, the Commission of the European Communities has emphasised the scientific aspects of precautionary decision-making and ignored almost totally the justification of its basic values (for a discussion see Carr 2002). Without clarification of the normative background of the precautionary principle, it is impossible to satisfactorily answer several important issues, such as the question of whether the implementation of the principle is compatible with the common values shared in a society.¹⁰ It is worth noticing that the popularity and highlighted nature of the precautionary principle may reflect a change in people's fundamental values and world-views and/or a changed situation with regard to the inducement and management of environmental threats and health hazards.

The practical value of the study is further increased by the fact that the relevance of the precautionary principle is not limited to a single regulatory context, but it plays a role in a number of them. The precautionary principle has been invoked in various fields of risk debates and policymaking. It is also mentioned in several official documents within different regulatory contexts. Its relevance touches upon, for instance, marine and fisheries protection (see e.g. VanderZwaag 2002, 171-173); the regulation of chemicals; climate change and global warming debate; the protection of the ozone layer (e.g. *Montreal Protocol* 1987;¹¹ the *Vienna Convention* 1985);¹² nuclear power risk; risks associated with radio frequency electromagnetic

⁹ René von Schomberg (2006) discusses the normative basis of application of the precautionary principle in a recent article.

¹⁰ In Finnish society, these are typically taken to include social equality and solidarity, for example.

¹¹ Preamble, Paragraphs 6 and 8.

¹² Preamble, Paragraph 5.

fields of power lines as well as with cellular telephones and cellular telephone base stations;¹³ the conservation of our natural environment;¹⁴ biodiversity protection; the governance of modern biotechnology (see e.g. I; IV; Ahteensuu 2007; Myhr & Traavik 2003; CPB 2000), and the debate over nanotechnology (e.g. Weckert & Moor 2006).

Actually, the significance of the precautionary principle goes beyond the above. It has been argued that the principle played a major role in a change of approach towards nature in (international) environmental law and policy. According to this standpoint, whilst the traditional (anthropocentric) approach to environmental issues was based upon the preservation of economic, health and aesthetic concerns, the modern (ecocentric/reformed anthropocentric) approach emphasises the vulnerability and intrinsic value of nature and different species, sustainable development, precaution and global concerns. An incontestable transition towards environment-oriented apprehensions and policy can be observed. In his book *Precautionary Legal Duties and Principles of Modern International Environmental Law* (1994), Harald Hohmann concludes that

[t]his analysis validates the reference to a change of paradigm in international environmental law. Traditional international environmental law, which had been focused on efficient allocation of resources, has developed into its modern phase principally concerned with environmental protection. Since 1982-1987, modern international environmental law has been largely characterized by precautionary legal duties and principles. Our analysis has shown that the precautionary principle is now established in modern international environmental law. (Hohmann 1994, 344.)¹⁵

¹³ For discussion see e.g. Balzano & Sheppard 2002; Foster et al. 2000.

¹⁴ See e.g. The Precautionary Principle Project: Sustainable Development, Natural Resource Management and Biodiversity Conservation (in <URL: <http://www.pprinciple.net/> [12.7.2006]).

¹⁵ It should be noted that not everybody agrees upon this stance, i.e. on the role of the precautionary principle in international (soft) law and on the categorisation of the approaches in international law. However, the Commission of the European Communities, for instance, affirms the former claim when it states that the precautionary principle has “become a full-fledged and general principle of international law” (CEC 2000, 11; see also Hohmann 1994; Trouwborst 2002). Furthermore, even if the significant changes in international environmental law have been named, described, and classified variously, the shift towards the ideas of sustainable development, precaution and global concerns can be found in most of the classifications – at least in the accurate ones.

In general, as (undesirable) consequences of new scientific and industrial developments have become more complex and difficult to predict, less limited spatially (i.e. they cross national borders) and temporally (they affect the future generations), and sometimes irreversible (see Beck 1992), a clear shift towards anticipatory and precautionary approaches in environmental (and health) regulation and policymaking as well as in the related non-academic and academic debates can be noticed. Many people, especially in affluent Western countries, are less willing to accept a “trial and error” (risk) management approach, that is, to possibly seriously damage the environment and human and animal health by proceeding with new technologies and products unless they can be scientifically proven to pose a risk.

In the theoretical literature, this transition towards anticipatory and precautionary approaches¹⁶ is encapsulated in the juxtaposition of risk and uncertainty (e.g. Stirling 2002, esp. 77-82), prevention and precaution (Sandin 2004b, 463; Trouwborst 2002, esp. 35-44), reactive and proactive approaches (IV), (normal) science and post-normal science (Funtowicz & Ravetz 1993; Ravetz 2004), simple modernity and reflexive modernity (Beck 1992), expert-driven decision-making and participatory practices (Johnson 2007; Funtowicz & Ravetz 1993; see also Weinberg 1972),¹⁷ just to mention but a few examples.

This “anticipatory (or precautionary) turn” in environmental protection and institutionalised risk governance is also inextricably linked with the distribution of the burden of proof and the choice between minimising type-I errors and type-II errors in scientific studies. The requirement for the reversal of the burden of proof, which is typically connected with the precautionary principle (see e.g. O’Riordan et al. 2001; Parker 1998; I; II; IV), is closely related to methods of scientific inquiry, that is, to the statistical analyses in quantitative studies. Specifically, this concerns the choice between minimising false positives (type-I error) and false negatives (type-II error). In the context of scientific risk analysis, type-I error usually refers to a situation where one concludes wrongly that a technology (or product) is unsafe, whereas type-II error refers to a situation where one concludes wrongly that no severe damage will result from using a

¹⁶ In the academic literature, several terms and phrases have been used to refer to the anticipatory and precautionary approaches. Brian Wynne (1992), for example, employs the term “preventive paradigm”. In his view, the precautionary principle brings the preventive approach into effect (ibid.).

¹⁷ According to Genevieve Fuji Johnson (2007, 82), “discursive democracy tends to imply precautionary public reasoning”.

technology. Minimising type-I errors reduces the chance of accepting false identifications of risks as the basis of decision-making. Accordingly, there is a greater burden of proof on the individuals and collectives who postulate some, rather than no, severe consequences. On the other hand, minimising type-II errors would reduce instances of failure to identify real risks with harmful consequences in environmental and health decision-making. This would place the burden of proof on risk imposers rather than on risk victims and regulators. In scientific practice, it is common to prefer minimising false positives (type-I error). In risk governance, it is currently disputed whether one should minimise either type-I errors (i.e. false assertions of harm) or type-II errors (false assertions of no harm). The choices are mutually exclusive, i.e. there is a trade-off between type-I and type-I errors. (For further discussion see e.g. Belt & Gremmen 2002; Shrader-Frechette 1991.)

The EU's approach to GMOs provides a topical and concrete example of the "strive for trials without an error" approach.¹⁸ *Directive 2001/18/EC*, which is concerned with the deliberate release and placing on the market of GMOs, states in its *General Obligations* that

[m]ember States shall, in accordance with the precautionary principle, ensure that all appropriate measures are taken to avoid adverse effects on human health and the environment which might arise from the deliberate release or the placing on the market of GMOs (ibid., Article 4; see also CEC 2000).

Besides explicitly mentioning the precautionary principle several times, it can be argued that the directive builds up a precautionary regulatory framework. René von Schomberg from the European Commission states that

[t]his framework (...) takes a normative stand on GMOs as such, since it defines GMOs as a priori *potentially* hazardous and shifts the burden of proof to the proponents of the activity, e.g. the applier for a GMO has to demonstrate safety rather than regulatory agencies or third parties have to demonstrate a risk (Schomberg 2006, 13).

In particular, the precautionary nature of GMO risk governance is reflected by the fact that in environmental risk assessment (e.r.a.), not only direct and

¹⁸ The EU has adopted the precautionary principle in its modern biotechnology risk governance (see CEC 2000). *Directive 2001/18/EC* mentions the principle several times. Moreover, the principle is incorporated into the *Treaty on European Union* since 1992 as one of the basic principles upon which all its environmental policy should be based (Article 130r[2] of the Treaty Establishing the European Community). The other principles mentioned are the principle of preventative action, the polluter pays principle, and the source principle.

immediate but also indirect and delayed effects are considered (see *Directive 2001/18/EC*, Annex II[A]); by shifting the burden of proof onto potential risk imposers; by the commitment that environmental and human health issues take priority over economic benefits (or concerns); and by the requirement of case by case analysis.

The introduction of GMOs into the environment should be carried out according to the 'step by step' principle. This means that the containment of GMOs is reduced and the scale of release increased gradually, step by step, but only if evaluation of the earlier steps in terms of protection of human health and the environment indicates that the next step can be taken. (Ibid., (24).)

Small cautious steps are taken, and errors avoided. Historically, the precautionary principle was used as a justifying reason for the *de facto* EU Council moratorium on commercial approvals of GM crops. Between late 1999 and 2004 no authorisations were given.

In sum, given the importance of the precautionary principle in modern societal risk governance, the way in which the principle is viewed and implemented has wide social implications. At its best, theoretical research on the research tasks explicated above has importance for environmental law and policy. The final estimation of the practical significance of this study is left to the decision-maker's own consideration. In every case, it is a fact that the governance of risks has come to the fore both in the theoretical literature and in public discourses, and that the precautionary principle is presumed to provide an answer regarding how to deal with uncertain and often complex environmental risks.

Precaution and Public Engagement. Traditional environmental risk governance was based upon "sound" science and expert judgements, i.e. scientific risk assessment and management. Modern (precautionary) environmental risk governance, in its turn, also relies upon science but acknowledges its limits (see Weinberg 1972; Funtowicz & Ravetz 1993) and also takes into account the views of the public. Paper VI evaluates the objectives of public engagement in general and of GMO consultation in particular. Besides few exceptions (e.g. Johnson 2007; Klinke & Renn 2002; Stirling 2001), the issues of precaution and public engagement have not been considered together in the relevant theoretical literature. Nevertheless, the current practices of GMO consultation in the EU may be interpreted as an implementation of the precautionary principle. Reasons for this are as follows: As argued in Papers I-V, precautionary measures can take the form of outright bans and phase-outs, moratoria, pre-market testing, labelling and requests for extra scientific information before proceeding. However,

another kind of a precautionary response is the establishment and implementation of new precautionary risk assessment methodologies. The focus then is not only on how to deal with established threats, but also on methods to anticipate and assess threats in the first place (see Klinke et al. 2006; Tickner 2003). Although the first-mentioned question might also provide an interesting – but to date somewhat neglected – ground to connect “precautionary governance” and public engagement, GMO consultation makes it in the latter sense. Citizens’ views and input are taken into consideration at the level of scientific risk assessment, not that of risk management. Specifically, only comments that provide new information related to scientific risk assessment are taken into account (VI). As a consequence, risk assessment, ideally speaking, becomes “extended” and a product of expert and public dialogue, and can thus be considered precautionary in nature. Although there have obviously been many reasons for establishing GMO consultation (ibid.), the practice might be interpreted to presume that science (esp. experts) alone is considered insufficient even in the framing and assessment of environmental threats and health hazards. As becomes clear in Chapter 2. (I; II; IV; see also Starr 2003), the precautionary principle is commonly taken to challenge the prevailing quantitative risk assessment methodology. Moreover, *Directive 2001/18/EC*, upon which GMO consultation practice is legally based, has been described as a precautionary regulatory framework (see e.g. Schomberg 2006, esp. 13).

Precaution, Prohibitions, and Moral Philosophy. Taking precautions is a choice, and a deliberate choice *per se* implies values, norms, or preferences (even if the agent her/himself is unaware of them). Paper VII discusses moral norms and restrictions on action in general. Including the paper in this study presents an attempt to address the relation between the debate on the precautionary principle and the wider context of moral philosophical tradition. My claim is that the precautionary principle has been connected to ethics (i.e. to moral philosophy) in an insufficient fashion.¹⁹ In fact, the lack of this kind of analyses poses a problem because the discussion becomes easily philosophically shallow. Hence, this paper might provide exploratory input and new ideas for subsequent research on precaution. Although the principle is not assessed or explicitly referred to, several interesting connections between taking precautions and imposing moral prohibitions exist. A direct connection between the issues – and the most significant implication – is that if prohibitions were weightier than other norms on a moral scale, then precautionary measures that are prohibitive in nature

¹⁹ I am only aware of Marc Saner’s (2002) paper which tries to connect the precautionary principle with three traditional theories of normative ethics.

(phase-outs, moratoria, etc.) would be morally weightier. Second, if it is morally worse to do wrong by committing a positive act than by committing a negative act (i.e. an omission), then anthropocentric threats should be given priority when taking precautions (III). Moreover, it would also follow that imposing new environmental threats and health hazards by introducing new (bio)technologies is ethically worse than are the risks related to the postponement of the introduction of these technologies (II; IV). In general, several environmental policies seem to rest upon an implicit distinction between acting and omitting (i.e. doing and allowing), and to date this is not sufficiently addressed in the discussion on the precautionary principle.²⁰ Third, in certain formulations and interpretations, the precautionary principle is considered to imply a duty for anticipatory actions. In others, taking precautionary measures is optional.²¹ (III.) However, the debate on the principle has only rarely been connected to the moral philosophical discussions on duties, morally indifferent actions and supererogatory actions, and that on rights.²²

1.3. Approach

The present thesis is about applying theoretical analysis to an issue that is – at least in the end – practical and concrete in nature. The approach employed, and which I try to elaborate, is analytical: mainly conceptual, argumentative and ethical. The principal methodological presumption is that certain methods of philosophical enquiry are suitable for the analysis of the precautionary principle, and for the explication and evaluation of the dispute over it. The study draws upon the Western tradition of philosophy – specifically that of Anglo-American style – and philosophical bioethics on the one hand, and upon sources of law, decision-making practices (e.g.

²⁰ Marion Hourdequin (2006) has considered the relation between doing, allowing, and precaution.

²¹ As explicated by Sandin (1999, 895), 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).

²² Lastly, moral critics have invoked the precautionary principle in general in trying to make our ordinary morality more demanding. However, as is seen in Papers I-V, the principle includes a great variety of different forms/interpretations, and thus invoking and acting in accordance with it does not necessarily imply changes in our moral views (i.e. in common/prevaling morality).

national consultations of the public) and concrete cases at the EU level and in its member countries on the other.²³

What is, then, meant by the philosophical approach? In other words, how is the study conducted in practice? Three main approaches can be distinguished: conceptual clarification, argumentation analysis, and ethical analysis.

Conceptual clarification refers to the clarification of the meaning and history of concepts. This means (1) an attempt to reveal conceptual presuppositions, implications and imprecision of certain uses of a concept, and (2) an evaluation of the distinctions made and established conceptual frameworks within which the concepts are employed. In this study, the conceptual clarification takes a broad form. The precautionary principle is explicated by clarifying its core propositions; by identifying its paradigm examples; and by abstracting its basic structure (III; IV). Moreover, the principle is distinguished from other principles, approaches and concepts which have typically been taken to be synonymous or otherwise related to it (e.g. in the sense of being subordinate to the principle). In addition to this somewhat ahistorical viewpoint, the origin of the principle is considered (IV; Section 2.1.).²⁴

The fact that the discussion on the precautionary principle contains conceptual ambiguities and imprecision, and that there are several interpretations of the principle and its key concepts (see e.g. Manson 2002; Sandin 1999) demonstrates a need for conceptual clarification. There are conceptual issues to be solved. As an example, the distinction between weak interpretation and strong interpretation of the principle has been employed in various meanings without proper explication (V). In the academic literature, the need for a systematic analysis of the key concepts has been stressed on several occasions (e.g. Foster et al. 2000; Manson 2002, 263).

²³ The research material employed is not restricted to academic philosophical and bioethical argumentation. Besides the academic commentary literature, documentation such as research institute reports, national legislation and international treaties, other official documents (e.g. policy recommendations, declarations) and judicial decisions have been used.

²⁴ Given the variety of the ways of explication employed, historical view and the lack of purely hypothetical thought experiments, the traditional conceptual analysis which aims at establishing a set of necessary and sufficient conditions for the use of a concept (see e.g. Stanford Encyclopedia of Philosophy: concepts) should not be straightforwardly identified with the conceptual clarification employed in this study.

Besides being about concepts, philosophy is argumentative and dialectical in its very nature. The argumentation analysis involves reconstructing arguments from a chosen context of argumentation. Conclusion(s), premises, relations between the identified premises, relevant background presuppositions, and the strength of the inference from premises to conclusion(s) are explicated and systematically evaluated. By reconstructing arguments, it is possible to abstract various theoretical positions which need to be evaluated independently. As a result of argumentation analysis, fallacies and other inconsistencies in argumentation can be detected, sound and unsound arguments can be separated, and it is possible to point out premises that spring from deep value commitments. The need for argumentation analysis results from the fact that although certain particular formulations of the precautionary principle have been subjected to a critical evaluation (e.g. Turner & Hartzell 2004), there are only a few analyses of the arguments presented for and against the precautionary principle.²⁵ Argumentation analysis is employed in Papers II and IV.

Ethical analysis, roughly speaking, consists of explication and evaluation of value basis and normative background assumptions in given arguments and theoretical positions, and also of providing explicit ethical theories. The question of whether or not the precautionary principle presents a well-founded policymaking tool in societal risk governance is fundamentally an ethical and socio-political one; thus, it cannot be answered by science alone.²⁶ Although scientific findings play a necessary role in the decision-making of societal matters, they cannot alone provide the justification for a certain mode of action. Decision-making is about making choices, and a deliberative choice implies values or norms which cannot be exclusively derived from scientific knowledge (I; Hume 2000). Accordingly, there is a definite need for ethical analysis (see also Carr 2002, 31). Especially Paper III employs this approach.

There are at least two further reasons for applying the philosophical approach to study the precautionary principle. First, philosophy may be

²⁵ The only ones which I am aware of are that of Per Sandin and his colleagues (see Sandin et al. 2002) and that of Stephen M. Gardiner (2006).

²⁶ The issues related to the precautionary principle touch upon several academic disciplines, however. The principle can be seen as a junction of technological know-how (what can be done?), policymaking (what has been done?), science (what can be known about the effects of an action?) and ethics (what should be done?). Consequently, a complete – and even a satisfactory – analysis of the precautionary principle is necessarily interdisciplinary in nature, and (moral) philosophical analysis forms an indistinguishable part of it.

suitable for providing a uniting – and perhaps to some extent impartial – overview of the ongoing discussions in different contexts (e.g. in risk analysis literature, in legal and social sciences literature, and in public discussions). Second, given the nature of certain somewhat theoretical problems in the current debate on the principle (V), these issues might be best solved by philosophical analysis.

During the study, I try to embrace two methodological virtues, namely those of simplicity and concreteness. The aim is not to make complex issues even more complicated, but to illuminate the issues under study, and to make these matters attainable also for non-specialists. Besides purely philosophical ambitions, I hope to further discussion within environmental and health risk policymaking. The thesis is, thus, intended for an interdisciplinary audience. Second, by binding the study to actual practices (e.g. to *de facto* decision-making procedures) and by providing concrete case examples (law texts and official policy decisions), I attempt to take into consideration the relevance of context in these matters, and to conduct an analysis with clear practical implications. In sum, the approach chosen as well as the research material employed were versatile in nature, reflecting the aim of elucidating a comprehensive understanding of the precautionary principle.

1.4. Framework

The overall framework of this study is environmental (and health) risk governance, with a special consideration for the EU level decision-making practices (IV; VI).²⁷ Although environmental risk governance includes a variety of methods developed to identify, assess and evaluate environmental threats and health hazards, and to cope with the risks,²⁸ it is usually considered to consist of scientific risk analysis which includes risk assessment, risk management and risk communication, and of the related legislation and policymaking.

²⁷ The study is about well-founded governance of complex and uncertain environmental risks (e.g. loss of biodiversity) and health risks (e.g. increased allergies). Other kinds of risks are considered only indirectly. For instance, economic risks are taken into account while assessing the right role of the cost-benefit analysis (CBA) in precautionary decision-making (II; IV).

²⁸ As an example, environmental impact assessment, technological assessment, and epidemiology.

Risk assessment, as commonly characterised, is a process based upon science in which knowledge about hazards is produced. It consists of different phases which follow each other. Environmental and health risk assessment includes (1) identification of biological, chemical and physical agents that may cause adverse effects to human and animal health, and to the environment; (2) characterisation of the adverse effects which are associated with the identified agents; (3) determination of the relationship between exposure to the identified agents and the severity and/or frequency of the associated adverse effects, and evaluation of the likely intake of the agents; and (4) estimation of the probability of occurrence and severity of the adverse effects, and evaluation of uncertainties which are identified during the assessment process. (See e.g. NRC 1983.)

Risk management, in turn, consists of decision-making and action in which the characterised risks are governed. More precisely, it is a process of evaluating and selecting between policy alternatives (i.e. regulatory actions and inaction) in the light of the results of risk assessment, and implementing the chosen regulatory actions. In addition to the risk assessment results, risk management includes consideration of social factors (such as political, technical and economic factors, and the attitudes of the general public).

Risk communication may be briefly described as the interactive exchange of information and opinions throughout the risk analysis process among risk assessors, risk managers, stakeholders and the lay people. Two-way communication between experts and the general public is usually presumed. From the side of specialists, it should include a non-technical explanation of risk assessment findings and the basis of risk management decisions.

The precautionary principle has typically been thought to present a risk management principle or tool (e.g. CEC 2000, 3,13). The following statements, for instance, reflect this fact: “[p]recautionary principles have been proposed as a fundamental element of sound risk management” (Löfstedt et al. 2002, 381) and the principle “is invoked in the process of risk management” (Rogers 2001, 1). In practice, this means that the precautionary principle can be applied when a risk has been identified in the preceding risk assessment but a considerable amount of uncertainty remains (i.e. the probability of the risk cannot be quantified or the magnitude of the risk is unknown).

Nevertheless, there have been other standpoints as well (IV; V). Many authors have argued that the precautionary principle should already be taken into consideration at the level of risk assessment. According to this position, the principle works not only as a risk management principle/tool, but it also

affects the way in which risk assessment is conducted (Goldstein & Carruth 2004, 491-493; see also Levidow et al. 2005, 268-269). Notions such as “precautionary appraisal” (Klinke et al. 2003) and “precautionary assessment” (Tickner 2000, Chapter 7.) reflect this kind of claim. The dissension can be stated as follows:

- (1) The precautionary principle is a risk management principle/tool. An application of the principle is always a risk management decision that should be kept separate from the process of risk assessment.
- (2) The PP should already be taken into consideration at the level of risk assessment, not only in the process of risk management. The use of the principle in a regulatory framework changes the way in which risk assessment is conducted.

The identified theoretical positions (1&2) seem to reflect a genuine disagreement. The positions are mutually exclusive, that is, a consistent person cannot believe in both of them at the same time. This derives from the fact that a third proposition, i.e. risk assessment and risk management should be separated, is presumed by the two positions. In practice, risk assessment and risk management have traditionally been strictly separated. While the former is based on scientific methods and some have even thought it to be value-neutral, the latter is a decision-making process which is in the end necessarily a political one (e.g. Farrow 2004, 727). For instance, Recommendation 1 of the so-called Red Book of risk assessment says that

[r]egulatory agencies should take steps to establish and maintain a clear conceptual distinction between assessment of risks and the consideration of risk management alternatives; that is, the scientific findings and policy judgements embodied in risk assessment should be explicitly distinguished from the political, economic, and technical considerations which influence the design and choice of regulatory strategies (NRC 1983, 151).

The normative position that risk assessment and risk management should be separated cannot be easily threatened by the accumulation of new knowledge (i.e. by scientific developments), because it derives from fundamental commitments (moral standpoints, epistemological positions and world-views) which exceed the scope of science. Even if risk assessment, in practice, includes decisions that cannot be derived from scientific methods and even if science *per se* is not a value-free enterprise (see e.g. Rudner 1953; Longino 1983), the normative view that the processes of risk assessment and risk management should be distinguished (as far as it is possible) may still be convincing.

In order to empirically undermine the claim that the theoretical positions identified (1&2) reflect a genuine disagreement, one would have to demonstrate that risk assessment and risk management are necessarily intertwined, and that any application of the precautionary principle belongs to the blurred area where the distinction cannot be made. The burden of proof seems to lie with the proponents of this empirical claim. In the meantime, the methods of applied ethics and epistemology can be used to assess the credibility of the two positions. Yet the disagreement may be hard to solve if neither of the theoretical positions explicated can be shown as inherently incoherent or otherwise unconvincing.

In this study, I do not see any *prima facie* type reason to restrict the role of the precautionary principle to the risk management phase. Such a limitation may, however, be justified in a specific regulatory context.

The main focus of the study is on societal risks. Societal risks such as the possible negative consequences of the global climate change²⁹ may be contrasted with individual risks. Roughly, the latter are chosen, i.e. they arise from an individual's choices (such as the possible negative consequences of active smoking), whereas in the first case an individual's possibilities to affect his/her risk exposure are more limited (see e.g. Shrader-Frechette 1985, 19-20). It should be noted that the distinction is a matter of degree, not of a qualitative difference. As an example, an individual has some power over her/his modern agri-biotechnology risk exposure, for instance, owing to labelling requirements. Governmental authorities typically regulate the production of societal risks. Societal risk decision-making is presumed to be transparent, proportional and non-discriminatory, and based on (commonly accepted) due reasons. Whilst the present thesis concerns primarily the governance of societal risks, many of the conclusions reached seem to be valid for the assessment of individual risk-taking (under serious and uncertain risks) as well.³⁰

In the study, the precautionary principle is considered 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. This presumption

²⁹ For example, in the form of increased hurricanes (or typhoons) (see e.g. Webster et al. 2005).

³⁰ Individual and societal risk decision-making differ in relevant respects, however. Decision-making concerning societal risks ought to be well-grounded. There is a moral obligation to give commonly accepted reasons for decisions which concern groups of people; the decisions taken should not be arbitrary.

leaves much space for different interpretations of the right status of the principle, and it is undertaken in order to complete an analysis that is as general as possible. In the relevant academic literature, the precautionary principle has been regarded as a decision rule (Hansson 1997), epistemic (i.e. belief-guiding) principle (Peterson 2007), a risk management tool (CEC 2000, 3,13), a legal principle (Trouwborst 2002), an ethical principle (Carr 2002, 31; see also Parker 1998, 638), a methodological rule for risk research (see Ahteensuu 2006, 554-555), and an organising concept for various contemporary ideas that challenge the regulatory *status quo* (Jordan & O’Riordan 1999).

It is obvious that from the metaethical point of view, the precautionary principle cannot be considered the ultimate moral norm from which all theories, other principles and judgements can be deduced. The situations in which the principle is relevant are limited to certain risk decision-making problems, i.e. to complex environmental and health risks which are serious and of which we lack adequate scientific understanding. For example, the principle cannot be invoked when the effects of different possible actions are known or when (objective) probabilities can be assigned to them. Hence, it is necessary to view the precautionary principle in the context of other same level principles, more general (higher level) theories,³¹ and more specific (lower level) rules and particular judgements.³² Similarly, in the context of decision theory, the precautionary principle cannot be regarded as the sole principle of rational action because of the limited set of decision-making situations in which it can be applied.

Complete with these objectives, approach and framework, let us now begin by explicating the precautionary principle.

³¹ As will become clear later on, several different theories and approaches may provide justification or even imply the implementation of the precautionary principle. It has been argued, for instance, that a general approach based upon sustainable development requires the implementation of the precautionary principle as part of it (see Section 2.4.)

³² Tom L. Beauchamp and James F. Childress (1994), for example, have suggested this kind of role for ethical principles.

2. THE PRECAUTIONARY PRINCIPLE

The precautionary principle lacks clarity and is a matter of confusion. Despite the clear common sense appeal of the general idea of precaution, the precautionary principle seems to resist an exact definition (see e.g. VanderZwaag 2002). According to Andrew Jordan and Timothy O’Riordan,

[the precautionary principle] is neither a well-defined nor a stable concept. (...) Admittedly, precaution lacks a specific definition. As yet, it cannot prescribe specific actions or solve the kind of moral, ethical and economic dilemmas that are part and parcel of the modern environmental condition. (...) To date, precaution provides few, if any, operable guidelines for policy makers nor does it constitute a rigorous analytical schema. (Jordan & O’Riordan 1999, 16.)

This selective quotation may not do justice to Jordan and O’Riordan’s general argument. Instead of taking the elusiveness of the precautionary principle as a weakness, they consider it – rather unintuitively – as a strength (II). However, the quotation highlights a commonly agreed fact about the precautionary principle: the principle and its application are shrouded in mystery. Even a short review of the relevant academic literature reveals the absence of consensus in regard to several issues of the principle. There is neither a commonly accepted definition of the precautionary principle nor an agreement upon the interpretation of its key concepts. Shared and consistently followed guidelines for its implementation are also lacking. In fact, these two facts are explicitly mentioned in a number of the academic articles on the principle (see e.g. Adams 2002, 302; Kaiser 1997, 203; Lemons et al. 1997, 210; Manson 2002; Sandin 1999; VanderZwaag 2002).

The precautionary principle is a matter of ongoing disagreements. These dissensions are not restricted to its exact definition and well-founded implementation, but they touch upon almost all the relevant questions of the principle, e.g. the origin of the principle, its first appearance in official documents, and terminological issues (Section 1.2.). I do not claim that there have not been any serious attempts to clarify and define the precautionary principle in the relevant academic literature and elsewhere. For certain there are such studies (CEC 2000; Gardiner 2006; Manson 2002; Sandin 1999). Nor is my intention to argue that no progress has been made in the discussion. Nevertheless, it seems evident that the precautionary principle has remained intangible (i.e. elusive) and contentious. Although the attempts to clarify the principle are laudable in their own right, they are partial at best

because of concentrating merely on one aspect of the precautionary principle, e.g. on the abstraction of its formal structure.

The aim of this chapter is to explicate the precautionary principle by means of conceptual clarification. More precisely, I try (1) to clarify the origin of the principle, (2) to elucidate terminological issues, (3) to identify the core of the principle by explicating the substantial propositions it implies, by identifying its paradigm examples, and by abstracting its basic structure, and (4) to distinguish the principle from other principles, approaches and concepts.

2.1. Origin

Various views have been proposed concerning the origin of the precautionary principle. Furthermore, there is a disagreement over the first appearance of the principle in official documents (see e.g. Adams 2002). My objective here is to illuminate the issue of origin and development. Specifically, I try to show that attempts to trace back the origin of the precautionary principle can be subsumed under three classes. These include (1) the general idea of precaution, (2) specific (non-judicial) codes of conduct and arguments from precaution, and (3) official documents. The main purpose is explicatory, although the relevance of the identified sources is briefly evaluated.

General Idea of Precaution. It has been argued that the origin of the precautionary principle can be found in the general and everyday idea of precaution. According to it, “precautions should be taken”. Philippe H. Martin, for instance, claims that

[t]he precautionary principle is an age-old concept. Unambiguous reference to precaution as a management guideline is found in the millennial oral tradition of Indigenous People of Eurasia, Africa, the Americas, Oceania, and Australia. (Martin 1997, 276.)

This view reflects a wide understanding of the precautionary principle, not restricted to environmental and health concerns. Precaution has played a role in oral traditions around the globe, and it guides us not to inflict harm with our actions. Furthermore, the core of the precautionary principle is seen as a rule of thumb instead of regarding it as a formal and well-defined decision-making principle.

No doubt, taking precautions seems to be instinctive for human beings, and it is certainly in accordance with common sense. “The idea that care and foresight are required in the face of (...) uncertain future is universal and of all times” (Trouwborst 2002, 7). The essence of precaution is captured by several English sayings such as “better safe than sorry”, “look before you leap”, “a stitch in time saves nine” and “an ounce of prevention is worth a pound of cure”.³³ In fact, the close relation between these sayings and the precautionary principle is mentioned in several relevant academic articles (e.g. Resnik 2003, 329; Sandin 2004, 462; Trouwborst 2002, 8; VanderZwaag 2002, 166).

Despite the apparent similarities, it should be noted, however, that these sayings and aphorisms are general in nature; thus, they do not provide specific guidance for concrete situations.³⁴ Moreover, although these sayings emphasise the avoidance of harm and preparing for the uncertain future, they seem to do it in a wider sense than does the precautionary principle. As an example, unlike the general idea of precaution, the precautionary principle is triggered only by inadequate and/or disputed scientific knowledge concerning certain types of environmental threats and health hazards.

Furthermore, even if we sidestep the obvious differences in content between precaution and the precautionary principle, we might still end up with another more theoretical problem. Following Sandin,

[f]or a principle to be present, we might demand that the agent as a minimum subscribes to a claim like ‘precaution should be taken in situations of type *T*’. That the agent believes that precaution should be taken in the particular situation *S* is not sufficient. In addition, there must be a claim like ‘precaution should be taken in situation *S* and *in relevantly similar situations*’, with the relation of ‘relevantly similar’ somehow specified. (Sandin 2004a, 4.)

³³ Interestingly, there are other sayings that seem to urge against being cautious, or that require action instead of inaction. These include, for instance, “nothing ventured, nothing gained”, “(s)he who dares wins”, “(s)he who hesitates is lost”, “fortune favours the brave”, “you cannot make an omelette without breaking eggs”. (In Finnish, there are also similar sayings, e.g. “*Rohkea rokan syö*” and “*menköön syteen tai saveen*”.)

³⁴ Some authors have argued that the precautionary principle cannot provide specific guidance for action in concrete cases either (see e.g. Bodansky 1991, 5; for a further discussion see II).

This minimum condition is not fulfilled in the case of sayings or the other writings mentioned above because the similar cases in which precaution should be applied are not specified.

Instead of regarding precaution to be equivalent to the precautionary principle, it can still be considered an origin (or as a predecessor) of the precautionary principle. Moreover, the general idea of precaution might be used to explain the remarkable attention that the precautionary principle has received. According to VanderZwaag (2002, 166), “[a] prime reason for the international popularity of precaution is its reflection of common sense notions evident in numerous cultures”. The principle provides a practical implementation to several wisdoms or sayings. Arie Trouwborst argues, similarly, that

[t]he appearance of the precautionary principle in environmental policy and law can thus be viewed as no more (or less) than the application to a specific problem area of a notion taken from everyday life (Trouwborst 2002, 8).

VanderZwaag and Trouwborst are certainly right in that a part of the evident “magnetism” of the precautionary principle springs from the intuitiveness of the general idea of precaution. It should be borne in mind, however, that several other factors may have had a greater influence in explaining why the precautionary principle has come to the fore in environmental policy debates. First, stakes have become higher than before. Human action can lead, and it has already at least contributed, to serious and irreversible environmental damage (see EEA 2001). Second, there is growing recognition of the sensitivity and intra-/inter-dependencies of ecosystems. Third, our limited understanding of several natural processes and the related risks has increasingly been admitted and emphasised (II; see also Weinberg 1972).³⁵

In sum, although various forms of precaution have certainly been taken as long as human beings have existed, it would be problematic to argue that the precautionary principle has actually been invoked in the above-mentioned cases. Nevertheless, the general idea of precaution seems to have played a role in the formation of the precautionary principle, and it can be employed to partly explain the wide endorsement of the principle.

³⁵ Tim O’Riordan, James Cameron and Andrew Jordan (2001) list reasons for the introduction of the precautionary principle to environmental risk management in their article entitled “The Evolution of the Precautionary Principle”.

Specific Codes of Conduct and Arguments from Precaution. The origin of the precautionary principle has sometimes been traced to specific (non-judicial) codes of conduct and arguments from precaution. According to the former view, the basic idea of the precautionary principle has been present in ethical codes and policies, for instance, in public health policy. Some scholars have even argued that the first reference to the precautionary principle can be found in the Hippocratic Oath *primum non nocere* (first, do no harm) (Ozonoff 1999, 100). John D. Graham and Susan Hsia state that

[i]nstitutionalized precaution can be found in the early days of medicine, in the form of one of the more well-known phrases of the Hippocratic Oath (Graham & Hsia 2002, 374).

I agree that certain traditional ethical codes and policies might be correctly attributed as being precautionary in nature. However, in the end, these codes and policies seem to resemble more closely the general idea of precaution than the precautionary principle itself (as the latter is usually understood).³⁶

The second strategy is to trace the history of the precautionary principle to certain arguments from precaution which have been presented in various contexts, e.g. in energy policy criticism. This is the case when Julian Morris asserts that

PP-like arguments have been used in the USA since the 1950s; at that time, groups of political conservatives opposed fluoridation of water on the grounds that fluoride was used as rat poison and that involuntary fluoridation amounted to mass medication, a step on the road to socialism. In the 1960s, left-wing radicals similarly used PP-like arguments against nuclear power. (...) By highlighting th[e] possibility of catastrophe, regardless of the probability of its occurrence, campaigners were able to instill fear of the technology as such. (Morris 2000, 2.)³⁷

In the 1970s, these arguments were picked up by social scientists (...), who presented them in a more general framework (ibid.).

Morris himself does not explicate the phrase “PP-like arguments”. This leaves the reader with a spectrum of possible interpretations. On the one hand, Morris may mean that the content of the precautionary principle is

³⁶ The relevance of the precautionary principle in the philosophy of medicine and bioethics is analysed in issue 3 of *Journal of Medicine and Philosophy* 29 (2004).

³⁷ Morris refers here to an earlier study on the issue made by Allan Mazur. It is worth mentioning that the term “precautionary principle” or the phrase “PP-like arguments” cannot be found in Mazur’s (1996) article.

present in these contexts of policy-criticism and other argumentation. On the other hand, he might just intend to say that the precautionary principle and PP-like arguments have a shared denominator in a weaker sense, e.g. in the form of a general risk-avoidance approach.

This logical space can be narrowed down by taking a closer look at the cited paragraphs. From social scientists (whose argumentation relates most closely to the precautionary principle), Morris explicitly names David W. Pearce and Robert E. Goodin. They contend that when a technology poses the possibility of a catastrophic and/or irreversible risk, we should not proceed with that technology. According to Pearce, we should not introduce new technologies “without first having solved the problems they create” (Pearce 1980, 58). For example, we should refrain from using nuclear power as long as the waste disposal problems remain unsolved. Goodin (1980), in his turn, invokes the possibility of a catastrophe as a reason against the use of nuclear power.

[L]essons may be far too costly. Some nuclear mishaps will no doubt be modest. But for the same reasons small accidents are possible, so too are large ones and some of the errors resulting in failure of nuclear reactor safeguards may be very costly indeed. This makes trial and error inappropriate in that setting. (Goodin 1980, 418-419.)

The mere possibility of a catastrophe is used to justify restrictions. A similar means of justification can be found in certain understandings of the precautionary principle (for discussion see Manson 2002, 270-274; Rääkkä 2004). Accordingly, because Goodin’s argument resembles some formulations of the precautionary principle, there might be a weak sense in which it can be said that the principle is actually invoked here. At least, Sandin’s minimum condition is fulfilled in the argumentation of Goodin and Pearce. Similar cases are defined, for example, by the common emphasis on the irreversibility of effects as a trigger condition (i.e. criterion) for taking precautions. Second, arguments admittedly emphasise a proactive and pre-emptive approach (in the form of inactions) which also characterises the precautionary principle.

This strategy is also put forward by Derek Turner and Lauren Hartzell. They (2004, 452) contend that German philosopher Hans Jonas “gave an early version of the precautionary principle” in his book *The Imperative of Responsibility*.

But just this uncertainty, which threatens to make the ethical insight ineffectual for the long-range responsibility toward the future – an uncertainty not confined, of course, to the prophecy of doom – has itself to

be included in the ethical theory and become the cause of a new principle, which on its part can yield a not uncertain rule for decision-making. It is the rule, stated primitively, that the prophecy of doom is to be given greater heed than the prophecy of bliss. (Jonas 1984, 31.)

Although Jonas' vision is general in nature, it has clear similarity to the very basic idea of the precautionary principle. First, the principle implies that when considering the introduction of an activity, certain environmental and health risks outweigh the possible (economical) benefits of that activity. Second, Jonas is concerned about the possible irrevocable consequences of technological developments, and this also reflects the common understanding of the precautionary principle.

In addition to the cited examples, there have been several other claims about the origin of the precautionary principle which can be subsumed under this class (see e.g. EEA 2001; Martin 1997, 264). Given the apparent similarities and lines of development of ideas, these arguments from precaution deserve to be notified when the history of the precautionary principle is under study.

Judicial Documents. The most common strategy to search for the origin of the precautionary principle is to look for instances of it in law texts and other official documents. This may take two forms. The first strategy is to identify early explicit mentions of the precautionary principle or other equivalent terms. The polemic with this strategy arises from the fact that the first references to the principle were often short and the principle was not defined. Moreover, several phrases have been employed, such as the term "precautionary measures"³⁸ and "precautionary approach"³⁹ (see e.g. Adams 2002, 304-305).

A commonly agreed predecessor of the precautionary principle can be found in *Vorsorgeprinzip* (literally, foresight-planning) which was introduced to German environmental policy and law in 1970s.⁴⁰ The *Vorsorgeprinzip* emphasises identification of early warnings of environmental threats and preparing beforehand for the uncertain future and for its risks. It was first incorporated into air and water protection law in West Germany, but it soon

³⁸ E.g. *Montreal Protocol* 1987, Preamble, Paragraphs 6 and 8.

³⁹ *Second International Conference on the Protection of the North Sea* 1987, Preamble, Paragraph 7.

⁴⁰ For a discussion see e.g. Boehmer-Christiansen 1994. The other four basic principles in German environmental policy were *Verursacherprinzip*, *Kooperation*, *Wirtschaftliche Prinzip* and *Gemeinlast Prinzip*.

became a fundamental principle of German environmental law. According to the *Bundesministerium des Innern* (BMI 1984, 53),

[t]he *principle of precaution* commands that the damages done to the natural world (which surrounds us all) should be avoided in advance and in accordance with opportunity and possibility. *Vorsorge* further means the early detection of dangers to health and environment by comprehensive, synchronized (harmonized) research, in particular about cause and effect relationships (...), it also means acting when conclusively ascertained understanding by science is not yet available. Precaution means to develop, in all sectors of the economy, technological processes that significantly reduce environmental burdens, especially those brought about by the introduction of harmful substances. (Cameron & Abouchar's [1996, 38] translation is followed.)

Despite the obvious similarity between the *Vorsorgeprinzip* and the precautionary principle, some authors have considered the former as a more value-laden concept than the latter (e.g. Myers 2002, 215-216). However, it should be borne in mind that both principles are value-laden and that the precautionary principle takes a wide range of forms in its implementation (Section 2.3.; I-V). The currently used German translation of the precautionary principle is the *Vorsorgeprinzip*.

The first explicit mention of the precautionary principle (or more precisely, a precautionary approach) in an international environmental treaty was approximately twenty years ago. The Ministerial Declaration of the *Second International Conference on the Protection of the North Sea* states that

[a]ccepting that in order to protect the North Sea from possibly damaging effects of the most dangerous substances, a *precautionary approach* is necessary which may require action to control inputs of such substances even before a causal link has been established by absolutely clear scientific evidence (*Second International Conference on the Protection of the North Sea* 1987, Paragraph 7; italics added).

The second strategy to search for the origin of the precautionary principle is to identify cases in which the principle is thought to be present even if it has not been explicitly mentioned. Accordingly, the first instance of the precautionary principle in an official text may be found in the *World Charter for Nature*, adopted by the United Nations General Assembly, as early as in 1982.

Activities that are likely to pose a significant risk to nature shall be preceded by an exhaustive examination; their proponents shall demonstrate that expected benefits outweigh potential damage to nature, and *where potential adverse effects are not fully understood, the activities*

should not proceed (*World Charter for Nature* 1982, Principle 11b; italics added).

Principle 11b includes the basic constituents of the precautionary principle: a reference to an unacceptable threat of damage, to scientific uncertainty, and to precautionary measures in the form of inactions.

Much more polemic cases have also been suggested (see e.g. Myers 2006, 4-6). Among several others, Daniel Bodansky (1991) argues for the early use of the precautionary principle in law and policy (see also EEA 2001). In his view, although the principle is not explicitly mentioned in the environmental law of the United States (US),⁴¹ the precautionary principle has been the basis of much of it for several years. The “no discharge” requirement of the 1972 Federal *Water Pollution Control Act* Amendments is provided as an example of this. The act presumed that discharges of pollutants are harmful to the water quality in the first place even without any scientific predictions, and it included the so-called ALARA (as low as reasonably achievable) approach as the required response. Examples of the precautionary principle can also be found at international level. In the 1970s, a moratorium on commercial whaling “was justified on the basis of uncertainty about the impacts of continued whaling (...) rather than on the basis of scientific evidence (...)”. (Bodansky 1991, 5.)

The further development of the precautionary principle in environmental law and policy is not reviewed here extensively. Several such analyses are available. The most comprehensive which I am aware of is that of Trouwborst (2002; see also Cameron 2001; Freestone & Hey 1996).

2.2. Terminology

Terminological issues present another source of confusion and disagreement in the discussion on the precautionary principle. For instance, while most authors speak about one definite principle (e.g. Rogers 2001), others use the indefinite plural form (e.g. Löfstedt et al. 2002). Second, several terms have been employed. In official documents, phrases such as “precautionary measures”,⁴² “precautionary principle”,⁴³ “principle of precautionary

⁴¹ The US, however, endorses some international agreements that contain an explicit mention of the precautionary principle (e.g. UNCED 1992).

⁴² *First International Conference on the Protection of the North Sea* 1984, Operative Paragraphs D.3 and H.7; *Montreal Protocol* 1987, Preamble, Paragraphs 6 and 8; *Vienna Convention* 1985, Preamble, Paragraph 5.

action”,⁴⁴ “precautionary approach”⁴⁵ can be found. An even more diverse set of phrases has been used in the commentary literature pertaining to the principle. Besides the afore-mentioned terms, the examples include “precaution” (Levidow et al. 2005), “precautionary thinking” (Trouwborst 2002), “precautionary appraisal” (Klinke et al. 2003), “precautionary assessment” (Tickner 2003), “precautionary science” (Cranor 2003), and “precautionary principle/approach” (see e.g. VanderZwaag 2002, 167).

The use of several terms opens up a logical space for (at least) three possible explanations. First, different phrases may refer to one construct (or entity). Second, they might allude to distinct constructs. Third, terms can be purposely employed in order to differentiate between constructs which overlap and have only subtle differences. Although the last explanation is certainly true of certain cases (especially those in the academic literature), the use of several terms can be neatly explained in the light of the first one.

The following points make it understandable that some legal scholars (e.g. Hohmann 1994) use the plural form, i.e. *precautionary principles*, when they refer to the precautionary principle. First, there are several formulations of the principle in official documents (see e.g. Trouwborst 2002). Second, these formulations differ considerably from each other. Although differences in formulations of the principle are common in different regulatory contexts given the different situations in regard to risk imposition, knowledge about risks, and manageability of risks, formulations differ considerably also within a regulatory context. Let us briefly consider an example of this found in marine environmental protection. Whilst The Ministerial Declaration of the *Second International Conference on the Protection of the North Sea* states that precautions can be taken in the absence of absolutely clear scientific evidence, in the corresponding statement of the third conference, no evidence to prove the causal connection is required.

[A] precautionary approach is necessary which may require action to control inputs of such substances even before a causal link has been established by absolutely clear scientific evidence (*Second International Conference on the Protection of the North Sea* 1987, Paragraph 7).

⁴³ E.g. *Treaty on European Union* 1992, Article 130r(2); In the *Third International Conference on the Protection of the North Sea*, the term is mentioned three times: in Preamble, in Paragraph “Common Actions: Inputs of Nutrients” and in Paragraph 25.

⁴⁴ E.g. *Parcom Recommendation 89/1 on the Principle of Precautionary Action* (1989).

⁴⁵ E.g. UNCED 1992, Principle 15; CPB 2000, Article 1.

[P]recautionary principle, that is to take action to avoid potentially damaging impacts of substances that are persistent, toxic and liable to bioaccumulate 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).

Daniel Bodansky (1991, 5) has phrased an obvious worry lying in the background: because different formulations of the precautionary principle state the trigger for taking precautions and the appropriate precautionary measures in radically differing ways, “it is difficult to speak of a single principle at all”.

Nevertheless, instead of speaking about several principles, (at least, apart from judicial studies) it seems to be more fruitful to say that there is only one principle which is formulated (or understood) in various ways. The use of singular and plural may just indicate the fact that the precautionary principle is thought of at different levels of generality as Sandin notices.

‘[T]he precautionary principle’ may refer to one or other principle of national or international law. Various precautionary principles, if I may use the plural, have been included in several international legal documents. Secondly, the phrase ‘the precautionary principle’ is used more broadly, referring to some principle that can (or should) be applied by decision-makers and policy-makers in general. (Sandin 2004b, 468.)

In the academic literature, the third explanation seems to be true of some cases. Different terms have been employed to point out slight differences between theoretical positions. Joel Tickner (2003) has introduced precautionary assessment in which the principle has implications for the risk assessment phase. This goes against the typical view of the precautionary principle as merely a risk management tool (Section 1.4.). That one concept has, sometimes, been used in several meanings is also worth noticing. For instance, the term “precaution” has been employed to refer to the precautionary principle (e.g. Levidow et al. 2005), to the prescribed precautionary measures, and to the general idea of precaution (Sandin 2004b).

In official documents, the use of different terms seems not to imply a difference in content (at least, not in the sense of the second explanation). For instance, the terms “principle of precautionary action” and “precautionary principle” have been used synonymously. The most debated terminological issue is the possible disparity between the terms “principle” and “approach”. It is not straightforwardly clear as to whether there is a difference in meaning between the precautionary principle and the

precautionary approach (see e.g. Conco 2003, 642-643; Trouwborst 2002, 3-5; VanderZwaag 2002, 166-167). It has been thought that the precautionary approach represents a less stringent version of the precautionary principle, and that it thus avoids theoretically implausible forms of absolutism such as total reversal of the burden of proof (II). According to Francisco Orrega Vicuña,

[s]ince scientific uncertainty is normally the rule in fisheries management a straightforward application of the precautionary principle would have resulted in the impossibility of proceeding with any activity relating to marine fisheries. It is on these grounds that the concept of the “precautionary approach” surfaced with a view to provide a more flexible tool for the specific needs of fisheries management. (Orrega Vicuña 1999, 157.)

Whilst the precautionary principle is seen as practically unworkable, the precautionary approach is invoked as a well-founded regulatory tool in the context of fisheries management (for a further discussion on this view see Trouwborst 2002, 3-5).

Another example can be found in the argumentation of Gregory Conco who relates the view that there is a real difference between these notions to the US government and to certain corporations and industry associations. These institutional actors insist on distinguishing between the precautionary principle and the precautionary approach. Following Conco’s description of this view, the precautionary principle implies total reversal of the burden of proof. Innovators or the proponents of an activity must prove the safety of their activities. Moreover, the fact that threats have different probabilities is not taken into consideration when acting upon the principle. The precautionary approach, in its turn, is in accordance with good guidelines for risk governance – risk assessment procedures and management decisions are standardised.⁴⁶ (Conco 2003, 642.)

⁴⁶ Interestingly, it could be argued that the precautionary principle actually presents a more unequivocal guideline for specific action than does the precautionary approach. The former is a principle, and as a principle it can provide a justification for certain actions in concrete situations. In contrast, the precautionary approach might just be predicated to a regulatory approach that is considered precautionary in nature without implying any specific guidance for concrete situations. As noted earlier, it has been claimed that *Directive 2001/18/EC*, for instance, forms a precautionary regulatory framework (Schomberg 2006, 13).

Nonetheless, several authors hold the opposite view that the terms “precautionary principle” and “precautionary approach” can be used interchangeably (e.g. Mascher 1997, 70). According to Trouwborst,

the basis in state practice for a distinction between the basic characteristics or legal consequences of application of the “approach” as opposed to those of the “principle” is extremely narrow (...) Rather, the terms are used synonymously in this respect. Consequently, a strict, hierarchical distinction after choice of terminology does not appear to find a solid foundation in international law. (Trouwborst 2002, 4.)

The latter view is founded upon several facts. Certain official documents treat the terms as equivalents, i.e. they are used without any indication of a possible difference between them.⁴⁷ Most academic authors have also used the notions synonymously (Trouwborst 2002, 5). Furthermore, in its *Communication* on the precautionary principle, the Commission of the European Communities (CEC 2000) does not make a difference between the precautionary principle and the precautionary approach. Lastly, the formulation of Principle 15 of the *Rio Declaration on Environment and Development* (UNCED 1992) which is typically considered a paradigm example of the precautionary principle actually includes the term “precautionary approach” (for a more detailed discussion see Trouwborst 2002, Chapter 3.).

In this study, “precautionary principle” is employed as a uniting term for the various phrases found in official documents and in the relevant academic commentary literature. The disparities that the use of different terms sometimes implies are taken into consideration by means of speaking about different understandings of the principle (I-V).

2.3. The Core of the Precautionary Principle

One possible way to explicate a notion is to explore the meaning(s) of the concept(s) involved. This is the case when Sandin (2004b) analyses the concept “taking precautions” in order to establish necessary and sufficient conditions for its use. After distinguishing precaution from the related concepts (“prevention” and “pessimism”), Sandin introduces three criteria for an action to be considered precautionary in nature. As a result of the

⁴⁷ See e.g. *Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities* 1995, Annex B. no. 32, Paragraphs 23(i), 104(b)(i), 111(a), 118(b)(i) and 124(b)(i) (excerpted from Trouwborst 2002, 4).

conceptual analysis, he proposes the following definition of precautionary action:

An action *a* is precautionary with respect to something undesirable *x*, if and only if

- (1) *a* is performed with the intention of preventing *x* [the *criterion of intentionality*],
- (2) the agent does not believe it to be very probable that *x* will occur if *a* is not performed [the *uncertainty criterion*], and
- (3) the agent has externally good reasons (a) for believing that *x* might occur, (b) for believing that *a* will in fact at least contribute to the prevention of *x*, and (c) for not believing it to be certain or highly probable that *x* will occur if *a* is not performed [the *reasonableness criterion*] (Sandin 2004b, 467).

Sandin's contribution provides us with a more precise concept of precaution.⁴⁸ Pessimism, for instance, has typically been linked to taking precautions. It is undoubtedly useful to show this connotation as erroneous. The relevance of the analysis for the discussion on the precautionary principle is not immediately clear, however. When the concept "precaution" is analysed in terms of our common sense intuitions and with the help of thought experiments, the result is an elaborated version of the general idea of precaution, not the right definition of the precautionary principle. Admittedly, Sandin (2004b, 468-470) does not argue that he has established the right definition of the principle, but that the criteria established can be employed to answer (or sidestep) two criticisms, i.e. arguments against the precautionary principle.

Whether an analysis of the general concept of precaution can be employed in the definition of the precautionary principle is unclear. This is because decision-making rules/principles and principles of law, such as the precautionary principle, may have been given a precise definition which is strange to our common understanding of the terms involved in their name (or even unrelated to the ordinary meanings of the concepts). Although the names of these principles often reflect their content, this needs not always be the case. It is also worth noticing that most formulations of the precautionary principle do not state a criterion to differentiate between precautionary and non-precautionary acts. They merely specify a trigger condition and

⁴⁸ Somebody might, nevertheless, question whether an agent who believes it to be very probable that *x* will occur if *a* is not performed, but who has externally good reason for not believing it to be certain or highly probable that *x* will occur if *a* is not performed, can also be regarded as acting in a precautionary way. The described situation may take place as an instance of self-deception. Accordingly, the need for the second necessary condition, the *uncertainty criterion*, might be problematised.

precautionary response. According to our everyday intuitions, some formulations (or definitions) may be considered more precautionary and others less so. Obviously, this does not make the former superior.

In this section, I aim to explicate the precautionary principle (1) by illuminating three substantial propositions implied by it, (2) by identifying two paradigm examples of the principle, and (3) by abstracting its basic structure. Several approaches are used for explicatory purposes. To date, only a few serious philosophical attempts to clarify the core precautionary principle exist (Gardiner 2006; Manson 2002; Sandin 1999). Most authors who have written about the principle have just stated that there is no agreement on the exact meaning of the principle.

Substantial Propositions. Even if the exact meaning (or right definition) of the precautionary principle is a matter of disagreement, a general core idea which leaves room for different interpretations can be identified.⁴⁹ Ethically speaking, three substantive propositions are implied by the principle.

First, serious environmental damage (such as loss of biodiversity) and health hazards (e.g. increased allergies) should be anticipated before they actually take place. 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 and health threats, and also tell us about what we do not know. However, there may always remain possible outcomes that we do not know that we do not know about. In these cases, we are unaware of our lack of knowledge or omission from risk assessment. It would be highly impractical (i.e. costly and resource-demanding) and also partly impossible in principle to try to avoid these outcomes. Surprisingly, to date, this first substantial proposition 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*

⁴⁹ Obviously, the fact that there is a wide range of understandings of the precautionary principle does not rule out the possibility that all the understandings share a common core. A rough analogy might be drawn to what Walter B. Gallie meant by essentially contested concepts. A distinction can be made between a concept (e.g. justice) and different conceptions (definitions/theories of justice) of it. According to Gallie (1956, 169), “there are concepts which are essentially contested, concepts the proper use of which inevitably involves endless disputes about their proper uses on the part of their users”.

view may be contrasted with the *reactive* approach which states an obligation to remedy or compensate damage after it has come to fruition. (Of course, one possible position would also be not to care about these kinds of harm at all.) A similar account of the second core 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 (ibid.).

The third substantial proposition flowed from the precautionary principle concerns the right role of scientific knowledge in environmental and health decision-making. According to the principle, adequate scientific understanding of an identified threat is not a necessary condition for taking precautions. This feature distinguishes the principle (or the precautionary approach) from the 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).

Trouwborst distinguishes between “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. It will be argued in Papers I, II and IV that the proposition does not imply that any suspicions of risks, educated guesses or results of junk science are enough to trigger taking precautions, but that we “should act based on the best available science, albeit tentative, inconclusive, or in dispute” (Soule 2002, 21).

Paradigm Examples. Despite the commonly agreed core idea, the precautionary principle has various forms which specify qualifications for

the substantial propositions. As noted before, a number of formulations can be found in official documents such as in 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 explicitly mentioned in most academic articles on the principle. It is typically presented as a basic example of the principle. (e.g. Manson 2002; Myers 2002, 211; VanderZwaag 2002, 167.) Furthermore, the formulation is included in several other official documents. The *Cartagena Protocol on Biosafety* (CPB 2000, 3), for instance, reaffirms this formulation. Lastly, when the precautionary principle is considered in the terms of strong interpretation and weak interpretation, this formulation is the most frequently given example of the latter (V).

Another standard formulation was introduced at a conference organised by the SEHN in 1998. 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 mentioned in several academic articles on the precautionary principle as its basic example (e.g. Myers 2002, 211). According to Derek Turner and Lauren Hartzell (2004, 451), this formulation is “[t]he closest thing to a canonical version of the precautionary principle”. Environmentalists have typically endorsed the formulation (e.g. the SEHN). It is the most frequently provided example of the strong interpretation (V; see also Morris 2000; Soule 2002).

Although these two formulations are considered the standard examples of the precautionary principle, that they differ is obvious. The former says only that uncertainty shall 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, in the following paragraphs, the *Wingspread Statement* says that the burden of proof should

be shifted from the public (and governments and NGOs) to industry (and scientific community). Lastly, whilst in the *Rio Declaration* the term “precautionary approach” is employed, the *Wingspread Statement* mentions “precautionary principle”.

Basic Structure. In addition to the clarification of the core propositions of the precautionary principle and identification of its paradigm examples, a basic structure as a decision-making principle can be abstracted. Some authors have proposed common elements or dimensions of the precautionary principle (Gardiner 2006; Manson 2002; Sandin 1999; see III, endnote 4). These elements, dimensions and logical core structure(s) of the precautionary principle are certainly laudable in their own right, and they provide us with a better grasp of the principle. Sandin’s structural schema (see 1999, 890-895) can be used 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 relevant to speak about thresholds and prescribed actions, not about dimensions or elements.⁵⁰

The basic structure of the precautionary principle can be stated as follows: every formulation of the precautionary principle is a function of two variables, namely a 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.

The trigger is two-fold. It consists of (a) *damage* and (b) *knowledge thresholds* which determine the necessary and jointly sufficient preconditions for the application of precaution. The damage threshold concerns harmful or otherwise undesirable outcomes. More specifically, the relevant types of harm 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

⁵⁰ Another problem shared by Sandin’s and Manson’s structural schemata is that they do not seem to exhaust all the understandings of the precautionary principle even if they cover a number of its formulations found in official documents and in the academic literature. In concrete, the principle is sometimes viewed not only to affect the way in which the uncertain risks are governed (or managed) but also the way in which the threats are being identified and characterised in the first place (Section 1.4.). To be fair, Sandin softens the claim about the applicability of the structural schema in his later writings. According to him (2004b, 470), “there are, however, other versions of the precautionary principle which cannot be interpreted with the aid of the four dimensional if-clause”. Sandin himself considers the formulation of the precautionary principle in the *Rio Declaration* (UNCED 1992, Principle 15) an example of this.

economic ones – if taken into account at all (see Nollkaemper 1996) – are considered only indirectly. Although certain formulations of the precautionary principle include further qualifications for the relevant kinds of harm, the damage threshold is ultimately determined by the general chosen level of protection, or by the agreed level of acceptable risk.

The damage threshold is specified variously in different definitions found in the academic literature (see Manson 2002, 267; Sandin 1999, 901) as well as in official formulations of the precautionary principle. Examples of the latter include formulations such as

“possibly damaging effects of the most dangerous substances” (*Second International Conference on the Protection of the North Sea* 1987, 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 second element of the trigger is the knowledge threshold which defines the required level of scientific understanding (of an identified threat) at which the prescribed precautionary response is well-founded. A narrow view based upon a decision-theoretic classification suggests that the principle can be applied when (i) the (objective) probability of a risk cannot be established, i.e. in the state of scientific uncertainty,⁵¹ or when (ii) 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 (for a discussion see e.g. Manson 2002).⁵² A broader view which rests upon the level of scientific understanding (in a more general sense) 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.

⁵¹ It should be emphasised that, despite the fact that the precautionary principle is pre-eminently a principle of law, the uncertainty which triggers its application is related to limitations on scientific understanding of a risk, not to legal uncertainty and/or proof.

⁵² For a detailed discussion about different risk decision-making situations, see e.g. Stirling 2002, 77-82.

The knowledge threshold is also specified variously in the official formulations of the precautionary principle and in the different definitions found in the relevant academic literature (Manson 2002, 267; Sandin 1999, 901). An interesting case example of the former comes from the Ministerial Declarations of the second and third international conferences on the protection of the North Sea:

(...) which may require action to control inputs of such substances even before a causal link has been established by *absolutely clear scientific evidence* (*Second International Conference on the Protection of the North Sea* 1987, Paragraph 7; italics added);

(...) to take action (...) 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; italics added).

Other examples found in the official formulations 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).

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 in data or poor quality data. Second, analysis methods used may be invalid. This may take place, for example, in the form of faulty models, assumptions, and extrapolations from evidence. The relevant actual causal pathways do not necessarily correspond to those identified and tested. Third, our knowledge can also be limited by the high complexity and indeterminacy of some natural systems. Human factors (i.e. decisions in the future), for instance, can significantly reduce the accuracy of our predictions.

The second structural part of the precautionary principle is the prescribed action. Precautionary response means taking pre-emptive measures. These may take the form of outright bans or phase-outs, moratoria, pre-market testing, labelling, and requests for extra scientific information before proceeding. Another kind of precautionary response would be the establishment and implementation of new precautionary risk assessment

methodologies (Section 1.4.). The latter reflects a heavy emphasis upon the first substantial 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 in the first place.⁵³

Examples of the definition of the precautionary response in the official formulations of the precautionary principle include,

“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, Paragraph 7);

“precautionary measures” (*Wingspread Statement on the Precautionary Principle* 1998).

In addition to those mentioned above, Manson (2002, 267) provides us with the following examples of suggested precautionary measures (or e[nvironmental]-remedies in his terms): postpone the e-activity, encourage research alternatives to the e-activity, try to reduce uncertainty about the causal relationship between the e-activity and the e-effect, and search for ways to diminish the consequences of the e-effect (see also Sandin 1999, 901).

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

- | | |
|-----------------------------------|--|
| (1) <i>Trigger condition</i> | (environmental damage, health hazards, harm to other sentient beings) |
| (a) <i>Damage threshold</i> | (e.g. irreversibility, mortality) |
| (b) <i>Knowledge threshold</i> | (scientific uncertainty, ambiguity) |
| (2) <i>Precautionary response</i> | (e.g. bans, moratoria, labelling, precautionary risk assessment methodologies) |

This schema illuminates the precautionary principle, and it can be employed to evaluate different understandings/formulations of the principle (I-V). It

⁵³ As an example of precautionary risk assessment methodologies, see Tickner 2003. For an analysis of the (narrow and broad) precautionary policies implemented within the EU, see Levidow et al. 2005.

should be noted that particular formulations of the principle determine further qualifications for the trigger condition and precautionary response (III).

2.4. Close Concepts, Principles and Approaches

So far, I have tried to illuminate the precautionary principle and its history in various ways. In the present section, a different approach is brought into play. Instead of explicating what the precautionary principle is, the emphasis is on what it is not. Specifically, I will briefly discuss certain concepts, approaches and principles which have sometimes been considered synonymous or closely related to the principle.⁵⁴ The aim is to show in which ways and why they differ from the precautionary principle.

Close Concepts. The phrases “environmental risk”,⁵⁵ “scientific uncertainty” and “precautionary measures” form the basis for different understandings of the precautionary principle. These phrases (or some equivalent notions) can be found in the various formulations of the principle. They may thus be referred to as its basic elements. Other concepts such as “irreversibility” (e.g. UNCED 1992, Principle 15), “reversal of the burden of proof” (*Wingspread Statement on the Precautionary Principle* 1998), “cost-effectiveness” (e.g. UNCED 1992, Principle 15), “incertitude” (Stirling 2004; Stirling 2002), “ambiguity” and “ignorance” are closely related to the principle. Some of them are employed as extra qualifications for the trigger condition or prescribed action in specific formulations of the precautionary principle. Others are introduced in the academic literature in order to clarify the principle (see e.g. *ibid.*, 77-82). Nonetheless, it is important to notice that any of the above-mentioned notions alone does not cover the meaning of the precautionary principle. Analysis of these terms (such as “irreversibility”) can still be highly valuable. It might be used to systematise the application of the principle. For instance, it may be useful in the determination of the damage threshold.

The concepts of “pessimism” and “prevention” have strong connotations with precaution. Even so, the notions are distinct. Sandin (2004b) claims that whilst precaution implies talk of actions, the notion “prevention” can also be employed in the case of events (of non-occurrence) without an intentional

⁵⁴ This list is by no means meant to be exhaustive. For example, the ALARA (As Low As Reasonably Achievable) approach is not considered.

⁵⁵ Also “threat of environmental harm or health hazard”, “threat of damage”, and so on.

contribution. “[T]he small bush prevented me from falling off the cliff” (ibid., 463). Perhaps more importantly, we can take preventive actions even when the consequences (of inaction) are known beforehand. Precautions, in their turn, can only be taken under the condition of substantial uncertainty. Sandin’s argument for the difference between precaution and pessimism is simple but plausible. As pessimism is related to one’s attitudes and (the formation of and concentration on) certain kinds of beliefs, taking precautions is about what one does (ibid., 463-464). One can take precautions wholly regardless of her/his pessimism or optimism. In this regard, precaution seems to be closer to conservatism (or traditionalism) in policy. Furthermore, it should be borne in mind that the general idea of precaution *per se* is in itself distinct from the precautionary principle (Section 2.1.).

Principles of Law. In the context of law, the precautionary principle is commonly regarded as an independent legal principle (see e.g. CEC 2000, 11; also Hohmann 1994; Trouwborst 2002). Seemingly notwithstanding this, in his article “The Precautionary Principle in Science and Technology”, Andy Stirling (2002, 65) considers prevention, polluter pays, no regrets, clean production and biocentric ethics as the key subordinate principles (and approaches) to the precautionary principle.⁵⁶ Even if this is a terminological blunder, it is worth explicating the way in which the precautionary principle differs from these and other similarly related principles and approaches such as sustainability.

Admittedly, there are at least two arguments for Stirling’s claim. First, certain principles of environmental law such as the polluter pays principle⁵⁷ and the prevention principle may be thought to reflect a precautionary approach in a wide understanding of the latter term. Second, the terminology of (and demarcation between) these principles is still under discussion in the law literature. Nevertheless, this does not imply that these principles would be subordinate to the precautionary principle or implied by it, as Stirling seems to claim. I will now consider chapter and verse the relation between prevention, sustainability and biocentric ethics, and the precautionary principle.

⁵⁶ Precisely, he employs the term “precautionary approaches”.

⁵⁷ The polluter pays principle determines in what scope the agent who places strain on nature is accountable for the effects on the environment which are consequences of the action(s). Roughly speaking, everyone whose actions have damaging effects to the environment or who imposes a risk of damage is responsible for the costs of anticipatory and remedying measures and/or for the possible compensation of that damage.

First, there is a difference between the precautionary principle and the prevention principle.⁵⁸ Theoretically, when focusing on concepts, the distinction between prevention and precaution seems to be quite clear. The former implies higher certainty concerning the effects (or outcomes) which it is attempted to avoid than does the latter. Chronologically, precaution precedes prevention. As our knowledge about the effects advances, actions taken become less precautionary on the one hand and more preventive on the other. Although there may be cases where the distinction becomes blurred, clear examples (which leave no place for doubt) can be identified. If the effects are known, we can only take preventative actions. In the case of hunches or educated guesses without scientific evidence, taking precautions is in order. Accordingly, a typical argument for the difference between the prevention principle and the precautionary principle is that the former is to be applied when the probability of an unacceptable threat can be assigned in risk assessment. If the probability of the risk cannot be assigned, then the precautionary principle may be applied.⁵⁹

In practice, the distinction between prevention and precaution is far more complicated. First, in the legal realm, certain official formulations of the precautionary principle include the phrase “preventative measures” as part of the definition or clarification (see Trouwborst 2002, 40). For instance, “measures to prevent environmental degradation” is used in the *Ministerial Declaration on Sustainable Development in the ECE Region* (1990, Paragraph 7). Second, the principles are not always distinguished from each other in environmental policy. The precautionary principle has been referred to with the term “preventive, precautionary approach” and with other similar notions (Trouwborst 2002, 38-39). At other times, the principles are, however, sharply distinguished. For example, both principles are explicitly mentioned in the *Treaty on European Union* (1992, Article 130r [2]) as basic principles upon which all Union’s environmental policy should be based.

Several legal scholars consider the precautionary principle to be rooted in the prevention principle. The former is seen as an enlargement of the latter.

⁵⁸ Several phrases have been used to refer to the principle: “preven(ta)tive principle”, “principle of preven(ta)tive action” and “preven(ta)tive approach”. Trouwborst (2002, 35-36) briefly considers the relation between the prevention principle and the principle of avoidance of transboundary harm. (Sometimes, the latter is called the prevention principle.)

⁵⁹ The precautionary principle cannot be applied to any imagined threats without evidence, but only to the ones that fulfil the trigger condition.

(Trouwborst 2002, 39.) This interpretation can be based upon the fact that several official formulations of the precautionary principle include the passage “even if scientific understanding of the threat is inadequate” or some equivalent (e.g. *Wingspread Statement on the Precautionary Principle* 1998; see also UNCED 1992, Principle 15). The impression that pre-emptive actions should be taken in the case of risks whose probability can be assigned and even when risks are uncertain (i.e. in the case of risks whose probability and/or magnitude cannot be assigned) is a tempting one. Availability of full scientific understanding no longer draws the line on whether or not to take pre-emptive actions (Section 2.3.). “Action must be taken not *because of*, but *despite* the uncertainty” (Trouwborst 2002, 40). In this light, it seems that precaution would actually be subordinate to (or continuation of) prevention, not *vice versa*.⁶⁰

Second, the precautionary principle needs to be distinguished from (the principle of) sustainable development and the principle of sustainable use.⁶¹ This is the case even if the precautionary principle is typically viewed as part of a change in approach towards the environment in environmental policy which is closely related to the general idea of sustainability (Section 1.2.). However, it may be a fact that implementing a strategy based upon sustainability requires the invocation of the precautionary principle as its part (see e.g. Deblonde & Jardin 2005; Karlsson 2003).

In order to achieve sustainable development, policies must be based on the precautionary principle. Environmental measures must anticipate, prevent and attack the causes of environmental degradation. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent

⁶⁰ Nonetheless, it is not implausible that the evolution of the precautionary principle might entail consequences for the prevention principle. The latter may lose (at least partly) its status as an independent (law) principle. Official documents which refer to the precautionary principle but not to the prevention principle may be thought to imply the latter. The *Rio Declaration* (UNCED 1992), for instance, only mentions the precautionary principle (literally, the precautionary approach). It does not make sense to claim that because of the precautionary principle there is a commitment to take pre-emptive actions in the case of uncertain threats which count as serious, but not to take preventive measures as the knowledge of the risks in question advances/becomes complete (see also Trouwborst 2002, 44).

⁶¹ “Sustainable development” has been defined and interpreted in several ways, e.g. in regard to its possible normativeness. Its most well-known formulation can be found in the report, entitled *Our Common Future* (1987), of the World Commission on Environment and Development. This report is often called the Brundtland Report.

environmental degradation. (*Ministerial Declaration on Sustainable Development in the ECE Region 1990*, Paragraph 7.)

Third, the precautionary principle does not imply a commitment to biocentric ethics, i.e. to a bundle of ethical theories which give a moral status (e.g. rights) to non-human species and which consider life (in all its forms) as having at least some intrinsic value. Not only human beings and their interests are valuable, but also ecosystems, other mammals, birds, fishes, insects, plants, and so on. Regardless of the plausibility of this standpoint, the precautionary principle *per se* “does not take a particular position as to why the environment should be valued” (Parker 1998, 638). As argued earlier, the principle implies two norms with regard to the environment. First, environmental damage should be anticipated before it actually takes place. Second, pre-emptive actions should be taken in order to protect the environment even if scientific understanding of the risk in question is inadequate. (Section 2.3.) Neither of these substantial propositions presupposes a specific justificatory reason for the preservation of the environment. Nature is somehow valuable; thus, we should take active steps to protect it. Although the precautionary principle does not straightforwardly imply biocentric, anthropocentric or any other specific ethical theory, it is obviously in accordance with several biocentric justifications as well as with the anthropocentric claim that precautions should be taken to protect human interests (II; III). “Perhaps we do not have to kill the last fish and poison the last river before realising that we cannot eat money”.

Decision Theory. Albeit the precautionary principle has not received much attention from decision-theorists, some of decision theory’s developments come close to its basic idea. First, striking similarities can be found between the precautionary principle and the maximin decision rule.⁶² The latter was proposed in the mid-forties as the rational decision-making rule (or principle) for decisions under uncertainty. Maximin guides us to choose the decision option that maximises the minimum outcome. After identifying and assessing possible outcomes for various actions, we should choose the action whose worst outcome is the least bad/damaging. Second, irrevocability as a qualification of the damage threshold of the precautionary principle seems to have earlier counterparts. Irreversible consequences in terms of restricting tomorrow’s set of opportunities (or decision possibilities) with today’s choices have been a subject of close scrutiny and debate in decision theoretic literature since the early seventies (see e.g. Immordino 2003).

⁶² It is also called “maximin principle” (e.g. Harsanyi 1975) and “maximin rule” (Hansson 1997).

Given the above, it is not unexpected that decision theory has been employed to formalise the principle. Sven Ove Hansson (1997, 305), for instance, has argued that “[t]he maximin rule can be used as a formal version of the precautionary principle”.⁶³ This is a good point as the similarities (such as the emphasis on avoiding the worst possible outcomes) between these two conduct-guiding norms are obvious. However, there are also clear differences. The maximin rule is applicable to a wide range of decision problems, whilst the precautionary principle is typically taken to concern environmental risk decision-making under uncertainty. The level of generality is different. In particular, the precautionary principle does not merely concern eschewing the worst possible outcome, but it prescribes a pre-emptive response to all identified threats that fulfil the trigger condition. The precautionary principle also qualifies the avoidable states of affairs as certain environmental and health outcomes. Moreover, the precautionary response prescribed by the precautionary principle includes a variety of different measures in addition to the possibility of inaction, whereas maximin merely tells us which (externally identified and assessed) decision option we should (not) choose.

Even if we sidestep the obvious differences in content and applicability and accept the possibility that the maximin rule could be used to formalise the precautionary principle, one may ask whether there are substantial benefits in doing so. In the end, several debated questions pertaining to the precautionary principle also apply to the maximin rule. First, the knowledge threshold of the precautionary principle is hard to define accurately. It can always be purposely disputed (to further interests which are unrelated to the environmental protection) because strict scientific standards for the relevant evidence are not required. Science cannot be used to settle the matter. Scientific proof is not a necessary condition for applying precautionary measures, but nor are logical possibilities sufficient either (see Manson 2002; Rääkkä 2004).⁶⁴ In this regard, the maximin rule *per se* seems not to offer any further advice because it does not specify how (im)plausible threats should be taken into account. Second, both the precautionary

⁶³ For other attempts to formalise or clarify the precautionary principle with the help of decision theory, see e.g. Chisholm & Clarke 1993. An interesting discussion can also be found in the argumentation of Stephen Gardiner (2006) who tries to narrow the scope of plausible interpretations of the precautionary principle with the help of the Rawlsian maximin principle.

⁶⁴ The well-founded threshold is between these extremes, and it is purely a normative choice.

principle and the maximin decision rule may be applied in random and unjustified ways. Implementing invoked precautions is sometimes argued to culminate in a greater overall risk (II; see e.g. Goklany 2001). As Hansson (1997, 306) admits, similarly local applications of maximin “may add up to global incautiousness”. Third, not only is the precautionary principle a matter of ongoing disagreements and substantial criticism, but it has also been argued that the maximin decision rule and its modifications “lead to serious paradoxes because they suggest wholly unacceptable practical decisions” (Harsanyi 1975, 594).

Not surprisingly, Hansson ends up modifying the maximin rule in order to formalise the precautionary principle. Given the clear theoretical and practical value of finding answers to the debated issues outlined above, he takes upon a real challenge when trying to solve the problems of the precautionary principle and the maximin decision rule simultaneously.

2.5. Discussion

Philosophically speaking, if one wants to comprehend an entity, there are three basic questions to answer. How this entity came into being? What kind of an entity it is?⁶⁵ How it differs from other entities? In this chapter, these questions have been considered with respect to the precautionary principle. First, the origin of the principle was traced to three classes of sources. Second, terminological confusion was clarified. Third, the core principle was illuminated. Fourth, the relation of the precautionary principle to certain close concepts, principles and approaches was analysed.

On the basis of the analysis above, the core idea of the precautionary principle can be stated as follows: unacceptable environmental and health risks should be anticipated (*foreseen*), and they ought to be prevented (*forestalled*) before the damage comes to fruition even if scientific understanding of the risks is inadequate.

⁶⁵ Other questions – such as what are the inherent features or constituents of the entity in question and what, if any, is the function of the entity – may be subsumed under these basic questions.

3. SUMMARY

The aim of the preceding chapter was to provide a preliminary but firm conceptual grip of the precautionary principle. In particular, the principle was explicated by (1) clarifying its origin and development, (2) elucidating terminological issues, (3) identifying its core, and (4) distinguishing it from other principles, approaches and concepts. In conclusion, although certain authors refer to the precautionary principle in the plural form, it is more fruitful to speak about one principle that is formulated – and can be understood/interpreted – in various ways. The core idea of the precautionary principle is that unacceptable environmental and health risks should be anticipated (*foreseen*), and they ought to be prevented (*forestalled*) before the damage comes to fruition even if scientific understanding of the risks is inadequate (see also I-V).

In Paper I, the background and history of the precautionary principle as well as its connection to modern biotechnology are first briefly discussed, and the distinction between the weak interpretation and strong interpretation of the principle is clarified. Second, a three-part structure shared by every formulation of the precautionary principle is identified. These three structural parts are the knowledge condition, damage condition and precautionary action. Third, it is claimed that the implementation of the precautionary principle currently has to deal with many open questions and problems. These also include new challenges for democratic decision-making procedures. Fourth, it is argued that two particular criticisms – the argument from absolutism⁶⁶ and the argument from the unscientific nature of the precautionary principle – do not lead to the abandonment of the principle.

The origin and development of the precautionary principle is explicated in more detail in Paper IV (see also Section 2.1.). In particular, it is shown that the attempts to trace back the origin of the precautionary principle can be subsumed under three classes. These include (1) the general idea of precaution, (2) specific (non-judicial) codes of conduct and arguments from precaution, and (3) official documents. The connection between the precautionary principle and modern agri-biotechnology is considered at length in Paper IV. The distinction between the strong and weak interpretations is put under critical scrutiny in Paper V. The basic structure

⁶⁶ Sandin (2004b) uses the phrase “argument from absolutism”.

of the precautionary principle is elaborated upon and slightly revised in Papers III and IV (see also Section 2.3.). It is then summarised as follows:

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

In Paper II, it is argued that three criticisms which have been presented in academic discourses, political arenas, and also in public discussions with the aim of rejecting the principle altogether do not result in the abandonment of the precautionary principle on the whole, but only of its particular implausible interpretations. The criticisms are labelled as the argument from vagueness, the argument from incoherence, and the argument from adverse effects. The argument from vagueness says that the precautionary principle is ill-defined, and thus too vacuous to offer any useful guidance for decision-making; consequently, it should be abandoned. The argument from incoherence refers to the following kind of inference: incoherent principles should not be used as the basis for societal risk decision-making; the precautionary principle is incoherent; thus, it should be rejected. The argument from adverse effects is the claim that implementation of the precautionary principle would lead to serious and commonly unwanted consequences, and thus that the principle should be abandoned as a policymaking tool. Each of the three arguments is explicated and its more detailed versions are assessed. Lastly, a brief review of the reasons for taking precautionary actions is provided. The rationale for taking precautions includes the fact that human action can lead – and has already contributed – to serious and irreversible environmental damage. Ecosystems’ sensitivity and intra-/interdependencies are increasingly acknowledged. Traditional environmental risk governance has disregarded real risks with highly detrimental consequences. The conclusion drawn from these factors is that the burden of proof remains with those who reject the principle altogether.

Paper III introduces a framework which both illuminates different normative commitments and choices related to the implementation of the precautionary principle and enables ethical evaluation of specific understandings of the principle. Normative underpinnings present in the implementation of the precautionary principle are 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*

In Paper IV, the precautionary principle is considered in relation to the current dispute over the well-founded risk governance of modern agri-biotechnology. Two facts call for the precautionary principle in agri-biotech risk governance. First, there are uncertainties concerning health hazards and long-term environmental impacts. Second, several alleged risks are matters of ongoing scientific debate. The risks of modern agri-biotechnology are briefly discussed, after which the meaning of the precautionary principle is illuminated by explicating the substantial propositions that it implies, by identifying its paradigm examples, and by abstracting its basic structure. Two opposing views on the right role of the precautionary principle in agri-biotech risk governance are subjected to critical analysis. According to the first view, the precautionary principle should be implemented in the risk governance of modern agri-biotechnology. The second view says that the principle should not be implemented in the agri-biotech context. Neither view is found to be satisfactory. Finally, a middle stance is suggested.

The main argument of Paper V is that the current usage of the traditional distinction between the weak form and strong form of the precautionary principle – upon which the ongoing debate has been centred – is ambiguous, inexhaustive and semantically misleading. First, the traditional distinction has been employed or defined in several ways (i.e. the distinction is made on the basis of different criteria). Second, the distinction does not cover all the interpretations of the precautionary principle found in national and international risk governance and in the related academic literature. Third, not all the strong interpretations are actually especially strong, or the weak ones especially weak. It seems superficial to speak of the strength or

weakness of the weak and strong interpretations in general. Furthermore, the way in which the strength/weakness is spoken of within the two interpretations derived from the use of particular decisive criteria does not make sense. The analysis also discloses elementary understandings of the principle, and thus provides a sound basis for subsequent scrutiny. In particular, the precautionary principle (or any particular formulation of it) needs to be considered at least in regard to the following dimensions: (1) the principle as a concrete risk decision-making tool vs. a guiding principle in the design of a regulatory framework, (2) the status of the principle in scientific risk analysis, (3) placement of the burden of proof, (4) definition of the knowledge threshold (i.e. how much evidence for a threat is required [not] to invoke precautionary measures), (5) the status of cost-benefit analysis (CBA), and (6) the nature and normative status of precautionary measures.

These five papers present the main thesis of this study. In particular, it is argued that the debate needs to be shifted from the question of whether the precautionary principle or its weak or strong interpretation are well-grounded in general to the questions about the theoretical plausibility and ethical and socio-political justifiability of specific understandings of the principle. Notwithstanding this, much of the current discussion has still concerned the former question(s). Even so, the issue is too generally (i.e. poorly) formulated, and thus it is impossible to give a satisfactory answer. Instead of focusing on the oversimplified “yes” and “no” stances or on the distinction between the weak interpretation and strong interpretation, further constructive discussion can only concern elaboration of the middle standpoints.

The real picture of the precautionary principle is more complex than that found (i.e. presumed) in much of the current academic, political and public debate surrounding it. The wide range of different understandings of the principle cannot be captured by simple classifications such as the traditional distinction between its strong interpretation and weak interpretation. The specific interpretations of the precautionary principle may only be correctly evaluated one by one and in relation to the relevant regulatory context(s). As a result of the analysis, certain presumptions and interpretations of the precautionary principle were found to be sound, while others are theoretically flawed or present serious practical problems. In other words, the range of plausible readings of the precautionary principle was narrowed down.

Paper VI highlights shortcomings in public consultation practices on the deliberate release and placing on the market of GMOs in the EU. It is argued

that current GMO consultation practices do not meet the aims and objectives on which their introduction is typically justified. Specifically, they do not necessarily serve democracy, increase consensus, enable better decisions to be made, or establish trust. It is concluded that there is a clear need for the active development of GMO consultation practices and for critical discussion on the ethical foundation of public engagement.

Paper VII discusses the question of whether acting against moral prohibitions is worse than acting against some other moral norms in the light of three classical distinctions in ethics. The prohibition thesis, that is, the claim that on a moral scale prohibitions are weightier than other norms is related to the distinction between negative and positive rights, that between acts and omissions, and that between duties and supererogatory acts. Although the distinctions as such do not imply normative consequences, they have frequently been employed by moral critics. The strict interpretation of the prohibition thesis is concluded to be false.

Finally, the analysis has disclosed conceptual and ethical presumptions and elementary understandings of the precautionary principle, critically assessed current practices invoked in the name of the precautionary principle and public consultation, and sought to build bridges between precaution, engagement and ethics. Hence, it is intended to provide a solid basis upon which subsequent academic scrutiny can build.

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