2005

Australia's environmental regulation of genetically modified organisms: risk and uncertainty, science and precaution

Fern Wickson

University of Wollongong

Griffith Journal of the Environment, Issue 1, June 2005: Ecopolitics XVI Conference; selected papers, Article 7, 1-27.

Australia's Environmental Regulation of Genetically Modified Organisms: risk and uncertainty, science and precaution

Fern Wickson

University of Wollongong

Introduction

The advance of recombinant DNA technology (popularly known as 'genetic engineering' or 'genetic modification') has seen an intense social debate develop around the potential hazards this technology may pose for human health and the environment. Originally, concerns about the potential environmental impact of genetically modified organisms (GMOs) focussed on the possibility that these organisms may escape from laboratories, survive and have a negative environmental impact (Wright 1994, 136-159). Approvals are, however, now being routinely sought for the *deliberate* environmental release of GMOs for commercial production and this has lead to increased pressure on governments to regulate the release of these organisms in a way that is capable of minimising negative impacts on social and biological environments. The governance problem of controlling the environmental impact of GMOs, and how this problem has been approached in the Australian context, form the central concerns of this paper.

In 2001, Australia implemented a new regulatory system for gene technologies through its enactment of the Gene Technology Act 2000. The objective of this legislation is stated as being:

> *to protect the health and safety of people, and to protect the environment, by identifying risks posed by or as a result of gene technology, and by managing those risks through regulating certain dealings with GMOs (*Commonwealth of Australia 2000, 1).

The agency established for the regulation of gene technologies in Australia, the Office of the Gene Technology Regulator (OGTR) has therefore been charged with the objective of 'protecting the environment' by 'identifying and managing risks' posed by GMOs. One of the

key problems associated with this objective is that while the environment has undoubtedly become an important social and political concern in modern industrial societies (Eder 1996, 163-5; Szerszynski et al. 1996, 19), the nature of 'the environment' and what it means to 'protect it' remain fiercely contested. Most notably, there is a paradigmatic divide between those viewing the environment instrumentally as primarily a human resource that can be protected through the appropriate application of economic measures and technological advances, and those who view organisms and natural systems as having some degree of inherent value that can only be protected through altered social structures and beliefs. This can be described as a divide between shallow and deep environmental critiques of industrial modernity or between reformist and revolutionary (or radical) environmentalism (Doyle and Kellow 1995, 66-70; Porritt 1984, 5; Pepper 1996, 7.).

As concerns for the environmental impact of new technologies have increased in modern industrial societies, and in light of the governance challenges associated with this, there has been an accompanying increase in demand for tools and methods that can be used in aid of decision making. This demand for assistance in environmental decision making has seen the development of such processes as life cycle analysis, environmental impact assessment, environmental modelling and risk analysis (Harding 1998, 133). For new technological developments, the concept of risk has increasingly come to dominate decision making processes (Winner 1986, 138) and has been recognised as particularly prominent in public policy deliberations relating to the environmental impact of new technological developments (Jasanoff 1999, Rosa 2000). As the objective of the Gene Technology Act indicates, Australia has adopted this dominant discourse of risk for its approach to making environmental regulatory decisions for GMOs.

The technical definition of risk used in environmental decision making refers to "a combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence" (Harding 1998, 167). The OGTR has stated that for their regulatory decision making, "Risk is measured in terms of a combination of the likelihood that a hazard gives rise to an undesired outcome and the seriousness of that undesired outcome" (Office of the Gene Technology Regulator 2004, 7). In line with these

two definitions then, risk is predominantly viewed in policy contexts as equalling the probability of a hazard occurring, times the magnitude of its impact.

As these definitions indicate, the dominant approach to risk taken by state organisations is one based around the notion of actual or objective risk (Adams 1995, 10; Robins 2002; Stirling 1999). This is an approach that is structured around the belief that risk is a real phenomenon that exists "out there" as a property of the technology or system under investigation and which can therefore be measured and calculated in an objective manner by an appropriate set of experts. This can be referred to as a 'realist' approach to risk and is a position on the nature of risk that is particularly prominent in the natural sciences. Through examining social science approaches to the notion of risk, however, we find that just like the concept of 'the environment', the concept of 'risk' too is contested. Within various disciplines of the social sciences, risk is presented as something that does not exist in an objective sense, but which is to some degree socially and culturally constructed. Through highlighting the limitations of realist approaches to risk, these social science theories represent a serious challenge to the appropriateness of employing technical discourses of risk in environmental decision making.

In this paper I begin by exploring some of the diversity in social science approaches to the notion of risk. Through this theoretical review, I begin to sketch an emerging theoretical shift in environmental decision making away from science based approaches focussed primarily on an objective quantification of risk, towards what are beginning to be contrastingly described as precaution based approaches, centred on the negotiation of uncertainties. In describing this emerging shift, I draw particular attention to the difference between a precautionary approach and the application of a precautionary principle in environmental decision making and also highlight the different forms of uncertainty involved in making environmental decisions about new technologies.

Having sketched the poles of a spectrum of competing approaches to environmental decision making, I then analyse Australia's framework for the environmental regulation of GMOs in terms of whether it can be most appropriately classified as a science or precaution based approach to decision making. In this paper, I argue that Australia's current framework

for the environmental regulation of GMOs represents a largely technocratic approach that effectively marginalises the influence of factors highlighted as important for precaution based approaches to environmental decision making. In drawing this conclusion, I complete this paper by making some recommendations as to how Australia's framework for the environmental regulation of GMOs could evolve to more effectively combine scientific analysis and a quantification of risk with deliberative processes aimed at negotiating inherent uncertainties.

Social Science Theories of Risk

In the late 1970s, the persistence of public fears over certain technologies (such as nuclear power) that had been assessed by experts as being safe or posing only a small and acceptable degree of risk became a source of confusion for regulators and industrialists (Slovic 1987). As experts were seen as having performed an objective and rational assessment of the risks posed by a particular technology, the conclusion drawn was often that the public's fears represented a false perception of risk, an 'irrational' response to the technology that arose due to ignorance (Turner 1984; Shrader-Frechette 1998; Douglas and Wildavsky 1982, 75).

To successfully alleviate public concerns over particular technologies, it became increasingly important to try and understand exactly why the public perceived risks in the way that they did – for example why were the comparatively low risks from nuclear power plants an issue of fierce contention and widespread social rejection, while the high risks associated with driving a motor vehicle were generally well accepted? What was driving this difference in risk perception? This intriguing and politically relevant question opened the way for explorations of the social dimensions of risk (Krimsky 1992, 5) and saw a wealth of social science studies into public risk perceptions develop across a number of different disciplines, including geography, political science, sociology, psychology and anthropology (Slovic 1987; Wildavsky and Dake 1998). The following discussion explores two of the important bodies of social science theory on risk perception: the psychometric approach that was developed within the field of psychology and the sociological and anthropological approach of cultural

theory. These two distinct social science theories on risk primarily differ in the sense that one body of theory (psychometric) is focussed on individuals while the other (cultural) is directed more towards social or group explanations and analysis (Krimsky 1992, 20-21).

The Psychometric Approach

The psychometric approach to risk perception represents a body of research that aims to illuminate the psychology behind why members of the public may choose to reject some risks, that by expert analysis, represent an acceptable level of danger if calculated according to the levels of risk that are accepted in other areas of day to day life. The most widely cited finding to emerge from psychometric studies is that various factors or characteristics of the risk in question (beyond likelihood and magnitude) influence how it is assessed by members of the public. The characteristics revealed to be of importance included the degree of voluntariness, familiarity, controllability, catastrophic potential, equity and impact on future generations (Slovic et al. 1982; Slovic 1987; Slovic 1991). Recent studies using a psychometric approach to risk perception have also shown that factors such as gender, race, political worldview and trust can also all affect risk judgements (Davidson and Freudenburg 1996; Peters and Slovic 1996; Siegrist 1998; Siegrist 2000; Slovic 1999). Psychometric approaches have suggested that all of these factors play an important role in whether or not particular risks are deemed to be acceptable by the public.

Through highlighting the importance of various characteristics on public risk assessments, psychometric research has suggested that while experts tend to assess risks solely on a statistical basis in relation to probabilities and mortality rates, the public uses a much broader conception of risk (incorporating a consideration of characteristics such as familiarity, controllability, voluntariness etc) in their assessment of risks and their acceptability. Psychometric approaches to risk have therefore served to highlight how the public is capable of sensitivity to non-statistical considerations in their assessments and how they tend to perform a more holistic or contextual assessment of the risks posed by a particular technology (Slovic et al. 1982; Slovic 1987; Otway 1987).

The finding that the public generally employs a broader or more holistic conception of risk than that used by experts suggests that there are important factors of technological risk that are not currently being captured during formal risk assessments. The ability to incorporate these broader elements of risk into decision making processes is seen to be dependent on a reconceptualisation of the role for expertise in risk assessments (Otway 1987), the establishment of a two way path of communication between the public and experts (Otway 1987) and the encouragement of increased public participation and deliberative decision making processes during the assessment of technological risks and their acceptability (Slovic 1998). As long as experts maintain a monopoly on authority in risk assessment and communicate with the public only according to a knowledge deficit model, the broader and more contextual elements of risk that are deemed important by members of the public will continue to remain outside the scope of formal risk assessment processes and debates about the risks associated with contested technologies are likely to continue.

While the psychometric approach to risk perception has made an important and influential contribution to social science understandings of risk, it has not escaped criticism. One criticism is that the lack of attention the psychometric approach gives to the way socio-political factors may also shape public assessments is an important limitation of this psychological approach to explaining risk perception (Otway and Thomas 1982; Covello and Johnson 1987). Wynne (1983) has also emphasised the importance of a socio-political dimension to risk perception through his presentation of the idea of a 'social risk', which he defines as the potential for a technology to substantially alter social structures or basic moral tenets. This proposition indicates a shift away from simply thinking about the characteristics of physical risks as influencing public assessments to highlight the additional importance of potential socio-political impacts.

An associated criticism has been that the characteristics or factors identified as being important in psychometric approaches are not actually objective or inherent in the technology itself, but rather are factors that are themselves influenced by social and historical experience (Jasanoff and Wynne 1998; Douglas and Wildavsky 1982, 17). According to this criticism, the psychometric approach takes the factors themselves as being static and real and does not

place enough emphasis or importance on the way society and culture will influence not only the perception of risk but also the perception of the characteristics identified in psychometric approaches. Some of these limitations of the psychometric approach to risk perception have been countered through the development of sociological and anthropological approaches to risk perception, most notably through the development of what is now referred to as the cultural theory of risk.

Cultural Theory

The basic premise of cultural theories of risk is that perceptions of risk are influenced by cultural factors. While this general statement is supported by a range of social science theorists on risk, the title of 'cultural theory' has been co-opted by a much smaller group of researchers with a far more particular theory on how cultural influences can be conceptualised. The key distinguishing feature of the body of social science theory on risk that has come to be known as "cultural theory" is the belief that commitment to a particular preferred form of social organisation implies common values and will therefore lead to common fears.

While the cultural theory literature contains some variation in the number of different social groupings used to understand the influence of social organisation on risk perception (Rayner 1992; Renn 1992), the most widely referred to analytical tool for cultural theorists is a four fold typology or 'grid/group'. In the first instance, this typology relates to human nature and describes four different cultural biases about preferred forms of organising social relations. As developed by Douglas and Wildavsky (1982, 138) the horizontal axis of *group* is used to describe the boundary that is erected between people and the outside world while the vertical axis of *grid* refers to all other social distinctions and delegations of authority that are used to limit how people behave towards one another. More concretely, the horizontal axis of group runs from a belief in human nature that is individualistic to a more collective approach while the vertical axis can be described as separating human behaviour on the basis of prescribed inequality or prescribing equality (Schwarz and Thompson 1990; Thompson et al. 1990).

Following Adams and Thompson (2002), a description of the four different classifications is outlined below.

- The **individualist** tag (weak group, weak grid position) classifies those who believe in freedom from outside constraints but who may try to exert control over others. Individualists support the notion of freedom of opportunity and believe in the free market rationale that the selfish behaviour of individuals leads to improvements for society as a whole. A good example of the type of person within this individualist category would be a venture capitalist.
- A **hierarchist** (strong group, strong grid position) is someone who generally belongs to groups with binding prescriptions and who is prepared to submit to hierarchical social organisation. A good example of a hierarchist would be a soldier.
- **Egalitarians** (strong group, weak grid position) have strong group loyalties but unlike the hierarchist, do not support externally imposed rules. Equality is an important principle for them and group decisions are sought through participation, deliberation and cooperation. Members of environmental pressure groups can be seen to be good examples of those falling within this category.
- **Fatalists** (weak group, strong grid position) are those people within society who choose not to belong to organised groups but who, unlike the individualist, believe they exercise little control over their own lives. They are resigned to their fate and are hence given the title of fatalists. The untouchables of the Indian caste system are given as an example of those classifiable as fatalists.

When applying cultural theory to an understanding of environmental risk perception, it is suggested that another fourfold typology can be laid over this one dealing with social relations. Schwarz and Thompson (1990) adopted and added to a description from Holling (1979 and 1986) to create a second typology that can be used in cultural theory analysis, a typology that describes four "myths of nature": nature benign, nature ephemeral, nature perverse/tolerant and nature capricious. The differences between these beliefs have been usefully represented through the metaphor of how a ball may behave in varying landscapes.

In the **nature benign** category, nature is seen as being "predictable, bountiful, robust, stable and forgiving of any insults humankind might inflict upon it" (Adams and Thompson 2002). The accompanying image is of a ball in a cup and this is to suggest that no matter what perturbation is encountered, the ball will always return to rest safely at the bottom of the cup. **Nature ephemeral** is essentially the diametrically opposed view that nature is "fragile, precarious and unforgiving" (Adams and Thompson 2002) and is therefore easily threatened by human activity. In the image given for this category, the ball rests precariously atop an overturned cup and this indicates that the ball's balance can be easily disturbed. The **nature perverse/tolerant** category is essentially a combination of the two myths already described. The idea here is that nature is predictable and stable in the face of perturbations, but only within certain limits (Adams and Thompson 2002). The representative image is a wave diagram with two peaks and a single trough, with the ball resting in the trough. This is used to imply that the ball will remain within the trough given only modest disturbance, but any major perturbation will send it over the edge. The final myth is **nature capricious** where nature is viewed as being entirely unpredictable and essentially uncontrollable (Adams and Thompson 2002). The illustrative image here is one of a ball sitting on a straight line to indicate the belief that if disturbed, the ball's (nature's) behaviour will not be predictable.

When this typology of different myths of nature is laid over the typology of human behaviour described earlier, the suggestion is that the nature benign view corresponds with individualist category, nature ephemeral with egalitarian, nature perverse/tolerant with hierarchist and nature capricious with fatalist But what does all this have to do with risk perceptions? According to cultural theory, differences in the perception of risk can be understood as flowing from the commitment to different forms of social organisation and beliefs about nature; therefore, in any debate centred around physical risks, people will be found to be arguing from different premises, premises that stem from their commitment to a particular cultural bias in relation to social organisation and beliefs about nature. The cultural biases and myths of nature given in the typologies are therefore provided as means of identifying, explaining and conceptually organising the different perceptions of risk that might emerge in technological debates. This position implies that societal concerns about risk and

divergent risk perceptions can be explained not by a lack of rationality or by the characteristics of the hazard involved, but rather by the disparity in the perceptual filters adopted by different social actors. Rather than a rational and an irrational position in relation to risk then, a plurality of rationalities begins to emerge in which risk debates are seen to be occurring between people operating from different premises.

In the beginning of this paper I suggested that realist concepts of risk tend to dominate policy environments. Through describing the psychometric and cultural theory approaches to risk I have highlighted two important bodies of social science theory that challenge the adequacy of realist approaches to the notion of risk. While psychometric approaches emphasise the importance of individual psychology and cultural theory emphasises the importance of group dynamics and social commitments in public risk assessments, both approaches can be seen to represent constructivist rather than realist understandings of the notion of risk because both social science approaches highlight the importance of social and contextual factors for risk evaluations. According to these approaches then, the process of risk assessment is not seen to be adequately performed by experts focussing solely on calculating issues of likelihood and magnitude either because this process fails to take of account the nature of the risks involved (whether they are familiar, controllable, reversible etc) and/or because it fails to consider the way in which judgements about risks and their acceptability can be differentially framed by competing worldviews and cultural biases. According to these approaches then, to use risk analysis as a decision aiding tool appropriately, participation by members of the public with diverse views and values is vital.

The Shift from Risk Analysis to Uncertainty Negotiation

When a technical discourse of risk is employed in environmental decision making, the focus is obviously on quantifying risk, while uncertainty, the flipside of the risk concept, is usually only conceptualised as a lack of knowledge. In the literature on risk and uncertainty in environmental decision making, however, there are a number of different typologies of uncertainty emerging that represent a further challenge to the adequacy of technical risk analysis as a decision making tool.

While these typologies differ in how they draw boundaries of distinction and define what constitutes the different forms of uncertainty relevant to environmental decision making, some patterns can be extracted and developed into conceptually useful categories. Firstly, there appears to be agreement in the literature that the term risk is specifically relevant to situations where both potential outcomes and the probabilities associated with those outcomes can be reasonably well characterised (Wynne 1992; Stirling 1999; Stirling and Gee 2002). Uncertainty is a term that is best applied to those situations where there is some agreement about the potential outcomes but the basis for assigning the relevant probabilities is not strong (Wynne 1992; Stirling 1999; Stirling and Gee 2002). In this sense, uncertainty is a form of incertitude that can conceptually be reduced by further research; it is a situation where there is agreement on the potential outcomes but the research on which an assignment of probabilities can occur needs further development. These understandings of risk and uncertainty are those that have traditionally been employed in risk analyses.

When attempting to assess the environmental impacts of new technologies and their acceptability, particularly technologies such as genetic engineering, new types of incertitude arise that are not well addressed by traditional approaches to risk analysis and the notion of uncertainty as it has been understood in these approaches. These types of incertitude can be titled ambiguity, indeterminacy and ignorance. Ambiguity can be seen as a result of contradictory information and/or the existence of divergent framing assumptions and values (Klinke and Renn 2002; Stirling and Gee 2002) (e.g. divergent perceptions of environmental harm or relevant environmental endpoints). Indeterminacy can be described as the type of incertitude that exists because of the intrinsic complexity associated with predicting the outcomes (and probabilities) associated with the interactions of various open-ended social and natural systems (Wynne 1992), while the term ignorance can perhaps best be used to describe our inability to conceptualise, articulate and therefore consider the outcomes and causal relationships that lie beyond current frameworks of understanding – i.e. the things we don't know we don't know (Wynne 1992).

This typology of different forms of incertitude enables us to see how a technical discourse of risk fails to take account of ambiguity, indeterminacy, ignorance and even

uncertainty in some cases (Stirling and Gee 2002; Wynne, 1992). Failure to explicitly and transparently handle these forms of incertitude during decision making processes means that the psychological and social factors influencing public risk assessments (as described by psychometric and cultural theory) remain implicit and hidden. This failure to explicitly handle the different forms of incertitude means that technical risk analyses performed on new technologies like genetic engineering are likely to remain the subject of ongoing controversy and debate as people continue to emphasise different characteristics of the risks in question and argue from competing premises in relation to social and biological organisation. Recognising the inadequacy of traditional risk assessment processes, particularly when they are applied to the environmental impacts of new technologies, is said to represent 'the real justification and imperative for adopting newly emerging precautionary approaches' (Stirling and Gee 2002).

Precautionary Decision Making

The most widely cited definition of a 'precautionary principle' for environmental policy making is that adopted in the Rio Declaration of the 1992 United Nations Conference on Environment and Development (UNCED), where was presented thusly: "Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (UNCED 1992, Principle 15).

While the precautionary principle can be seen to represent a shift in the basis for environmental decision making, the extent to which it enables engagement with the full range of types of incertitude described above is debateable. This is because the understanding of 'scientific uncertainties' that is often adopted in application of the principle is one in which the only type of incertitude involved is one conceptually reducible through further research. This means that while the principle has developed to provide guidance for what should happen under situations of scientific 'uncertainty', it does not necessarily enable or encourage an engagement with the important issues and challenges of ignorance, indeterminacy and ambiguity.

Some of the various criticisms of the formulaic version of the principle include that the idea of what counts as a threat, the criteria for judging seriousness or irreversibility, how the degree of uncertainty is to be judged and the yardstick for judging what is cost effective are all issues for which no objective or single rational answer exists (Stirling 2002, 2-43). This means that applying the notion of precaution as a dogmatic principle or rule becomes problematic at least and paralysing at worst. While the precautionary principle may therefore be seen to represent admirable sentiments for environmental protection, important questions remain about how it can be practically applied in political decision making (O'Riordan and Cameron 1994). The combined weight of the criticisms directed at the precautionary principle has lead to an emerging theoretical shift away from discussions of how a specific 'precautionary principle' can be applied, towards a description of what a 'precautionary approach' to decision making might entail. In this sense, the notion of precaution is moving away from being a *formulaic decision making rule,* towards what might be described as a particular *process based approach* to decision making.

In a precautionary *approach* to environmental decision making, the recognition of the importance of uncertainty translates into the requirement for a greater degree of humility about scientific knowledge in the face of various types of incertitude (Stirling and Gee 2002). Associated with this need for a greater degree of humility is the requirement for a more reflective approach to science that enables the knowledge to be examined, reflected upon and considered in terms of the uncertainties, underlying assumptions and subjective judgements involved. This reflective approach to scientific knowledge can be undertaken by not only exposing particular knowledge claims to the scrutiny of various other scientific disciplines but also to stakeholders and the public more broadly– i.e. engaging in a process of 'extended peer review' (Funtowicz and Ravetz, 1994) or 'negotiated science' (Carr and Levidow 1999). Recognising the need for humility and critical reflection on scientific knowledge therefore leads to calls for precautionary decision making to involve broad based participation. Broad based participation in decision deliberations is certainly justified when decisions involve value judgements and widespread uncertainties, but it is also said to be

important for encouraging an engagement with the ambiguities and subjective elements involved in the framing of risk science (Stirling and Gee 2002).

In addition to a reflective approach to scientific knowledge and the encouragement of broad based participation in decision making processes, precautionary approaches are also said to require detailed consideration of the benefits and potential adverse effects associated with a *range* of alternative options (Fairbrother and Bennett 1999; Stirling and Gee 2002). This means that a range of policy options for delivering a particular good or service need to be considered when a particular activity or technology is judged in a regulatory arena (Stirling and Gee 2002). This requirement to consider various alternatives has also led to the suggestion that decisions need not necessarily focus on what is the 'best option' but perhaps also on how to maintain diversity, resilience, flexibility and adaptability across a range of policy options (Klinke and Renn 2002; Stirling 2002, 21). This is said to represent not only a way to handle ambiguity (diversification offering a way to accommodate different values and interests) but also as a way to approach the challenges associated with ignorance (when there are things we don't know we don't know, the best approach might be one focussed on flexibility and adaptability, or in other words, 'not putting all our eggs in one basket') (Stirling and Gee 2002).

The final important element in precautionary approaches to environmental decision making is stated as being the requirement for ongoing research and dedicated monitoring efforts (Klinke and Renn 2002; Stirling and Gee 2002). Through a commitment to ongoing research and environmental monitoring the idea is that uncertainty can continue to be reduced and our degree of exposure to surprises that may arise due to our ignorance can be minimised (Stirling and Gee 2002).

In summary then, the elements of what represents a precautionary approach to environmental decision making are:

1. A recognition of the limitations of scientific knowledge and a willingness to expose scientific claims to a reflective process of 'extended peer review'.

2. A commitment to reducing uncertainties and minimising surprises generated by ignorance through ongoing research and monitoring.

3. A transparent handling of ambiguity and indeterminacy through reflection on scientific knowledge claims, broad based public participation and the consideration and implementation of a range of policy options.

In general, a precautionary approach can be seen to represent a more inclusive, democratic and reflective process for decision making than conventional approaches to risk assessment where decision making is viewed as primarily a technical matter and the advice of scientific experts consequently granted ultimate authority. By distinguishing between 'science' and 'precaution' based approaches to decision making, though, I do not mean to imply that approaches using scientific information cannot involve the adoption of a position of caution or that precautionary approaches do not involve the use of scientific knowledge or experts. What I am essentially distinguishing between is the role and degree of influence awarded scientific knowledge and expertise. Calling these different approaches to decision making 'science' and 'precaution' based may be misleading and therefore we might better conceptualise the key differences existing between these approaches as differences between a technocratic approach, based primarily on scientific risk analysis (a science/risk based approach), and a more democratic approach focussed around the deliberative negotiation of uncertainties (a precaution/uncertainty based approach).

Australia's Regulatory Framework for GMO's

Having described some of the limitations associated with employing a traditional science/risk based approach and outlined an emerging alternative approach that can be described as precaution/uncertainty based, the question I will now focus on is where Australia's regulatory framework for GMOs can be positioned along the spectrum created by these alternative approaches to environmental decision making. To assess this, I will consider the four key elements of the role awarded science, the degree of public participation, how decisions on risk acceptability are made and the requirements for ongoing research and monitoring.

The Role of Science in Decision Making

The Risk Analysis Framework (RAF) used by the OGTR demonstrates that a positivist approach to scientific knowledge has been adopted and that this form of knowledge has been granted a privileged position in regulatory decision making. In the original version of the RAF it is clearly stated that the OGTR views risk assessment as "a scientific process that does not take political or other non-scientific aspects of an application to use a GMO into account" (Office of the Gene Technology Regulator 2002a, 12). It is also stated that the risk assessment will be "objective and scientifically based" (Office of the Gene Technology Regulator 2002a, 15). In the revised consultation version of the RAF it is claimed that "the process of assessing risks requires a systematic approach that is based on scientific evidence" (Office of the Gene Technology Regulator 2004, 11) and that "the requirement to focus on objective scientific information is evident in the matters specified by the Act that the Regulator must have regard to when considering risks" (Office of the Gene Technology Regulator 2004, 14). Through consistent reference to the objectivity of scientific knowledge, these quotes indicate that a positivist understanding of this form of knowledge has been adopted for Australia's environmental regulation of GMOs. The quotes provided here also indicate that through this conceptualisation, science has been granted authority over the decision making process.

The Gene Technology Act 2000 established three advisory committees to the OGTR - The Gene Technology Technical Advisory Committee (GTTAC), the Gene Technology Ethics Committee (GTEC) and the Gene Technology Community Consultative Committee (GTCCC). Interestingly, the Act has legislated that it is only the committee of scientific experts (the GTTAC) that must be consulted during the risk assessment process for all applications for deliberate environmental release and whose advice must be taken into account when making a decision. When preparing a draft Risk Assessment and Risk Management Plan (RARMP), the Regulator is required by legislation to seek advice from the GTTAC (Commonwealth of Australia 2000, section 50, 33) while there is currently no legal requirement that advice from the non-scientific committees be sought. It is also clearly stated in the Act that "the Regulator must take into account...any advice in relation to the risk

assessment provided by the Gene Technology Technical Advisory Committee" (Commonwealth of Australia 2000, section 51, 34), while the Regulator is not required by legislation to take into account any advice offered by the GTEC or GTCCC in relation to risk assessment or risk management. Of course the Regulator *may* take the advice of these non-scientific committees into account, but under current legislation there is no requirement that this advice be routinely sought on individual applications or taken into account when offered. This element of regulatory framing severely limits the influence these non-scientific committees have over decision making processes.

The lack of influence that regulatory framing has granted the non-scientific advisory committees has also been clearly demonstrated in practice. Before approval was given for the commercial release of GM canola in 2003, the GTCCC chose to advise the Regulator that "a state of unreadiness exists concerning the risks to the environment of the commercial release of GM canola, so significant that the applications should be declined at this time" (Gene Technology Community Consultative Committee 2003). As evidence of the lack of influence the GTCCC has on regulatory decision making, this advice was not taken and the first GM canola crop received regulatory approval. The lack of influence held by the non-scientific advisory committees is further evidenced by transkingdom GM crops being approved for commercial release before the GTEC has completed its investigation into the ethics of transkingdom crosses (Gene Technology Ethics Committee 2003). With the Regulator granting approval to GM crops before investigations from the non-scientific advisory committees have been completed and not acting on advice given when those investigations are complete, it becomes obvious that the non-scientific committees have not been granted the same degree of authority over the decision making process as the committee of technical experts. This is an element of regulatory framing that further indicates the predominance of a technical discourse of risk that awards scientific knowledge primary authority over the decision making process.

Public Participation in Decision Making

For Australia's regulation of GMOs, the Act essentially established two primary avenues for public participation in the decision making process. These avenues are the non-scientific advisory committees and written submissions on individual licence applications. The non-scientific advisory committees do not however provide an avenue for lay members of the public to participate in decision making because to be appointed to these committees you need to demonstrate skills or experience in one of the fields listed by the Act. These committees are therefore essentially made up of non-scientific experts and this frames social, ethical and political issues as matters best represented in the decision making process by groups of experts. Additionally, the general public is excluded from this avenue of participation because the meetings of these committees are not open to the public, even those of the so called 'community consultative committee'. Holding committee meetings in public (with commercial in confidence information excluded where necessary) would allow lay members of the public to raise concerns relating to socio-political impacts and would also arguably encourage deliberation between various worldviews and ideologies. I have, however, already discussed how the non-scientific advisory committees currently have limited power over decision making processes. This means that even if their meetings were held in public, according to the current framework, there would be no guarantee that public views and opinions would be granted any real access to decision making processes through this avenue.

The other avenue available for public participation in decision making is that of making written submissions on the draft RARMPs developed by the OGTR. As an avenue for public participation, this approach has a number of limitations. Firstly, in calling for public submissions on RARMPs, the public is being invited to react to an agency developed document. This means that the public is generally being invited to participate in the final stages of the decision making process, without the ability to contribute to how the problem, objectives or alternatives for the decision making process are framed.

The OGTR also states that comments made in submissions must relate to potential risks to human health and safety and the environment, or in other words, to scientifically quantifiable

dangers. When the public has raised social, ethical, economic or political concerns in written submissions these have simply been deemed to be "OSA" or outside the scope of the assessment. The types of issues raised in submissions on the RARMP for the GM cotton marketed Bollgard II® but deemed outside the scope of the assessment process include:

1. The intensive water and chemical usage associated with cotton cropping (Office of the Gene Technology Regulator 2002b, submission 3 & 12.),
2. The impacts of cotton cropping on the unique tropical savannah ecosystems of northern Australia (Office of the Gene Technology Regulator 2002b, submission 10 & 13).
3. The specific impacts of cotton cropping on river health (Office of the Gene Technology Regulator 2002b, submission 10 & 12 & 18)
4. Issues relating to the potential for contamination of neighbouring farms, affecting their ability to claim 'GE Free' status (Office of the Gene Technology Regulator 2002b, submission 23)
5. The lack of ecological research performed in the unique environments of northern Australia (Office of the Gene Technology Regulator 2002b, submission 13).

All of the concerns raised in these submissions relate to the practice of broadacre cotton cropping in general and its suitability to the environment of Australia's northern territories, issues that were deemed outside the scope of the OGTR's assessment. One submission called on the OGTR to address these types of concerns by looking "at the big picture in your assessment" (Office of the Gene Technology Regulator 2002b, submission 13), but this request too was deemed 'OSA'.

What these public submissions and the way they have been deemed OSA indicates is that while the public has been granted an avenue for participating in decision making, the avenue of written submissions has been framed in such a narrow way as to exclude the types of concerns that predominate in the community; concerns that go beyond scientifically quantifiable dangers associated with the GMO in isolation and relate to characteristics of the technology and the context within which it will be applied. The current framework for regulation

makes no mention of how these types of characteristics (identified as important by the risk perception literature) can be incorporated into the decision making process.

Assessing the quality of the quoted scientific information through a form of extended peer review is also currently being inhibited because the majority of the studies quoted in RARMPs are not publicly available. When I requested a copy of some of these studies from the OGTR during the course of my research, I was informed that I would have to pay to gain access to these documents. The lack of free access to the scientific studies used in assessment processes means that there is an inability to engage in critical reflection and an extended peer review of the science involved in the risk analysis process and this is severely inhibiting the application of precautionary decision making approaches.

While further research evaluating public participation in the OGTR decision making process is certainly desirable, what this discussion indicates is that the current framing and operation of regulatory decision making excludes the more holistic and contextual types of concerns held by the public, fails to encourage open discussions and deliberations about environmental values and inhibits the ability of members of the public to critically reflect on the science used in decision making processes.

Deciding on Risk Acceptability

While one might reasonably expect public participation to be employed in relation to decisions about what constitutes an acceptable level of risk, in practice, the OGTR simply uses current industrial practices as the comparative baseline for arriving at decisions about risk acceptability. For example, in the final RARMP for the GM cotton marketed as INGARD®, section three dealing with the decision on the application states that:

> *It is concluded that there are no risks to public health and safety or to the Australian environment arising from the proposed release of GM insecticidal INGARD® cotton that are additional to those posed by the commercial production of conventional cotton. Detailed risk analyses based on the available scientific information are provided in Appendices 2-6 in support of this conclusion. Therefore the Regulator has issued licence number DIR 022/2002* (Office of the Gene Technology Regulator 2002c)

The rationale behind using conventional agricultural practices as the baseline for acceptable risk comparisons is that the risks posed to the environment by conventional agriculture have already been accepted by society and therefore, as long as the levels of risk posed by GM crops are no greater, then they too should be considered acceptable. This approach to determining risk acceptability ignores the psychometric literature on risk perceptions that suggests that people use a range of different factors to decide what an acceptable level of risk is, factors such as familiarity, controllability and reversibility. If these factors were included in considerations of acceptable levels of risk for GM crops, we may very well find that the Australian people are not prepared to accept a lower level of physical risk to the environment from GM crops in comparison to the risks from conventional agriculture because the risks from GM crops are seen as unfamiliar, uncontrollable, irreversible and have the potential to impact on future generations. One could also argue that setting chemically intensive conventional agricultural practices as the comparative baseline for risk acceptability is setting a particularly low standard by which to judge the environmental impact of GM crops, especially given the unfamiliar, uncontrollable and irreversible nature of these impacts.

It is also worth noting that the use of conventional agriculture as the baseline for acceptable risk comparisons for GM crops also inhibits the consideration and implementation of a range of policy options. By simply comparing the risks posed to the environment from GM crops to those associated with conventional agricultural practices, the full range of options available for achieving particular objectives are not considered. For example, when a GM crop has been designed to minimise insect damage, the risks to the environment posed by this crop are not being compared to alternative means of achieving this objective, such as integrated pest management. This approach to determining risk acceptability works to maintain the status quo of industrial agricultural practices and limits the ability of the regulatory system to implement a range of policy options that could assist with handling the problems associated with ignorance and indeterminacy.

Monitoring Requirements

The Gene Technology Act currently contains no provisions for the regular review and renewal of licences granted. While the Regulator is granted the power to vary, suspend or cancel a licence if new information comes to light (Commonwealth of Australia 2000, section 68 & 71, 45-46), none of these provisions encourage the OGTR to be proactive in terms of encouraging, generating or applying this new information. Without a specific requirement for licence reviews and renewals, the question of whether new information regarding risks will be generated, comprehensively assessed and applied to licences already granted is left to the discretion of the Regulator. Without a legislative requirement for reviewing decisions and risk assessments in light of new evidence or experience in the field, the current regulatory framework fails to establish the type of ongoing monitoring requirements that were highlighted as an essential feature of precautionary decision making.

While the Act does have provisions for monitoring that grant the OGTR the power to audit and monitor licensed dealings, this only applies to the specific conditions applied to a licence (Commonwealth of Australia 2000, section 64 (b), 43) – i.e. the Regulator is given the power to monitor dealings only in the sense of ensuring that the licence holder is adhering to the conditions imposed on the licence. The responsibility for monitoring for unintended ecological impacts may, however, be viewed as one that rightfully belongs to the licence holder rather than the Regulator and section 65 of the Act does provide that licence holders must report any unintended impacts they observe (Commonwealth of Australia 2000, section 65, 43). Relying on the party that stands to benefit from continued commercial production to report on negative impacts is problematic on its own, but it is also worth emphasising that the requirement to report any observed unintended adverse impacts is not the same thing as requiring ongoing monitoring for these types of impacts.

The Act clearly states that the OGTR can issue licence conditions for data collection, including studies to be conducted (Commonwealth of Australia 2000, section 62 (h), 41). Interestingly, this requirement has not occurred in practice. For example, I made a submission to the OGTR that raised concerns about the potential non-target impacts of GM cotton. In the response I received it was stated that "there are currently few, if any, published data that would

enable a rigorous evaluation of potential risks to the structure and function of multi-trophic 'food-webs' via secondary, tertiary or higher order effects of Bt toxins" (Benyei 2003). Despite this acknowledged knowledge deficit, however, the gathering of data to enable a rigorous assessment of this risk was not made a condition of the licence. Without requirements for ongoing monitoring efforts, particularly in areas where the Regulator has deemed the available information insufficient, the ability of the current regulatory system to rapidly respond to risks that may emerge from ignorance and uncertainty is severely curtailed. Without requiring ongoing research and monitoring and without clear provisions for regular reviews of risk assessments and licence decisions capable of incorporating new information and experience, the current regulatory framework arguably fails to represent a precautionary approach to decision making.

Conclusion

In this paper I have reviewed some of the social science theory on risk and uncertainty in environmental decision making and suggested that the inadequacies of technical discourses of risk analysis are seeing an emerging theoretical shift towards approaches that focus on the negotiation of uncertainties. The emerging precaution/uncertainty based approaches to environmental decision making contrast with more traditional science/risk based approaches by employing constructivist rather than realist understandings of science, reimagining the role of expertise in environmental decision making, favouring increased public participation and negotiation and emphasising the importance of ongoing research and monitoring. According to the analysis presented in this paper, Australia's framework for the environmental regulation of GMOs appears more representative of the science/risk based end of this spectrum of approaches to environmental decision making.

There are a number of recommendations I could make for how Australia's framework for the environmental regulation of GMOs could evolve to overcome some of the described limitations associated with adopting a largely technocratic discourse and begin a shift towards more precaution based approaches to decision making. Firstly, there could be a requirement that the non-scientific advisory committees be consulted in the same way and to

the same degree as the committee of technical experts. Secondly, all committee meetings could be made open to the public or specific community forums could be established to deliberatively discuss criteria for risk acceptability or environmental endpoints for the assessment process. Thirdly, all scientific studies quoted in assessments could be made freely available to the public and fourthly, regular licence reviews and renewals could be made mandatory and enhanced research and monitoring efforts could be requested through conditions placed on licences. While none of these recommendations would require major institutional changes, they do require the political will to acknowledge the limitations of scientific knowledge and the various forms of incertitude affecting environmental decision making. Realistically, they also require that a more constructivist approach to the notion of risk, science and the environment is embraced by policy communities.

References

Adams, J. 1995. *Risk.* London: University College London Press.

Adams, J. and M. Thompson. 2002. *Taking Account of Societal Concerns about Risk: Framing the Problem* London: Health and Safety Executive.

Benyei, J. 2003. *Notification of decision on licence application DIR 022/2002 from Monsanto to undertake dealings with genetically modified cotton.* Personal communication: Office of the Gene Technology Regulator.

Carr, S. and L. Levidow. 1999. 'Negotiated Science - The case of agricultural biotechnology regulation in Europe.' In *European Discourses on Environmental Policy* eds U. Collier, G. Orhan and M. Wissenburg. Aldershot: Ashgate Publishers

Commonwealth of Australia. 2000. *Gene Technology Act (No. 169).* Canberra: Attorney-General's Department.

Covello, V.T. and B. B. Johnson. 1987. 'The Social and Cultural Construction of Risk: Issues, Methods and Case Studies.' In *The Social and Cultural Construction of Risk: Essays on Risk Selection and Perception* eds V.T. Covello and B.B. Johnson. Dordrecht: D. Reidel Publishing Company.

Davidson, D. J. and W. R. Freudenburg. 1996. 'Gender and Environmental Risk Concerns: A Review and Analysis of Available Research.' *Environment and Behavior* 28:302-339.

Douglas, M and A. Wildavsky. 1982. *Risk and Culture: An Essay on the Selection of Technical and Environmental Dangers.* Berkeley: University of California Press.

Doyle, T. and A. Kellow. 1995. *Environmental Politics and Policy Making in Australia.* South Melbourne: Macmillan Education Australia.

Eder, K. 1996. *The Social Construction of Nature.* London: Sage Publications.

Fairbrother, A. and R. S. Bennett. 1999. 'Ecological Risk Assessment and the Precautionary Principle.' *Human and Ecological Risk Assessment* 5(5):943-949.

Funtowicz, S. and J. R. Ravetz. 1994. 'Uncertainty, complexity and post-normal science.' *Environmental Toxicology and Chemistry* 13(12):1881-1885.

Gene Technology Community Consultative Committee (GTCCC). 2003. *GTCCC Communiqué (4th meeting, February 2003).* Last accessed 1st October 2003. <http.www.health.gov.au/ogtr/rtf/committee/4thcommgtccc.rtf>

Gene Technology Ethic Committee (GTEC) 2003, *GTEC Communiqué (4th meeting, April 2003).* Last accessed 1st October 2003. <http.www.health.gov.au/ogtr/rtf/committee/4thcommgtec.rtf>

Harding, R. 1998. *Environmental Decision-making: the roles of scientists, engineers and the public.* Sydney: The Federation Press.

Holling, C. S. 1979. 'Myths of Ecological Stability.' In *Studies in Crisis Management* eds G. Smart and W. Stanbury. Montreal: Butterworth.

Holling, C. S. 1986. 'The Resilience of Terrestrial Ecosystems.' In *Sustainable Development of the biosphere* eds W. Clark and R. Munn. Cambridge: Cambridge University Press.

Jasanoff, S. 1999. 'The Songlines of Risk.' *Environmental Values* 8:135-152.

Jasanoff, S. and B. Wynne. 1998. 'Science and Decisionmaking.' In *Human Choices and Climate Change Volume One: The Societal Framework* eds S. Rayner and E.L. Malone. Columbus: Battelle Press.

Klinke, A. and O. Renn. 2002. 'A New Approach to Risk Evaluation and Management: Risk-Based, Precaution-Based and Discourse-Based Strategies.' *Risk Analysis* 22(6):1071-1094.

Krimsky, S. 1992. 'The Role of Theory in Risk Studies'. In *Social Theories of Risk* eds S. Krimsky and D. Golding. Westport: Praeger.

Office of the Gene Technology Regulator. 2002a. *Risk Analysis Framework for Licence Applications to the Office of the Gene Technology Regulator.* Canberra: Department of Health and Ageing.

Office of the Gene Technology Regulator. 2002b. *Risk Assessment and Risk Management Plan for Bollgard II® cotton (DIR 012/2002).* Canberra: Office of the Gene Technology Regulator.

Office of the Gene Technology Regulator. 2002c. *Risk Assessment and Risk Management Plan for INGARD® cotton (DIR 022/2002).* Canberra: Office of the Gene Technology Regulator.

Office of the Gene Technology Regulator. 2004. *Risk Analysis Framework Consultation Version.* Canberra: Department of Health and Ageing.

O'Riordan, T. and J. Cameron. 1994. *Interpreting the Precautionary Principle.* London: Cameron May.

Otway, H. 1987. 'Experts, Risk Communication and Democracy.' *Risk Analysis* 7(2): 125-129.

Otway, H. and K. Thomas. 1982. 'Reflections on Risk Perception and Policy.' *Risk Analysis* 2(2):69-81.

Rayner, S. 1992. 'Cultural Theory and Risk Analysis.' In *Social Theories of Risk* eds S. Krimsky and D. Golding. Westport: Praeger.

Renn, O. 1992. 'Concepts of Risk: A Classification.' In *Social Theories of Risk* eds S. Krimsky and D. Golding. Westport: Praeger.

Robins, R. 2002. 'The Realness of Risk: Gene Technology in Germany. *Social Studies of Science* 32(1):7-35.

Pepper, D. 1996. *Modern Environmentalism: An Introduction.* London & New York: Routledge.

Peters, E. and P. Slovic. 1996. 'The Role of Affect and Worldviews as Orienting Dispositions in the Perception and Acceptance of Nuclear Power.' *Journal of Applied Social Psychology* 26:1427-1453.

Porritt, J. 2000. Playing Safe: Science and the Environment. London: Thames and Hudson.

Rosa, E. A. 2000. 'Modern Theories of Society and the Environment: the Risk Society.' In *Environment and Global Modernity*, eds G. Spaargaren, A.P.J. Mol and F.H. Buttel. London: Sage Publications.

Schwarz, M. and M. Thompson. 1990. *Divided We Stand: Redefining Politics, Technology and Social Choice*. Hemel Hempstead: Harvester Wheatsheaf.

Shrader-Frechette, K. 1998. 'Scientific Method, Anti-Foundationalism and Public Decision Making.' In *Earthscan Reader in Risk and Modern Society* eds R. E. Lofstedt and L. Frewer. London: Earthscan Publications.

Siegrist, M. 1998. 'Belief in Gene Technology: The influence of Environmental Attitudes and Gender.' *Personality and Individual Differences* 24(6):861-866.

Siegrist, M. 2000. 'The Influence of Trust and Perceptions of Risks and Benefits on the Acceptance of Gene Technology.' *Risk Analysis* 20(2):195-203.

Slovic, P., B. Fischhoff and S. Lichtenstein. 1982. 'Why Study Risk Perception?' *Risk Analysis* 2(2):83-93.

Slovic, P. 1987. 'Perception of Risk.' *Science* 236:280-285.

Slovic, P. 1991. 'Beyond Numbers: A Broader Perspective on Risk Perception and Risk Communication.' In *Acceptable Evidence: Science and Values in Risk Management* eds D.G. Mayo and R.D. Hollander. Oxford: Oxford University Press.

Slovic, P. 1998. 'Perceived Risk, Trust and Democracy.' In *The Earthscan Reader in Risk and Modern Society* eds R. E. Lofstedt and L. Frewer. London: Earthscan Publications.

Slovic, P. 1999. 'Trust, Emotion, Sex, Politics and Science: Surveying the Risk Assessment Battlefield.' *Risk Analysis* 19(4):689-701.

Stirling, A. 1999. 'Risk at a Turning Point?' *Journal of Environmental Medicine* 1:119-126.

Stirling, A. 2002. 'Risk, Uncertainty and Precaution: some instrumental implications from the social sciences.' In *Negotiating Environmental Change: Perspectives from Social Science* eds F. Berkhout, M. Leach and I. Scoones. Cheltenham: Edward Elgar.

Stirling, A. and D. Gee. 2002. 'Science, Precaution and Practice.' *Public Health Reports* 117:521-533.

Szerszynski, B., S. Lash and B. Wynne 1996. 'Introduction: Ecology, Realism and the Social Sciences.' In *Risk, Environment and Modernity: Towards a New Ecology, eds* B. Szerszynski, S. Lash and B. Wynne. London: Sage Publications.

Thompson, M., R. Ellis and A. Wildavsky. 1990. *Cultural Theory.* Boulder: Westview Press.

Turner, J. 1984. 'Who's afraid of technological catastrophe?' In *Sci-tech Report: Current Issues in Science and Technology* Sydney eds J. Turner. Pluto Press: Sydney.

United Nations Conference on Environment and Development (UNCED). 1992. *Report of the Conference*. Rio de Janeiro: United Nations.

Wildavsky, A. and K. Dake. 1998. 'Theories of Risk Perception: Who Fears What and Why?' In *The Earthscan Reader in Risk and Modern Society* eds R.E. Lofstedt and L. Frewer. London: Earthscan Publications.

Winner, L. 1986. The Whale and the Reactor: A search for limits in an age of high technology. Chicago: University of Chicago Press.

Wright, S. 1994. *Molecular Politics: Developing American and British Regulatory Policy for Genetic Engineering, 1972-1982.* Chicago: University of Chicago Press.

Wynne, B. 1983. 'Redefining the Issues of Risk and Public Acceptance: The social viability of technology.' *Futures* 15(1):13-31.

Wynne, B. 1992. 'Uncertainty and Environmental Learning: Reconceiving Science and Policy in the Preventive Paradigm.' *Global Environmental Change* 2(2):111-127.