

# Methodological Approach for Testing a Co-regulatory Bio-fuels Weeds Risk Management Model

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## Abstract

*Apart from scientific risk analysis, policy and regulations directed to manage weeds risk rely only to a limited degree on risk techniques to address biological invasions. It is the aim of this PhD research to investigate how commercial risk-based techniques can be better embedded into institutional arrangements to address the weeds risk associated with the use of energy crops to produce bio-ethanol. To this end, a conceptual architecture for a co-regulatory risk management model has been developed. It is the purpose of this paper to explain the methodological approach adopted to test the model. The first part of the paper explains the underpinning philosophical assumptions of this project. Research design for data collection to produce new empirical knowledge and inform the legal policy research process in relation to the bio-fuel weed risk is discussed in the second part. The second part of the paper also discusses the methodological challenges faced due to the nature of environmental law and the difficulty of communicating the concept of risk. The last part of the paper explains the criteria selected to assess the quality of this research. A table provided at the end of the paper gives an overview of the methodological approach and practical examples.*

## Introduction

Whilst they can become a substantial source of renewable energy through the production of bio-ethanol, some second-generation<sup>1</sup> bio-fuels crops present strong invasibility features. Depending on a series of complex and uncertain contributing and interacting factors (including climate change and human-induced activities), they may become weeds<sup>2</sup> and impact on a collectively valued natural heritage which encompasses habitats and rare fauna and flora. They may also generate severe economic and social costs.

The current Australian regulatory model for weeds relies mostly on traditional institutional arrangements in the form of prescriptive measures, voluntary action, government intervention and market-based instruments. These give insufficient environmental protection against biological invasions. Besides instrumental limitations,

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<sup>1</sup> These crops are part of a second-generation technology for the production of renewable energy. The House of Representatives Standing Committee on Primary Industries and Resources (2010, p. 72) reports that:

Second generation technology [...] represents a step change in technology – it has been physically demonstrated but is not yet commercial due to scale-up issues, or it is not commercially viable due to very high conversion costs.

<sup>2</sup> Sindel (2000, p. 4) defines a weed as 'both time and location specific'.

this model also suffers from excessive normative and institutional fragmentation. The policy-making process for weeds control is highly challenged by the multiple uncertainties associated with weeds risk. This is illustrated with the difficulty in determining whether a species has the potential to become invasives, which generates 'a profound lack of complete or coherent law and policy' (Miller and Gunderson 2004:1). Highly subjective decisions – underpinned by political biases – are often involved in assessing the characteristics and likelihood of: the weeds risk; the nature, vulnerability, resilience and robustness features of the risk target (environment, individual, institution) as well as the intensity of the impacts; and the extent and outcomes of the recovery process (if any). Ultimately, tax –payers remain the final risk-bearers for the costs related to policy failures for weeds control.<sup>3</sup>

Nationally and overseas, innovative risk management techniques informed by commerce are increasingly used to manage environmental risks, such as water scarcity, carbon pollution and biodiversity loss. However, with the exception of scientific quantitative- based risk management tools, these are rarely considered within the weeds regulatory context.

Drawing on these innovative environmental strategies, the PhD candidate and her principal supervisor have developed – in the first part of this research – a conceptual architecture for a co-regulatory risk management model. The model was based upon a literature review conducted from October 2009 to October 2010. Its construction derives from the extrapolation of institutional arrangements to manage other types of environmental risks, mostly stemming from the commercial and financial sectors. The model is directed towards improving the effectiveness of current institutional arrangements for weeds control and reducing the financial costs borne by the public sector for biodiversity restoration/conservation. This research thesis is based upon the premise that the weeds risk should be transferred onto the party which benefits from the risk being taken and is in a better position to control it. This research, then, also aims to design a risk corporate accountability approach to decide – on a political or economic basis – the specific institutions/people who should bear the risk associated with their actions in relation to second-generation energy crops-based biofuels production.

To improve the reliability of the strategy, the model<sup>4</sup> comprises a series of instruments to encircle the bio-fuel weeds risk in terms of time and geography. It is underpinned by key risk-management principles and requires, to varying degrees, intervention by both the public and private sectors. The techniques investigated rely on environmental standards, internalising risk and uncertainty for the decision-makers involved in introducing the risk, and differentiating within a broad spectrum of risky behaviours and pricing them accordingly.<sup>5</sup> The techniques ought also to contribute to improving

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<sup>3</sup> For a general discussion on the challenges associated with uncertainty from a social policy perspective, refer to Hammond (1996, p. 3–93).

<sup>4</sup> For a detailed explanation of this model, refer to Martin and Le Gal (2010).

<sup>5</sup> These include civil liability, financial responsibility mechanisms (environmental performance bonds, industry pooled risk sinking funds, environmental risk insurance), invasiveness risk inspection in property transactions, plantation permits, biofuels 'green' investment standards, eco-certification and eco-labelling schemes.

the decision-making process by providing risk-related information based upon scientific investigation; they are underpinned by contractual arrangements which should contribute to close the risk accountability loop within the private sphere.<sup>6</sup>

The second part of the research – currently underway – consists of testing the model described in the above paragraph, to identify the extent to which it represents a practical solution to the old problem of the ‘biological pollution’ caused by weeds. The research question can be framed simply: ‘Is this model workable?’ The method used for deriving an answer to the question is critical evaluation by independent experts.

The purpose of this paper, then, is to explain the methodological approach. The first section of the paper unravels the underpinning philosophical assumptions associated with the research and describes the intellectual journey which led the researcher to opt for a pragmatic approach. With a focus on research design, the second section describes the analytical tools selected to test the model, produce new empirical knowledge and contribute to improving the legal and regulatory policy-making process for weeds control. The second section justifies why the meta-criteria framework developed by Cooksey (2007) was adopted to further assess the quality of this research. The final part of the paper shows a table of practical examples to provide an overview of the methodological approach undertaken. Throughout the paper, methodological challenges are specifically emphasised.

## **The philosophical assumptions of the research**

Methodology can be defined as ‘a body of rules or postulates’ (International Encyclopedia of the Social Sciences 2008, p. 107) which relate to the choice of a research paradigm, based on values, beliefs and assumptions which often cannot be demonstrated. From a philosophical perspective, methodology provides the theoretical framework to understand the world and explain it. Defined as ‘a particular procedure or set of procedures’ (International Encyclopedia of the Social Sciences 2008, p. 107), methodology pertains to the selection of techniques to obtain and analyse information in relation to what is researched in order to produce knowledge.

Quantitative and qualitative approaches remain the core epistemological distinction in research traditions, although these tend to converge within the field of social sciences and natural resource management (Marsland, Wilson, Abeyasekera & Kleith 2001 online). To situate this research from a philosophical perspective and unravel its underpinning assumptions, elements from the two research paradigms across seven dimensions have been combined (Creswell, 2007, p. 17; Teddlie & Tashkchori, 2009, p. 86). This is shown in Table 2. Specifically, the core concept of risk which are associated in the research with the key concept of legal institutions have been extracted from the literature. This framework has been applied to the research to examine the key elements tending to be related to one of the two main research paradigms.

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<sup>6</sup> The researcher purposefully distinguishes between the terms ‘conceptual architecture’ and ‘model’. The former encompasses the risk management model and the different principles which underpin it.

As opposed to natural sciences methodologies guided by probabilistic and deductive reasoning, the application of social sciences methodologies is guided by qualitative inductive reasoning and informed by subjective methods (Denzin & Lincoln, 2005, p. 13-14). The complex construct of risk upon which the conceptual architecture overarching the proposed risk management model for bio-fuel weeds control draws has a dual dimension. Historically, its maturation and application is closely related to the history of the development of research methodologies (Bernstein, 1996). It can be objectively apprehended through a mathematical equation such as:

$$\text{Risk} = \text{probability}_{\text{event}} \times \text{damage}_{\text{event}} \quad (\text{Zinn 2009:5 para.3 online})$$

and, in this articulation, research is likely to be informed by statistical tools. Alternatively risk research can be associated with the exploration of subjective perceptions of risk. For some researchers, risk largely raises perceptual problems (Slovic, 2000, p. 220-231; Renn, 2008, p. 93-97). Cognitive and perceptual biases, underpinned by values and beliefs, contribute to what has been described as the 'pathology of risk perception' (Burgman, 2005, p.19), affecting people's judgments and their reactions to risk issues and uncertain events,<sup>7</sup> including their response to new laws and policies.<sup>8</sup> The socio-cultural context also significantly influences individual and societal risk perceptions, enhancing or thwarting legal and regulatory change (Tulloch, 2009, p. 138-167 online; Ferrari, 2009). In turn, a subjective assessment of risk may affect its objective evaluation (Baker, 1996, p. 83). As clearly shown in a table developed by Zinn (2009, p.8 para.4 online), the epistemological approach in different disciplines and approaches shows that the concept of risk operates across the two main traditional research paradigms.

Besides its emphasis on the concept of risk, this research also adopts a systems-based methodological perspective. It aims to identify the multiple complex interactions occurring within the relevant environmental-socio-economic systems in order to target legal and regulatory points of intervention and design a corporate risk accountability approach. Ultimately, it is intended to improve risk management strategies for biofuels weeds control.<sup>9</sup>

Systems theories are complex and rooted diversely in the two main core research paradigms. The one that informs the present research is embedded in Luhmann's social theory (2003), which is rooted from an epistemological standpoint in the

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<sup>7</sup> The disciplines of psychology and sociology have significantly contributed to the understanding of how people react to risks and uncertainties. For further developments, refer to the Prospect Theory developed by Kahneman and Tversky which shows that people become risk-averse when the chance of a small gain is more certain than the one of a large gain (Kahneman & Tversky. 1979, p. 263-291; 1984:341-350).

<sup>8</sup> For example, Botterill and Mazur (2004, p. 16) reports that [...]success of a range of agricultural and natural resource management policies and programs that are designed to increase productivity and sustainability is clearly dependent on understanding how farmers (and rural communities) perceive risk and how those perceptions vary among individuals, groups and communities.

<sup>9</sup> Systems theory originally originated in the natural sciences and has been transposed into the social sciences. For its application in agriculture, refer to Alrøe & Kristensen 2002:3-23).

constructivist paradigm. It considers that law is a social system in which human behaviours and institutional structures are influenced by a wide range of contextual factors, including values. Within this context, the exploration of social relationships through social science methodologies is used to unravel 'more informal and unobservable' artefacts (Cooksey, 2010), as part of an organisational iceberg (Hellriegel & Slocum, 1979, p. 7), to identify the social norms which influence the policy-making process. Such a perspective contrasts with the traditional positivistic approach to the legal phenomena, distinct from doctrinal research where the goal is to uncover what the law is (Hutchinson, 2006, p. 33-35). This also echoes the increasing shift towards the integration of social sciences methods such as behavioural economics to help to unravel what the law could or should be (Hutchinson, 2006, p. 87-118; Sunstein, 2000). The methods used for such explorations can be drawn from many disciplines, including economics, political science and (in a more specialist form) regulatory theory. From an ontological perspective, the law, conceived under the traditional positivistic approach as a sort of meta-phenomenon existing in a objective doctrinal vacuum' (Hutchinson, 2006, p. 87) and dictating how social relationships are shaped and regulated is, with the advent of social sciences, seen to be at least in part created out of social norms, political dynamics and the operation of the market.

Within this research, the systems-based approach has been adapted to the bio-fuel risk issue in order to understand the socio-economic system within which the risk<sup>10</sup> might occur. This approach should enable a deconstruction of the multiple interactions occurring between and within social institutions and the natural environment, to better identify the actors who drive them. It should then become possible to more effectively target potential responsible parties for financing biodiversity loss/conservation. Within this system, the biofuels risk pathway is represented as a linear sequence of transactions and events, addressing the entry, establishment, acclimatisation and spread of an invasive species. The coupling of this human system with a chronological representation of the evolution of the environmental hazard enables the researcher to target potential legal and regulatory points of intervention to then apply the risk management strategies<sup>11</sup> proposed in the risk management model.<sup>12</sup>

In light of what has been previously discussed, and as summarised in Table 1, this research is situated along the spectrum of the two main traditional research paradigms. Justifying the choice of specific research methods by arguing that the research should (for objective reasons of science) have been philosophically framed exclusively through the lens of either positivism or constructivism/interpretativism would have been misleading. This is mostly due to the dual dimension of the concept of risk which can be equally examined through positivistic and/or interpretative methodological tools and the nature of this PhD research.

<sup>10</sup> The researcher acknowledges that due to the dual dimension of the concept of risk, the term 'biofuel weed risk' can either refer to its objective assessment and/or its subjective perception by different relevant stakeholders involved at different stages and to varying degrees in the policy-making decision process

<sup>11</sup> This systemic approach has been used in other studies (Martin & Verbeek 2000; Martin, Williams & Stone 2008).

<sup>12</sup> This is beyond the scope of this research project and the researcher's skills and competences to apply a whole-of-system thinking to the weeds challenge.

Recognising that the primary goal of this PhD thesis was to find institutional arrangements addressing the weeds problem effectively and cost-efficiently, the researcher, using inferential reasoning which assessed the research question against the two traditional paradigms, decided to opt for a pragmatic approach as a theoretical methodological framework for the research. This is consistent with the normal practices of public policy development, where the processes of evaluation are multi-dimensional and the methods used seek to balance and take into account a wide variety of factors. The methods of this research are derived from the types of pragmatic approaches used by government for testing new policy concepts in the forms of legal and regulatory instruments; that is, to interrogate a variety of experts and stakeholders in order to 'triangulate' towards a decision as to the variables that will impact on the feasibility of the instrument being proposed (Hutchinson, 2006, p. 55-61).

As reported in Creswell quoting other authors (2007, p.23):

Pragmatism is not committed to any one system of philosophy and reality.

Individual researchers have a freedom of choice. They are 'free' to choose the methods, techniques, and procedures of research that best meet their needs and purposes.

However, despite this description of pragmatism, there are key metaphysical questions which are still to be considered in relation to the concept of risk, more specifically its complex multi-faced dimensions which encompass perceptual, cognitive and cultural problems.

## **Research design and data collection<sup>13</sup>**

This section discusses how the methodological challenges within the research have been addressed; the challenges derive from the nature of environmental law research and the difficulty of communicating the concept of risk. The section briefly describes the research tools used to collect data and to test the risk management model in order to – in a third phase – unravel the meaning of risk from a stakeholder's perspective and evaluate the extent to which it is 'workable'.

### **Methodological challenges**

Fisher, Lange, Scotford & Carlane (2009, pp. 213, 224) argue that the methodological challenges of environmental law research are insufficiently discussed in environmental law scholarship:

Many environmental law scholars perceive environmental law scholarship as immature. [...] We argue that the subject can only mature when we face its methodological challenges head on, and we identify four particular issues that have given rise to these challenges: the speed and scale of legal/regulatory change, the interdisciplinary nature of the subject, the heavy reliance in environmental law on a diverse range of governance arrangements and the multi-jurisdictional nature of the subject [...] With regard to 'dilettantism, there is a

<sup>13</sup> With the exception of the literature review, the researcher is at the stage of collecting data from stakeholders. This explains why the analysis of the data collected in the second part of this research process is not yet discussed. This will be exposed in a following article.

tendency for some scholars to be 'bower birds', dragging everything into their scholarship that is adorned by a certain label such as 'environmental' or 'sustainable development' with very little critical awareness that these concepts cannot be taken out of context and may mean different things in different contexts. [...] Another example can be seen between disciplines with scholars happily picking and missing social science disciplines. The literature on 'risk' is a case in point: scholars see the word 'risk' and presume it means the same thing in different disciplines and different bodies of social science thought.

The researcher, from the perspective of a PhD candidate, shares the opinion that environmental law scholarship is immature, not least because of substantive difficulties in translating science into legally relevant decisions. The three-tiered governance architecture of the Australian legal system, characterised by overlapping jurisdictions with diverse competences in weeds, energy and other natural resource management laws, jeopardises the possibility of integrated policies for weeds control supporting sustainable development. It also challenges the task of obtaining a thorough understanding of the legal and regulatory landscape for weeds management.

This institutional fragmentation is aggravated by a fragmentation of skills and expertise in environmental law, where scientists, lawyers and economist use different languages as in a modern version of the ancient tower of Babel. Furthermore, risk is a concept which has to be operationalised to be properly communicated. The specialised literature on the challenge of communicating risk is extensive (Poulsen, 2006; Leiss, 1996) and the researcher is currently experiencing this challenge in her research. Risk has no real physical existence until it is materialised through physical and/or economic harms and depends largely on risk perception (Slovic (2000, pp. 220–231)' Renn (2008, pp. 92–97). While energy crops pose a risk for some, they may represent significant commercial opportunities for others. The precautionary principle is probably the most visible and mediated legal transposition within the policy area arena of how the concept of risk can be incorporated within legislation and regulations (Weier & Loke, 2007). The same principle applied to different events perceived similarly as carrying environmental risks can result in unpredictable outcomes depending upon the political and economic interests involved, and the scientific techniques adopted for its analysis. This is illustrated with Australian decisions allowing the introduction of GMO technologies but rejecting the use of European bumblebees. In the first case, policy strategies shifted from prohibition to a more flexible restricted approach – moving from a simple risk avoidance (ban) to a risk management strategy mostly relying on biophysical safeguards (e.g. GMO trials). However, there are other legal and regulatory ways to internalise the concept of risk in a more nuanced way,<sup>14</sup>

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<sup>14</sup> For example, for the outlay of a relatively small amount of money (premium), weeds insurance policies could protect policy-holders against the economic losses suffered from weeds infestations. Such a strategy offers two options for weeds control: to compensate policy-holders should the risk materialise at an uncertain time or require them to pay a premium on a regular basis to protect them against the uncertain materialisation of the weeds risk. In both cases, as opposed to the precautionary principle, insurance mechanisms enable adjustment to contextual factors, including uncertain events.

including those proposed in the model presented in this paper. It is clear from the interviews conducted to date that, in practice, many of the stakeholders involved in biofuels weed risk and policy do not have clear conceptual frameworks for considering these complex issues.<sup>15</sup>

### Collecting the data

The approach taken for the research is for the researcher and principal supervisor to develop a single conceptual proposal using a range of risk instruments,<sup>16</sup> and to expose this to experts and stakeholders for their critical review. This critical review by experts will provide the researcher with a clear sense of the likely strengths and weaknesses of the model. It will then allow the formulation of a proposition of what a more feasible model might look like, and the identification of issues that would have to be addressed for effective implementation of the model. It will also enable preliminary judgment to be made about the likely feasibility of a risk-nuanced approach to biofuels weed risk. It is not necessary (nor intended) to 'prove' that the conceptual model or any aspect of it would work, as the purpose of the research is to identify only the sorts of issues that would be involved in making any innovation in the use of weed risk instruments effective.

To explain the risk management model to potential interview participants, the researcher and principal supervisor published a concept discussion paper (Martin & Le Gal 2010). They sought critical review through targeted interviews.

The empirical part of this project (interviews and collected data analysis) is not intended to prove definitively the feasibility or the acceptance by stakeholders of this conceptual model. It aimed to identify the architectural challenges of implementing the model, proposing refinements and improvements, and evaluating the potential for a model of this type to be implemented and to be beneficial as an alternative to more traditional regulatory approaches. This reflects the PhD researcher's awareness that moving from theory to implementation requires identifying the potential issues that might arise at the implementation level.

The researcher acknowledges that there are many other possible research techniques than the ones selected. However, mostly due to time, budget and resource constraints, the following techniques (classified in hierarchical order in light of current time constraints) have been selected:

1. Targeted in-depth semi-structured interviews (based upon a framework in which the researcher can ask additional questions);
2. Untargeted web-based structured questionnaire available on the following website: [://invasivebiofuelscrops.webs.com/](http://invasivebiofuelscrops.webs.com/) based upon the same framework. However no additional questions can be added.<sup>17</sup>
3. Targeted and untargeted feedback from the discussion paper posted on [://invasivebiofuelscrops.webs.com/](http://invasivebiofuelscrops.webs.com/);

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<sup>15</sup> This is particularly the case for green indexes.

<sup>16</sup> In the legal discipline, the term 'instrument' has a specific meaning independent of its significance within the positivistic paradigm context where it implies some measurement device. The phrase 'risk-based instruments' refer to the institutional arrangements which underpin them. These include both formal and informal rules.

<sup>17</sup> The distinction between structured, semi-structured and unstructured interviews is based on Fontana and Frey (2005, pp. 695-727).

4. Unstructured group discussion organised with the PhD candidate's Queensland- based Sponsors *Conservation Farmers Inc.* and *Williams and Partners.*

Stakeholders targeted belong to the following main groups:

- Lawyers involved in the bio-fuels related issues (mainly academic lawyers);
- Weeds policy experts;
- Bio-fuels experts;
- Natural resource management representatives<sup>18</sup> and
- Technical experts in risk instruments.

These groups have been selected on the basis of technical expertise. Farmers in general have not been targeted because of the limited (current) experience of farming to the complex technical aspects of the proposed model, and because of economic limits to the empirical research task.

The three first methodological tools are conducted simultaneously. Although mostly qualitative-based, the data collected might then be transformed into quantitative information with the use of specific software.

An overview of the research design process is represented in the following diagram (Table 1).

**Table 1: Research design: an overview<sup>19</sup>**

Step 1	Step 2	Step 3
<p><u>What?</u> Study of the concept of risk and its relevance for environmental protection (literature review)</p> <p><u>How?</u> Data collection: QUAL Data Analysis: QUAL</p> <p><u>Outcomes</u> Development of a risk management model for biofuel weeds risk</p>	<p><u>What?</u> Testing expert responses to the risk management model</p> <p><u>How?</u> Data collection: QUAL Data analysis: QUAL + QUAN (possibly)</p> <p><u>Outcomes</u> Identify institutional barriers</p>	<p><u>What?</u> Adapt, propose, refine and improve the risk management model</p> <p>Policy recommendations</p>

<sup>18</sup> These include some of the actors involved in the current NRM governance system (e.g. farmers and industry groups, representatives of government departments at different levels). For an overview of the different actors involved at different administrative scales and in various sectors, see Broderick et al. (2010).

<sup>19</sup> Inspired from Clark and Creswell (2008, p. 180-181).

## **Assessing research quality**

This brief section explains the criteria selected to assess the quality of this research and how it aligns with the pragmatic approach adopted in this project.

There is no consensus within the specialised literature for the choice of uniform and consistent criteria for assessing research quality (Creswell, 2007, p. 17) particularly in relation to the qualitative paradigm. As all are embedded in specific research traditions, it was the view of the researcher that they did not fit adequately within the theoretical methodological framework. More generally, [...] 'environmental laws scholars [...] lack consistent criteria for judging the quality of research' (Fisher et al., 2009, p. 224). The alternative approach that will be used is to adopt the multi-criteria framework developed by Cooksey (2007) for assessing the quality of research. Revolving around the central criteria of convincingness and supporting meta-criteria, these are paradigm independent. These are adequately aligned with a paradigm-independent pragmatic approach.

## **Conclusions**

Although the initial plan was to discuss triangulation for reinforcing the data analysis process, this changed with the choice of Cooksey's meta-criteria. At this stage, with data collection not yet complete, it seems unnecessary for the purposes of this research to build a compelling argument for the conceptual model. The model serves as a 'stalking horse' to evaluate the technical and public choice challenges that more sophisticated environmental risk management approaches might face. It is equally important to understand why it might not 'work' as it is to identify its strengths. Ultimately the main test for the quality of this research is 'Convincingness' (Cooksey 2007:7-9).

This paper was written in light of the as yet incomplete intellectual journey that has been undertaken since the beginning of this research process. Within this context modifications of the research process are still possible and the research question is still evolving as ideas mature and new challenges appear.

Table 1: Contrasting the research components with the philosophical assumptions of the traditional research paradigms<sup>20</sup>

Assumption	Question	Characteristics			Examples		
		Theme	<i>Positivistic paradigm</i>	<i>Interpretive paradigm</i>	<i>Positivistic paradigm</i>	<i>Interpretive paradigm</i>	
Ontological	<i>What is the nature of reality?</i>	Risk	Risk can be real and objectively assessed	Risk is subjectively assessed.	Researcher provides in the <b>literature review</b> examples where risk is quantified through commercial and scientific instruments (risk-pricing, scientific weeds risk assessments...)	Researcher uses quotes and themes in words of participants and provides in the analysis of the <b>in-depth</b> interviews evidence of the assessment of the participants' perception of the risks associated with the use of energy crops to produce bio-ethanol and the implementation of the risk management model.	
		Dual dimension of the concept of risk					
		Legal institution	It is composed of a set of existing formal rules. The law exists in an 'objective vacuum' <sup>21</sup> which dictates how social relationships are shaped and regulated.	The legal phenomenon is part of a broader dynamic and complex socio-economic system interacting with the physical environment.	Researcher provides in the <b>literature review</b> examples of current institutional arrangements based on <b>primary sources</b> to manage the weeds risk.	With an <b>institutional perspective</b> , the researcher adopts a <b>systems-based approach</b> associated with a <b>biofuels weeds pathway</b> and identifies possible points of institutional interventions as well as the variables which may impact the decision-making process and risk perception.	
In the analysis process, the researcher distinguishes between attitudes, beliefs, values and knowledge. With a focus on existing institutional barriers, the difference between the law is and what it could be justifies future refinements for the risk management model proposed.							
Epistemological	<i>What is the relationship between the researcher and what is being researched?</i>	Not applicable	Researcher stays as objective and external to the research process.	Researcher attempts to lessen distance between herself and that being researched	Researcher tries not to influence the outcomes of the 16 open-ended questions asked during the <b>interview</b> process. These questions also available on the <b>internet</b> do not require the intervention of the researcher. The researcher remains critical in the articles selected for the <b>literature review</b> .	<b>Interviews:</b> Researcher collaborates with participants who are not familiar with some of the risk-based instruments proposed. She spends time with the participants and asks additional questions if relevant, thus becoming an 'insider' in the research process.	
		The researcher tries to remain as objective as possible by not influencing the outcomes of the planned interview questions. However, she is aware that due to the complexity of communicating the concept of risk (including risk-based instruments), she may influence the outcomes of the participants 'response (intersubjectivity <sup>22</sup> ).					

<sup>20</sup> This table draws on Creswell (2007:17) and Teddlie & Tashkchori (2009:86).

<sup>21</sup> Hutchinson (2006:87).

<sup>22</sup> Clark & Creswell (2008:58).

Table 1: Contrasting the research components with the philosophical assumptions of the traditional research paradigms

Assumption	Question	Characteristics			Examples	
		Theme	Positivistic paradigm	Interpretive paradigm	Positivistic paradigm	Interpretive paradigm
Axiological	<i>What is the role of value?</i>	<i>Risk - Environmental policies- Decision-making Process</i>	Research is based on scientific methods (hypothesis testing, quantitative measurements...)	Researcher acknowledges that research is value-laden and that biases are present, but that the researcher's values are to be held apart.	The weeds risk is to be assessed on the basis on scientific sound predictions. The regulatory model for weeds model should reflect this objective assessment of the weeds risk.	Cognitive and perceptual biases underpinned by non-demonstrable values and beliefs affect risk perception which is the basis for people's behaviours and decisions. This might impact the adoption/non adoption of the risk management model proposed.
Rhetorical	<i>What is the language of the research?</i>	<i>Not applicable</i>	Researcher writes in a non-literary, formal style and uses quantitative terms.	Researcher writes in a literary, informal style using the personal voice and uses qualitative terms and limited definitions.	The 'meaning' of the proposed risk management model is interpreted from a stakeholders' perspective. Interview responses may express participants' own assessment of both the biofuel weeds risk and the potential risks associated with the design and the implementation of the risk management model. <sup>23</sup>	The risk management model proposed is expressed as a proposal from the researchers.
Possibly both						

<sup>23</sup> However, this is expressed in a qualitative way.

Table 2: Contrasting the research components with the philosophical assumptions of the traditional research paradigms

Assumption	Question	Characteristics			Examples	
		Theme	<i>Positivistic paradigm</i>	<i>Interpretative paradigm</i>	<i>Positivistic paradigm</i>	<i>Interpretative paradigm</i>
Methodological	What is the process of research?	<i>Not applicable</i>	Researcher uses deductive logic.	Researcher uses inductive logic within its context, and uses and emerging design.	The bio-fuels weeds risk could be assessed objectively through the use of statistically scientific methods. <sup>24</sup>	Researcher focuses on specific risk-based instruments and explores the context in which they have been used to manage other environmental risks.
			Both deductive and inductive logic are used within an iterative process=abductive reasoning <sup>25</sup>			
	Possibility of causal linkages	<i>Not applicable</i>	There are real causes, temporally precedent to or simultaneous with their effects	All entities are in a state of mutual, simultaneous shaping so that it is impossible to distinguish causes from effects	If the biofuel weeds risk was to be assessed on the basis of statistical tools, it would require to unravel the various assumptions made about the causal events contributing to the materialisation of the biofuel weeds risk. <sup>26</sup>	Risk perception is influenced by complex interactive contextual factors. However, causes and effects are not necessarily clearly distinguishable.
			Both (causal events contributing to the materialisation of the biofuel weeds risk are pointed out in the introductory chapter)			
	The possibility of generalisation	<i>Not applicable</i>	Time and context-free generalisations (nomothetic statements) are possible	Only time and context-bound working hypotheses (idiographic statements) are possible	Assessing the effectiveness of environmental policies on specific criteria is possible. <sup>27</sup>	Risk perception is substantially time and context-dependant
			Transferability <sup>28</sup>			

<sup>24</sup> However, this is not the focus of this research as this PhD thesis has a legal and policy orientation.

<sup>25</sup> Clark & Creswell (2008, p. 58).

<sup>26</sup> Same comment as in footnote 23.

<sup>27</sup> Professor Michael Faure argues that the legal and economic theoretical assumptions which underpin the debate around the effectiveness of specific environmental instruments are insufficiently supported by the empirical evidence collected by economists or social scientists, and, further, lawyers are insufficiently trained to understand these materials. Assessing policy effectiveness is highly context-dependent and there are multiple existing theoretical evaluation frameworks for environmental policies based upon diverse criteria. The existing institutional arrangements, the environmental legal context and the regulatory culture in which these instruments are embedded are key factors to be taken into consideration. See Faure (2009, pp. 1–2). There are also serious methodological challenges associated with the use of extrapolation for the purpose of generalising and transposing one legal model from one risk domain to another one. See Steel (2008) for a comprehensive overview of extrapolation problems within the policy-making arena.

<sup>28</sup> Clark & Creswell (2008, pp. 58).

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