Risk and Responsibility
In the GMO Discourse

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Abstract
An application of biotechnology that has been rapidly matured under the last ten years is genetically modified food. The deliberative release of GMO faces the challenge of complying with sustainable development and implies a precautionary approach to all possible risk involved. This study purpose is to investigate the problems of risks concerning deliberative release of GMO and to define the question of responsibility. These two themes, risk and responsibility, are discussed in relation to society, citizens, corporations and science. A more profound understanding of the relation between risk and responsibility in the GMO context could contribute to the sensitivity and deliberation in bio-politics, so it better can cope with democratic governance, public debate and risk deliberations. Politicians and other decisions-makers have a responsibility to assure that they have sufficient knowledge and understanding for the issue at hand before taking any decision. A responsible bio-politics departs from the precautionary principle in decisions making, gaining knowledge in dialogue with concerned GMO actors and tries to correspond to sustainable development. Hence, knowledge and understanding is needed which are reached in dialogue with other parties in order to allowed values, attitudes and knowledge to be deliberate more extensively.

Nyckelord
Risk, responsibility, GMO, moral responsibility, biotechnology, public perception, legal regulation, science, companies, consumers, society.
We are wholly convinced – and therein lies our *petitio principii* – that social freedom is inseparable from enlightened thought. Nevertheless, we believe that we have just as clearly recognized that the notion of this very way of thinking, no less than the actual historic forms – the social institutions – with which it is interwoven, already contains the seed of the reversal universally apparent today. If enlightenment does not accommodate reflection on this recidivist element, then it seals its own fate. If consideration of the destructive aspect of progress is left to its enemies, blindly pragmatized thought loses its transcending quality and, its relation to truth. In the enigmatic readiness of the technological educated masses to fall under the sway of any despotism, in its self-destructive affinity to popular paranoia, and in all uncomprehended absurdity, the weakness of the modern theoretical faculty is apparent.

Max Horkheimer and Theodor W Adorno

*Dialectic of Enlightenment*
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PART I

1. Introduction

Responsibility is an essential characteristic of being human. If the fundamental possibility of being responsible is taken away from humans, they are deprived of freedom and self-determination. That holds true for all our deeds – so also for our actions in connection with technology.¹

1.1. Biotechnology, Risk and Responsibility

The fast progress of science and technology in the field of biotechnology attracts more and more political and public interest. A recent breakthrough in microbiology leading to the mapping of the human genome, the HUGO project², cloning and genetically modified food has been argued as examples of contested technologies in the contemporary society, -technologies that are accompanied with particular risks. These progresses provoke questions concerning our comprehension of human beings in an existential way, as well as our relation to nature where science serves as both the source of the problem and the ones who offer solutions. Biotechnology has a potential impact in social life with far-reaching consequences, which raises questions of how biotechnology should be comprehend and implemented in the society. The development of biotechnology is controversial; -especially the purpose and consequence of biotechnology are debated. These issues, over the legitimacy of the development, have led to that biotechnology is a contested technology. It questions our values and conceptions concerning the human being and life in general as well as our relation to nature. Furthermore, biotechnology is considered to involve different risks and hazards depending on the application of the technology.

An application of biotechnology that has been rapidly matured under the last ten years is products of genetically modified food (GM food). GM food is developed from genetically

² HUGO = HUman Genome Organisation.
modified crops in agriculture and there have been numerous debates about the possible environmental impacts and the consumer acceptability of GM food. A common theme for public anxiety is the cultural threat by GMO\(^3\)-innovation to people’s sense of ‘the natural’. Our relation to nature is the heart of the matter in the genetically transformation of animal and plant life, which have possibilities to drastically change agriculture. Of course, biotechnology is not only subject to anxiety, but also to optimism. The motive power for optimism is prospects of economical profit in agriculture. There are also hope that biotechnology will help us find solutions to environmental problems and famines in the development countries by inventing plants that do not need as much insecticide and that can grow in extreme drought or have extra nutritious substance. Unfortunately, there are no large economical profit in defeating famine and environmental problems.

With the transition of modernity a specific cultural space has been developed together with a specific legal culture. The transformation of the cultural space can be described as constitutional, founded with respect to fundamental human rights.\(^4\) The constitutional state should be founded on a vision of the common good and justice with human beings possessing autonomy, dignity, integrity and vulnerability.\(^5\) The transition of modernity has been strongly linked together with the development of science and technology. As our knowledge has increased, the role of science in the contemporary society has become more and more complex. It seems that science produces problems as well as solutions to certain problems.

The acceleration of scientifically discoveries connected to the extended possibilities of human interaction, made possible with information technology, is believed to threaten the values of autonomy, dignity, integrity and vulnerability. The public apprehends that those responsible for technological development do not have the ability to foresee the consequences of their actions and can not perceive when important moral values are trespassed. Furthermore, connected to the velocity in technological advancement, a public uncertainty has been raised about the trust to the scientific community. Awareness about the difficulties connected to the problem of producing ‘certain’ knowledge has led to that people has started to question what can be true and if we really can possess the range of knowledge to defend our actions in complicated issues such as biotechnology. The public’s understanding about

\(^2\) HUGO = HUman Genome Organisation.
\(^3\) GMO = Genetically Modified Organism.
\(^5\) Ibid.
knowledge is reflected in the raised awareness of science where scientists are referring to the truth as degrees of probabilities and the latest scientifically reports.6

The public has also learned from the lesson of PCB, asbestos and more recently acrylamide, concerning the time-depending character of what is believed to be the truth. The uncertainty of our knowledge has led to a growing mistrust in the public sphere towards if science can produce the answers for tomorrow. What were once side effects are now challenging the core of our everyday assumptions. It is within the scope of an increasing consciousness in modern society that the public have taken a sceptical attitude towards technology. They are aware of that technological progress not only are bringing positive effects but are also creating risks. The mistrust in new technologies, such as GMO-technology and its use and benefits, has increased under the last decade. Technologies such as GMO depend on an interchange with scientific progress concerning knowledge and the development of new methods. Thus, the modern technology of GMO is science-based and the science of GMO is technology-based. These technological innovations concerning GMO is subject to public debate over the legitimacy of such developments.

1.1.1. Purpose of the Study

Modernisation is seen to have led to a set of risks and hazards that are not only threatening current generations, but might also prejudice the quality of life, and possibly the very survival of future generations. By the fast progress of the application of biotechnology societies are facing a ‘double-risk’. First, the complex uncertainty related to the market economy and democratic governance; second, the increasing social anxiety about high-consequence risks, such as those associated with biotechnology, and the inability of modern institutions to cope with such risks. The growing public awareness of these hazards and risks has been known as a reflexive modernisation, which is indicating an ongoing transition from an ‘industrial society’ to a ‘risk society’.7 The deliberative release of GMO faces the challenge of complying with sustainable development and implies a precautionary approach to all possible risks involved. These risks cannot be managed without taking into account the environmental and social impacts of scientific ideas, regulatory practise and political culture. The far-reaching consequences and risks of biotechnology bring up the question of responsibility. How is

6 For a more extended discussion about the relation between public opinion and biotechnology see chapter 2.2.3.
responsibility to be understood together with contested technologies? The technological innovations in modern biotechnology have raised a public debate over the legitimacy of such developments. Thus, there is an urgent need for a better understanding of the relation between risk and responsibility in the GMO context in order to develop the sensitivity in bio-politics, so it better can cope with democratic governance, public debate and risk deliberations.

Some more tangible questions in focus for this study are:

1. What is a risk? (Section 2.2.1)
2. How can the consequences of the risks affect people and the environment? (Chapter 1.2 and Section 2.2.2)
3. How does the public understand risks related to GMO? (Section 2.2.3)
4. What can we do in order to avoid risks? (Chapter 2.3)
5. In what way should we understand the concept of responsibility regarding modern forms of technology such as GMO? (Section 3.1.3)
6. Who has responsibility for risks connected to GMO? (Chapter 3.2)
7. What are the arguments for claiming responsibility? (Chapter 3.2)

My purpose is to investigate the problems of risks concerning deliberative release of GMO and to define the question of responsibility. These two themes, risk and responsibility, are discussed in relation to society, citizens, corporations and science. Those actors are considered to be the main actors concerning the ‘life span’ of GMO applications, including development, market releases and consuming. Therefore, risk and responsibility and the relationship to the GMO-actors must be analysed and defined in order to be able to create a theoretical understanding of risk and responsibility in the GMO contexts.

1.1.2. Method and Concepts

As mentioned above, the study’s focus on risk and responsibility is concerning a high-modern technology such as GMO. In order to understand these two concepts in relation to the actors involved in the legal and social fields of GMO, a conceptual analyse of risk and responsibility is needed. The technologies of GMO are entailing possible risks for the environment and the consumers and also challenge people’s conceptions of what is natural. Genetically modified food has almost become synonymous with different risks. Thus, there is a need for investigating the risks that has been put forward in relation to GMO. I will in this
paper present the different risks concerning the potential harm to the environment and human healths, posed by GMO, but also give an account of the public perception concerning risks. Beside these descriptive parts of risks I will also analyse what we mean when we talk about risks. Are we always meaning the same thing, and what does it mean when we are referring to something as a risk? What are the difference between risks and hazards and what does the perception of risk mediate? These are important questions when we are reflecting on the risks in GMO.

All technologies are also issues for ethical concerns. A technology such as biotechnology and GMO technology must be submitted to an intensive and extensive moral debate. But it seems sometimes that the advancement in the biotechnological sphere are leaving behind the prerequisites for moral deliberation as strong interests for economical profit sometimes collide with moral values. It is important that the society finds way of deliberating about the ethical and moral implications of the technology and gives the subject time for reflection. The reason for this is that we should not create a ‘gap’ regarding the moral considerations between the existence of a certain development in biotechnology and the implementation of it. It is a possible risk, it seems to me anyway, that those two moral reflections are sometimes only separated in time and when the time shrinks between a ‘new’ technological knowledge and its implementation, our moral deliberation are shifting towards the implementation of the technology. Thus, there must be room for both arguing about questions of whether a certain development in biotechnology is permissible as well as questions concerning how further developments that already are accepted should be implemented. The purpose of ethical reflection should not be to legitimate the morally content in a technology that already are implemented. In this paper I will look at the concept of responsibility and investigate how it relates to GMO technology and if it is useful to reconcile differences concerning the ethical reflection of moral values and the different interests in GMO technology. Can a more responsible attitude towards technology be used to mediate between our values and the technology?

1.1.3. The Disposition of the Study

After this introductory part I shall continue with the next chapter which is entitled Moral Issues in the Discourse of GMO and uncovers the ethical and morally implication of GMO-technology.
The second part of the study is called *Framing the GMO Discourse* and is divided into three chapters. The first chapter (2.1) is entitled *The Technology of GMO* and gives an account of the most common terms in GMO technology (2.1.1). It follows by a short introduction to the history of how the scientific knowledge in biotechnology has evolved (2.1.2). A description of how foreign genes are transferred into plants is done in 2.1.3. The next chapter is *The Risks Concerning GMO technology* which are also divided into three sections. In 2.2.1 I probe into the definitions of risks and present a more systematically approach to the relationship between risk and values. It is in this section that we find an attempt to answer the first explicit question for the study, namely ‘what is a risk?’ In section 2.2.2 a more explicit account for the possible risks are done regarding the ecological and human risks of GMOs. Thus, the question ‘how can the consequences of the risks affect people and the environment’ are discussed in this section. The last section in chapter 2.2 concerns the public perceptions of risks concerning GMOs (2.2.3) and reveals the public opinion towards biotechnology, which is the third question for the study. The main part of this section is a summarising of two doctoral theses concerning public perceptions of biotechnology and GM food in Sweden. The last chapter in the second part of the study is entitled *The legal Regulation of GMO* and discuss the legislation outgoing from three different geopolitical perspectives, namely the Swedish (2.3.1), the European (2.3.2), and the international (2.3.3). Furthermore an account for the permit process and how national states and citizens can influence the market adaptation of GMO are presented. This whole chapter is devoted to the fourth question, ‘what can we do in order to avoid risks?’

The third part of the paper, named *Responsibility in the GMO Discourse* consists of two chapters. The first chapter, *The Nature of Responsibility*, is divided into four sections. The Section 3.1.1 present three different categories of moral responsibility. The next section (3.1.2) discusses one of the classical issues in philosophy, namely the problem of moral responsibility versus the question of free will and determinism. I give an account for different aspects on moral responsibility and determinism before taking an own position in the matter. In 3.1.3 I discuss the relationship between technology and responsibility which relates to the fifth question concerning how one should understand the concept of responsibility regarding modern forms of technology. The point of departure in this section is that the development in biotechnology threatens the existence of a number of fundamental sets of values. Therefore we should steer the development of the technology so it reflects our purpose and our goal of giving rise to a good life. I discuss how responsibility could be understood in order to achieve
this development. Section 3.1.4 presents the rational premises for acting responsible. The other chapter in part three is called The GMO Actor’s and Responsibility where I present the concept of responsibility regarding the scientific community (3.2.1), the GMO companies (3.2.2), consumer (3.2.3) and the society (3.2.4). This chapter is devoted to the two last questions, namely ‘whom has responsibility for risks connected to GMO?’ and ‘what are the arguments for claiming responsibility?’

Finally, in the fourth part of this study, I bring together and summarise the main findings of the study and what it might have contributed to the picture of the challenging new ‘problem landscape’ that is brought on us by the biotechnological development. Hopefully, the study contribute with drawing some stroke of the brush in order to contribute to a reliable picture of this complex landscape, which we need for finding a way into a benevolent future.

1.2. Moral Issues in the Discourse of GMO

Ethical consideration regarding biotechnology has an important role in Sweden’s official standpoint.8 The Environmental Code emphasises in a rather strong way that a specific ethical consideration shall be taken. In official reports one can find expression like “…ethics must have a particular prominent space when it comes to biotechnology, because it is often very important values that are at stake.”9 The central debates have been around regulation, safety and the moral status of particular applications of modern biotechnology, such as GMO. There are entertained apprehensions concerning that the technology is being autonomous without public control because of its strategic character. The consciousness about the technology impact on contemporary life is getting more and more obvious as the application of biotechnology continues to develop. How can we then create a platform for handling with biotechnology in a way that harmonise with our views on a good life, i.e. in a sound, beneficial and environmental sustainable way? In the latest Government Official Reports concerning biotechnology it states that:

There is a great responsibility for the present generation to take care of the possibilities of the technology and to use it in a responsible way in harmony with fundamental values in the society.\textsuperscript{10}

To be able to use the technology in a responsible way we must know the risks and values that are at stake. The main problem concerning the risks against our environment is difficulties and uncertainties to foresee the long-term effects. We must here keep in mind that GMO plants have a serious peculiarity regarding risks for the environment. If there will be a spreading of genes to the environment, it will not only be a irreversible action, but if the genes in a plant cause a evolutionary advance it will probably ‘take over’ the natural habitat for the specific plant.\textsuperscript{11} It has already been experience the human inefficiency when it comes to stop non-indigenous rogue species that have gone out of control and caused enormous economical damage, for example, such as fire-ants, zebra mussels, or killer bees in the Western Hemisphere, or Chinese mitten crabs in Europe.\textsuperscript{12} There are thus great risks at stake at a context of uncertainties that increase by time. What must be determined is if GMO in agriculture is the right way of creating a sustainable agriculture for feeding a growing population concerning the risks for the environment in a long-term aspect. A more direct effect is risk connected to consuming GMO food, which I will return to. In the present-day situation, the main purposes for developing GMO products are economical profit. The allurement concerning economical profit has also contributed to the public anxiety regarding GMO products. Can the companies be trusted to put safety, which is expensive, before economical interest when many companies have difficulties raising enough capital even to stay in business? Another question concerns our responsibility towards future generations and their rights (if any?) of a non-polluted GMO environment.

And who can blame the adversary’s anxiety towards GMO technology if one starts to reflect of the poor record of responsible actions in the twentieth century that man can show up. It makes it difficult to deny with conviction that the existence of the risky potential will

\textsuperscript{10} Ibid, page 14, my translation.

\textsuperscript{11} To prevent such spreading the ‘killer’ gene or the ‘terminator’ was invented. The purpose of the killer gene was to prevent plants to multiply. There was thus a strong public response on this leading to that the GM-corporation draw it back. Technologies as ‘terminator’ force farmers to buy new planting seed every year, which threaten small farmers in the south, and is the opposite of a natural farming. Now the second generation of the terminator technology is brewing, the so-called ‘exorcist’ technology. See \textit{New Scientist}, 6 July 2002, page 33-36. Briefly, the exorcist technology remove the ‘cassette’ of engineered genes in the plant DNA by have a on/off switch that are triggered by a special protein. When the crop has growth up, the special protein is sprayed over the crops and the ‘gene-cassette’ is released from the plants DNA.
not result in damaging consequences to some extent. The possibilities seem to be beyond human comprehension regarding future application of reproductive technologies and gene therapy. Risks and ethical consideration could here be divided on one hand on the individual level and on the other on a more collective level. On the individual level, biotechnological applications such as GMO food can involve risks for allergy or diseases. It has been argued that we know to little today about the new GM-crops and animals genetically stability. Artificial changes can expect to be less stabile than the hereditary disposition that has been developed under thousands of years. Mutations can also unexpectedly arise. Worries concerning our ‘know-how’ about how genes act together and what might happen when you alter the orders of genes in plants and animal’s germ plasma has also been expressed. Therefore the need for a legal framework that protects the integrity and vulnerability towards the individual is needed, not only in Europe and USA but also on an international level.

On the collective level we must recognise that the advances in biotechnology have the potential to transform our society and the social life in drastically ways. And therefore must the future of biotechnology be submitted to public deliberation in order to reduce anxiety and secure that the science and technology of genetic engineering is rooted in common shared values of respect, dignity and integrity in society.

Given the scale of the potential implication, the future horizon of biotechnology is shrouded in obscurity, where optimism and anxiety mingle. In the ethical and moral sphere of GMO-technology the concept of risk and responsibility cut through all areas of its application. These two concepts are also what this study will focus on.

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PART II

2. Framing the GMO discourse

2.1. The Technology of GMO

Throughout history, plants have been grafted and crossbred in order to give them certain properties. The most common properties that were desirable, and still are, are those that could produce increased yields. In the last two decades genetic engineering has opened new possibilities to alter the properties of plants. The advantage in plant breeding is that plants are easy to cross and can often be bred asexually. These advantages have led to plant breeding becoming a very fertile area in which to perform genetic engineering. Besides increased yields from genetically engineered crops, which are the most important argument used by the genetic engineering industry, there are also other interests the biotechnological companies’ tries to meet. Examples on products that have been developed in the 1990s are the ‘Flavr-Savr’ tomato and ‘Roundup-Ready’ soya beans. The tomato was developed in 1995 and can be picked almost ripe from the vine, then shipped without refrigeration and still remain firm and unspoiled on the grocer’s shelf for over twice as long as the typical green-picked tomato. The other example, the ‘Roundup-Ready’ soya beans, was developed by Monsanto in 1996, and is the most widespread genetically engineered crop introduced so far. ’Roundup’ is a very effective weed killer; in fact the herbicide kills everything green, including the soya beans. Therefore Monsanto developed a novel protein, which allows the soya beans to thrive, even when sprayed with Roundup. Another well-known example is the ‘golden rice’ which are rice that have been genetic engineered in order to increase the content of Vitamin A. The purpose is to grow the rice in the poor part of the world where lack of Vitamin A contributes to blindness.

In this chapter concerning the technology of GMO I present some of the more common terms that are used in GMO technology. After that, I present the history of how the scientific knowledge in biotechnology has evolved and finally, I describe the different methods of transferring gene information and how modifications of genes are carried out.

2.1.1. The Terms in GMO Technology

Biotechnology has been known as the third strategic technology of the post-war period after nuclear power in the 1950s and 60s and information technology in the 1970s and 80s.15 Those strategic technologies are differentiated in varieties of applications. In media reports, the technology of GMO is sometimes confused by its technological terms. Terms such as ‘biotechnology’, ‘genetic engineering’ and ‘genetic modification’ are commonly used interchangeably. Before going any further we should disentangle the technology terms concerning GMO. There are three different technological terms that should be recognised and are important for the thesis.

- **Biotechnology** is the most general of these terms and refers to the use of organisms or their components in industrial or commercial processes, which can be aided by the techniques of genetic manipulation in developing e.g. novel plants for agriculture or industry.

- **Genetic engineering** (GE) is the set of techniques, also referred to as recombinant deoxyribonucleic acid (rDNA) technology. The techniques are used for modifying and recombining genes from different organism that would not naturally interbreed. The resulting organism is said to be ‘genetically modified’, ‘genetically engineered’, or ‘transgenic’.

- The definition of a **genetically modified organism** (GMO) is an organism in which the genetically material has been altered in a way that does not occur naturally by mating and/or natural recombination. It is done by using genetically tools in order to change the organism so that it is given properties that earlier was missing and maybe never could have in a traditional way. An important difference between the traditional breeding and gene technology is the crossing of the natural art barrier when using gene technology.

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Now when we have clarified the technological terms concerning GMO I will continue with a historical presentation of biotechnology.

2.1.2. The Biotechnology Revolution

Concerning scientific knowledge production, biotechnology occupies a special position. The scientific practise involves a variety of techniques that has been developing from the contribution of theoretical molecular biologists. In the case of GMO and plant breeding, genetic engineering aims at improving crop disease- and drought-resistance, eliminating the need for nitrogen fertiliser, and increasing yield and protein levels. In these areas, molecular biologists are employed for the commercial exploitation of biological organisms and processes.

A central issue for both science and industry is the mapping and sequencing of the DNA structure in plants, animals and humans, which will allow not only DNA probing for genetically diseases but also biotechnological inventions. The development in biotechnology and its techniques has evoked strong feelings. The prospect of having the world transformed by biotechnology has put different values in direct conflict, with the hope for absolute human mastery over nature on one side of the scale and the fear of catastrophes for humans and the environment on the other side.

The principal scientific breakthroughs, which have paved the way for today’s application, can be dated to the 1940s, 1950s, and 1970s.\(^{16}\) But already in 1869 was deoxyribonucleic acid (DNA) isolated for the first time by Johann Friedrich Miescher.\(^{17}\) He named it *nuclein* because it was isolated from the nucleus (central core) of the cell. In 1944, Avery, MacLeod and McCarty could show that it was not proteins but DNA that is carrier of genetic information.\(^{18}\) Under the early fifties the first identification of the bacterial plasmids was made.\(^{19}\) The plasmids are crucial for the modification of genes because of the plasmids’ possibilities of transferring genetic information from cell to cell. I will return to this more in detail when discussing methods of transferring foreign genes into plants. The identification of the bacterial plasmids was followed by Watson and Crick’s description in 1953 of the double-helix structure of DNA. This structure is the biological polymer of forming the genetic

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\(^{18}\) Hedengrahn, Gösta, 2000, page 19.

\(^{19}\) Strydom, Piet, 1999, page 34.
material of all living things.\textsuperscript{20} One of the most important discoveries in biotechnology is the discovering of the replication of DNA. Replication of DNA is the process of DNA making new DNA, which is necessary for the cells to be able to divide. With the identification of this process in the early 1970s, including the dissecting and rejoining of DNA, it made possible the isolation of individual genes – a development known as recombinant DNA (rDNA).

This was a short introduction to the history of how the scientific knowledge in biotechnology has evolved. Before turning to the issues of feasible risks with GMO technology I will present the methods of transferring gene information and how modifications of genes are carried out.

\subsection*{2.1.3. The Methods of Transferring Foreign Genes into Plants}

Several genetic engineering methods have been developed to use for plants. What they have in common is two characteristics. First, they must be able to obtain sufficient amounts of the genes that are transferred to the plants. Secondly, it is necessary that the method can insert the genes where they can be expressed as they where intended. In order to achieve this, the applied technique should have the ability to introduce new genes into plants in a site-specific manner. The first step in genetic engineering is now easily done, but putting new plant DNA into the cell in a position where it will be expressed properly has been difficult. A method of trying to achieve this has now been developed and is commonly used. It is known as the \textit{Agrobacterium tumefaciens technique}. I will return to this technique below. A tremendous advantage for molecular biologists that works with plants over those who work with other organisms is that many plant cells are \textit{totipotent}, even in mature plants. These cells can be grown in a medium and then induced to produce plants from single cells.\textsuperscript{21}

There are two principal methods of transferring foreign genes into plants. The first is to use bacterial or viral vectors to carry genes into a plant’s genome. The second is a more direct way of transfer DNA into the cell core by using either gene guns or micro-projectiles. Introducing foreign genes through bacterial or virus infections involves a number of steps. The first is to make recombinant DNA in test tubes by using enzymes isolated from micro

\textsuperscript{20} The symbolic influence of the double helix as an anthropomorphic concept should not be underestimating. As Hoffmeyer explain, “After all, the only place to go for models of the purposeful behaviour of living systems would be the cultural sphere of the human being. And ever since the Watson-Crick double helix model of the DNA molecule was introduces in 1953 the ‘nature as language’ metaphor has seemed attractive to many researcher.” See Hoffmeyer, Jesper, ‘Biosemiotics and Ethics’ in Shiva, Vandana and Moser, Ingunn, (eds.), \textit{Biopolitics: a Feminist and Ecological Reader on Biotechnology}, zed Books Ltd, London, 1995, page 144.

\textsuperscript{21} A totipotent cell is one that contains the full complement of DNA, all of which can be used.
organisms to cut and join together pieces of DNA from different organisms. The genes are multiplied and then transferred into plants through ‘vectors’, which are usually viruses or plasmids. Once inside the cells, the vectors with the foreign genes became a permanent part of the organism. Transgenic organisms are thus organisms that have been ‘infected’ by transgenes using vectors.

The most common vectors are combinations of natural genetic parasites and infective agents, including viruses that cause diseases in plants and animals, with their pathogenic function disengaged. The vector used most widely is derived from a tumour-inducing plasmid carried by the soil bacterium *Agrobacterium tumefacieus*. This plasmid is called the *Ti* plasmid, which stands for “tumour-inducing”. These bacteria naturally infect over one hundred plant species, and genetic engineers make use of this quality. Infections of plants by the soil bacterium *Agrobacterium tumefacieus* cause a tumour to grow on plants. The tumour can then be removed and the tissue extracted is put in culture in a solution containing an antibiotic to kill the *Agrobacterium*. The tumour can then be placed in a culture medium for growth in order to produce the necessary amounts of cells. But the gene-transfer method using *Agrobacterium* is labour intensive and is unsuitable for cereal crops, such as rice, wheat and maize, since it does not naturally infect their species.

The limitations of the *Agrobacterium* method has been overcome with direct-transfer methods using particle bombardments through ‘gene guns’ or ‘gene cannons’. Although direct methods lose the specificity of the plasmid or viral approaches, they are very convenient and direct. The direct-transfer methods were developed independently by John Saiford and colleagues at Cornell, and Dennis McCake and colleagues at Agracetus Company, USA, now owned by Monsanto. In the Biological Ballistic or ‘Biolistic’ method evolved at Cornwall, magnesium tungsten or gold particles are coated with DNA and literally blasted into the plant’s cells using a gunpowder detonation in a particle gun. The particles carrying DNA are accelerated at high velocity, enter the cell wall, and transfer the DNA. The DNA is taking up by the chromosome of the plant and, in some cases, genetically transforms the plants, using the new genes that have been inserted. Figure 1 compares the projectile approach with the *Agrobacterium* approach to insert new DNA into plant cells.

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22 The plasmids are a small piece of DNA, normally circular, which is commonly found in bacteria and contains sex factors, antibiotic resistance genes, and other material.

Figure 1. Two common methods for genetically alter plants. The *Agrobacterium* method and the DNA particle gun method. (Hill, Walter, 2000).
The Dupont Company has exclusive rights to use Cornell’s patented ‘Biolistic Gene Gun’ for developing commercial transgenic crop seed.24 Agracetus ‘Accell’ method uses electrical discharge to propel accelerated DNA-coated gold particles into plant material. A well-known product that has been developed by the Agracetus technology is the Monsanto’s ‘Roundup Ready’ soya beans.

Transgenic plants produced either by introducing foreign genes through vectors or through particle bombardments have a low rate of success. To separate plants that have incorporated the foreign genes from those that have not, antibiotic-resistance markers have to be used. Genetically engineered plant cells are then grown in a medium containing this antibiotic. Those that have survived are the ones that have taken up the transgenes with the antibiotic-resistance markers attached. These are then cultured and grown into mature plants.

The method and the technology for transferring genes are developing all the time but for present there is still a lack of predictability about the exact location of the inserted gene in the chromosome. A side effect of having genes inserted in unknown location is the possibilities of having gene expression that are unwanted and which are very hard to detect. That these unwanted gene expressions possess dangerous qualities for humans are one of the risks with GMO technology.

I have in this chapter showed the methods of transferring genes between species and will now focus on the risks with GMO.

2.2. The Risks Concerning GMO Technology

It might not be necessary to say something about the reasons why we should investigate possible risks concerning modern technology. It would be quite easy to defend the rational in contributing to our understanding of the nature of these risks and how such risks should be govern in order to minimise and more justly distributed them. But nevertheless, it could be worth mentioned something about the ‘risk context’. If nothing else, it explains my own view of the benefit of debating risk issues and what it can offer with respect to the indeterminate future and the potential dangers that lure in the ‘techno-salvation’ of the modern society and the techno-hazards that are beyond the reach of our sense perception.

As Ulrich Beck has stated, the contemporary society can be seen as an ‘experimental’ society. With ‘experimental’ society Beck wants to emphasise that society is being subjected

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24 Ibid.
to experiments over which it has no direct control and are often unknown to it. What has made the transforming of society into a laboratory is according to Beck that:

Science and the technology spree, with which the industrial age feeds and irresistibly drives its transformation of the world into world markets, take place as a kind of undemocratic, permanent change in all areas of life, and may even openly contradict the schoolbook rules of democracy. 25

The quote can be seen as a synthesis in the extensions of two widely known concepts. The first is Langdon Winner’s concept of ‘autonomous technology’ which he describes as the “general label for all conceptions and observations to the effect that technology is somehow out of control by human agency.”26 It has often been argued that technologies such as GMO-technology is in danger of being an autonomous technology as the public concern for legislation are put aside for the interest of a global market. In public polls such as the Eurobarometer, people express a fear of gene technology being ‘autonomous’ as their power to have any insight in the decision-making concerning the development and market release of GMO products are difficult to employ. I will return to the public perceptions of biotechnology more in detail in section 2.2.3.

The other concept is the issue of ‘legitimation crises in Western societies, which Jürgen Habermas developed in the 1970s. Habermas mean those crises are results from unresolved steering problems in the society.27 Legitimation crisis then, is a result from an increasing coupling between the political system and the economical, which must be legitimated through some administrative decisions. When the decisions of democratic institutions are been taken more and more independently of the citizens motives, these institutions experience identity crisis.28 These identity crisis gives rise to steering problems which might end up in legitimation crisis. The legitimation crisis can be avoided if the pressure for legitimation to which the administrative system is subjected can be removed.29 One can ask if it is the lack of motives that are contributing to the public mistrust concerning GMO products. That the issue of GMO has caused steering problems for the political system is something that has been

28 Ibid. page 36 and 75.
29 Ibid. page 93.
quite clear under the 1990s. The new EU directive (2001/18/EC) concerning deliberative release of GMO can be seen as an attempt at removing the pressure for legitimation.

Technology innovations such as releases of genetically modified organism into the environment and the food chain, without a certain knowledge about possible effects and the probability of unknown effects has contributed to the conception of the society as a ‘laboratory’. In legitimate crisis concerning the risks with GMO and public acceptance the question of who are in position to define risks are actualised. There is a strategically element in the social construction of risk.

It is the particular reliance on both interpretation and expert systems that have made risks the object of one of the most effective discursive strategies for changing the political horizon of modern industrialized society…

In order to use these discursive strategies of risk there must be expertise mediating knowledge in order to legitimate those strategies. Hence, it seems, it is no longer ‘interest’ that dominate the political horizon but instead different claims about the legitimacy of particular forms of expertise and knowledge.

These issues discussed here shows that to fully understand the concept of risk we must develop our knowledge from the prevalent genre of articulating risks from one based on calculation and also include the mediation character in risk perception. First when we have done that, we can also more clearly see that the connection between risks, technologies and futures are neither of a singular determination nor governed by linear causal connections.

2.2.1. Defining Risk

The phenomenon of risk and the role it plays in contemporary social life has in recent times been subject for an increasing interest in the theoretical debate in social and cultural theory. In those debates, three major theoretical perspectives on risk have emerged since the early 1980s. The first is offered by the work of Mary Douglas, which in her book Risk and Culture set forth an influential perspective on risk, one that adopts a cultural anthropological approach.

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31 Ibid.
approach. The second major influence has its source in the English sociologist Anthony Giddens, which has contributed with sociological diagnosis of the role of risk in the society. The German sociologist Ulrich Beck represents the third major influence on risk from a sociological perspective. Beck’s book *Risk Society*, first published in 1986, has been a major influence on the risk debate. But there are also other influences in risk theory, even if they have not had the same impact on the debate. Several theorists have taken up Michel Foucault’s writings on governmentality in order to examine how the state and other governmental institutions manage and regulate risk issues in the society. Niklas Luhmann has also written about risk in *Risk: A Sociological Theory* where he develop the concept of risk and how different social systems in modern society, such as politics, law, science, and the economy, react to exposures of risk.

As mentioned above, GMO technology has the possibility to induce different types of risk against humans and the environment. But it is not always clear what we mean when we say that something is a risk. The first known appearance of the term ‘risk’ was in the transitional period between the late Middle Ages and the early modern eras concerning applications in the fields of navigation and trade. Today the language of risk is still associated with the economical world of trade. But we also find it in relation to insurance, the medical world of health professionals and their clients, as well as dangerous sports. The word ‘risk’ often refers, rather vaguely, to situations in which it is possible but not certain that some undesirable event will occur. In addition, the word has several more specialised meanings. We can identify at least five distinct meanings of ‘risk’.

1. In the context of normative ethics, risk is as an *unwanted event* that may or may not occur; i.e. a ‘risk’ is the *possibility* that some harm will occur.

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2. In the context of Bayesian decision theory, a risk is the cause of an unwanted event that may or may not occur.

3. In the third context a ‘risk’ is the probability of an unwanted event that may or may not occur. This distinction is used in quantitative risk assessment (QRA) and is usually expressed as the average annual probability of fatality that a particular situation imposes on an individual, such as a coal miner.

4. The statistical expectation value of an unwanted event that may or may not occur. This distinction is used in risk-benefit analysis (RBA) and in this context ‘risk’ is often a monetary value assigned to some probably negative outcome such as loss of life.

5. The fact that a decision is made under the condition of known probabilities is used in the context of insurance, where a ‘risk’ is the chance of loss, often financial loss.

In the contemporary society, the term risk has been reserved for a negative or undesirable outcome and is often used synonymous with the term’s danger or hazards. A useful way of separating risk from danger and hazards could be to describe the latter as a set of circumstances, which may cause harmful consequences while risk then would be described as the likelihood of its doing so. For the very essence of risk is not that it is happening but that it might be happening. Furthermore, this distinction between risk/hazards introduces a moral dimension, namely the dimension of moral responsibility, such that the perpetrators of risk may be held to account in some way or another. I will return to the issue of responsibility later. What the definition between risk and hazards brings to the fore is that it points to a relationship between decision-making and knowledge. Since risks are not certain, they require knowledge about causal probabilities. In order to attain this specific form of knowledge of causal probabilities one should investigate and come to an understanding of at least three different areas, namely the relationship between particular conditions, specific actions and possible consequences related to the specific issues at hand.

Another aspect of risk is the constructed nature of it. With this I do not mean in the epistemological way, as ‘constructed’ often is understood, that is, if risks are real or ‘mere’ social constructions. Instead I am arguing for a need of a more profound understanding of risk

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construction and its role as producer of particular uncertainties which may have some harmful consequences. These constructions also separate risks from fears as the following quote emphasis.

Risks are manufactured, not only through the application of technologies, but also in the making of sense and by the technological sensibility of a potential harm, danger or threat. One cannot, therefore, observe a risk as a thing-out-there – risks are necessarily constructed. However, they are not constructed on the basis of voluntary imagination; that is, we are not free to ‘construct’ risks as we please. Instead risks are being revealed in their construction. The construction of risk must obey the logic (discourse or reason) of its revelation. In order to make sense it has to incorporate the technological sensibility (know-how) of that which granted its existence.  

The revealing of a risk separate risks from fears as risks must follow some kind of logic and thus finds its validity as risk in that. Fears do not need to be legitimate in that way as it refers to a subjective state of mind. What the quote implies is that risk only can exist inside the ‘frame of reason’. In revealing a risk we also reveal its construction as “risk must obey the logic of its revelation.” If the risk does not obey the logic of its revelation it is a fear.  

In the GMO context, the particular condition concerning risks is the possibility of having certain values threatened or violated. Those values can be the concern for nature or the fear that the technologies are being autonomous. The specific actions depend on what kind of GMO we are discussing and the possibility for a crop or product to threaten any related values. The specific history of a GMO application must also be taking under consideration. The possible consequences are of course also related to the type of GMO and its quality. It must be determine the probability for a crop or product to threaten any related values. For example, more research is needed on the possibility for GMO crops to spread their gene-engineered quality. But all these areas, the particular conditions, the specific actions and the possible consequences, are all related to different values. To make the relationship between risk and values more tangible, I will here present a more systematic presentation of how the relationship can arise.

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42 Ibid.  
43 Of course one could fear a risk and in that sense a risk would also be a fear.  
44 See chapter 2.2.4 for a more detailed account on people’s values concerning GMO technology.  
45 I would like to thank Prof. Bo Petersson for giving me the idea for this presentation.
(1). A person (P) has different values \(V_1 \ldots V_n\).

(2). Some consequences (Q) means that those values or some value of \(V_1 \ldots V_n\) are being affected. If these Q’s are affecting any value in a negative way it is considered as a hazard for P according to the above definition of hazards and risks.

(3). A certain action X can cause Q, given certain circumstances (C).

This means that:

(4). X is then a risk for P.

But only if:

(5). P is aware of (2) and (3).

Accordingly that gives us:

(6). P apprehends X to be a risk.

But in both of these cases X have some attributes that make its inclination for causing Q to shift on a scale between very likely and not so likely. In this cases the knowledge about the circumstances in (3) are important. What can we know about these circumstances and what is their effect on the possibility for causing Q? Here we find a moral responsibility in order to perceptive investigate these circumstances in order to gain knowledge about causal probabilities that are needed for decision-making. Knowledge concerning the circumstances is of great importance in the GMO context, for example where the effect of ignorance of some circumstances leading to gene spreading, which could have serious effects on its surrounding environment. Ignorance above circumstances that leads to unwanted gene expression when genes are moved to an ‘unfamiliar’ milieu are also an example. An important part regarding circumstances in the GMO context is the issue that is known as non-target effects. Margaret Mellon and Jane Rissler of the Union of Concerned Scientists did a thorough analysis of
American deliberative release experiments. Concerning non-target effect they find that there have been fifteen reports concerned insect-resistance crops expressing a bacterial insecticide protein normally found in *Bacillus thuringiensis*. None of the reports even mentioned the likelihood of adverse impacts on non-target organisms, which will come in contact with this insecticide for the first time.

In order to reduce anxiety and risk perception it is important that the specific circumstances are known, taking under consideration, and mediated to the public by NGO’s, retailer, government and everyone that are in contact with the product. I think this is possible without trespassing on the companies’ patent rights. Regarding risk assessment it does not mean that one should move the focus from possible consequences to circumstances but that one should incorporate and search for a more profound understanding of circumstances that can affect a GMO.

I mentioned earlier that to fully understand the concept of risk we must develop our knowledge from the prevalent genre of articulating risks from one based on calculation and also include the mediation character in risk perception. In the above example we can see that if P believe that the condition of (2) and (3) are fulfilled we would then have the same result in (6) namely that P apprehends X to be a risk. With the mediating character in risk perception which are actualised in this separation of the actual causality between (2) and (3) or just believing that (3) can cause (2), we can better understand risk conceptions as a strategically method for political will-formation. For example, in Sweden the debate concerning the referendum of EMU has been racing up pace for the time being. In this debate the risk concept is used as a discursive strategy in order to convince the public of the risks of joining EMU or to stand beside. Here we can understand the political power in either controlling the public channels, as done by the USA in the recent war against Iraq, or having expertise mediating knowledge in order to legitimate certain action when there are different risks involved.

How can we then decide whenever an action is worth the risk? There are at least three things to consider here. (1) The values in question, (2) the probability that X cause Q, and (3) our knowledge concerning the circumstances.

(1) Regarding the values at stake, there could be actions that contradict each other when we consider the effect of a certain action. A certain action X can cause Q, which threaten a value

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46 Mellon, Margaret and Rissler, Jane ‘Transgenic crops: USDA data on small-scale tests contribute little to commercial risk assessment.’ *Bio/Technology* 1995, no. 13.
V₁ but promote a value V₂. In such a case, there are two steps of proceeding. First, an order of precedence must be established between the values at stake. Secondly, the probability for that V₁ respectively V₂ are going to actual be affected should be taking under consideration. When this has been done a weighing between the importance of the value at stake and the probability for it to be affected can be done. So given a certain ranking of the values and given some knowledge about the probabilities, we then have a more profound understanding for if X should or should not be performed.

(2) But there are also some other things to consider. I have here been talking about the probability for a consequence Q to affect certain values. But there is also a probability regarding in what degree action X can cause Q. If this seems to be confusing I would like to remind, again, the reader about the distinction between risks and hazards. I said before that a hazard could be described as a set of circumstances, which may cause harmful consequences while risk then would be described as the probability of its doing so. The probability for a consequence Q to affect certain values is thus considered as hazards towards different values. The probability regarding in what degrees the action X cause Q is considered as risks towards different values.

I am aware of that it might seem as a contradiction to say that X can be a risk because of its possibility to cause Q if Q then could have a positive affect on some values. But this contradiction unveils itself to be superficial. It would be a contradiction concerning the logical reasoning if our values where fixed and static over time and that we would not have values that contradict each other when we consider a certain action. If anything, I could be accused for taking for granted that an agent would consider values that we can refer to as common and/or universal good. An example, a GMO product that could reduce the use of herbicide and thus contribute to a sustainable development would be regarded as having a promoting effect.

(3) When we have define the probability regarding in what degrees an action X can cause the consequence Q, we must also determine our knowledge concerning the circumstances in the specific case. I have above discussed the importance and the problems of taking these circumstances under consideration. Our knowledge about circumstances should be in relation to the earlier use of the GMO. If the use of a GMO application is closely related or same as other GMO-application we might have a greater understanding of the actual circumstances. An application that is introduced in a new surrounding could be argued that the possibility for
certain circumstances to have a negative effect could be greater and thus must have a greater weight when considering the deliberative release.

When the values in question, the probability that X cause Q, and our knowledge concerning the circumstances are being taken under consideration, one could argue that we have attain the knowledge of causal probabilities. This because we have come to an understanding of the three areas concerning risk I mentioned above, namely the relationship between particular conditions, specific actions and possible consequences related to the specific issues at hand.

2.2.2. Assessing the Ecological and Human Risks of GMO

I will here more explicit discuss the possible consequences concerning the risks with GMO. The concern regarding risks and plant biotechnology is that GMO-crops can damage ecosystem by eliminating or by intersecting with natural species. It is argued that the spreading of these industrial constructed GMO-crops can threaten the biological diversity. No one can today give any guarantees that the inserted genes will not spread (so-called genetically pollution) to other plants and/or animals in the environment. Pollen has been showed to be able to spread much longer than what the GM-corporations has claimed. The risk for gene polluting is greatest in parts that are similar or closely related to the same species.

Another problem related to the environment is that GM-application can be resistant against insecticide and weed-killer and is therefor tied to continued chemical farming and stands in contrast to the purpose of reducing chemical use. One purpose of GM-applications is to create a protection in crops, which has the advance of reducing the need of insecticide and weed-killer and thus also reducing the use of fossil fuel in the vehicles that spread those chemicals. But when the GMO-crops get resistant against the insecticide and the weed-killer they instead need to increase or use stronger insecticide.

Foodstuffs have always the potential to be toxic, even if it not produces by GMO-technology. Unfortunately, It is very difficult to determine whether food is toxic or not. One of the problems is how the long-term effects should be studied. Food that could be cancer inducing might not cause any tumours for after a long period and finding any causality between the particular food and a growing tumour is difficult. Concerning GMO food, it has been expressed that the transferring of genes by gene-technology always contributes to a risk of forming cancer- or allergy inducing substances. The reason for such apprehensions is the
difficulties, (which I have described earlier), with the predictability about the exact location in
the chromosome where the gene is inserted. Because of the lack of predictability there is also
difficulties to foreseen the expression of the transferred gene. The reason for that the gene
expressions that are unwanted are very hard to detect is that it can not be foreseen in advance
what kind of unwanted gene expression we get. The transferred gene can end up in the middle
of a normal gene and inactivate it or affect its gene-environment and give rise to unwanted
and unforeseen effects. Therefore is the proposal by the Swedish committee of Biotechnology
in the committee’s final report that “it could be reasons for testing foodstuffs [containing
GMO] before they are released to the market”47 a good recommendation. But at the same time
difficult, impossible maybe someone would say, because we do not know what kind of gene
expression we would look for.

2.2.3. The Public Perceptions of Risks Concerning GMO

In any survey concerning biotechnology, GM crops and particularly GM food are the most
rejected biotechnological applications. Why is that? What kind of values does GM food and
GMO applications challenge? What leads to this public resistance to GM products? In order
to be able to answer these questions, a lot of surveys have been done on both national and
European level. And a great quantity of articles in the subject has also been published.
Concerning public opinion towards biotechnology, the committee’s final report from the
Swedish committee of Biotechnology recognised three different areas in relation to the
public.48

1. Expectation and confidence;

There is a confidence gap between experts from the science community and
the environmental movement and large part of the public in the debate
about GMO. Research has shown that there is a widely spread resistance
against GMO. The technology was apprehended as an ecological threat and
an obstacle for global justice. There is also a feeling of being powerless and
not being involved in the process.

48 Ibid. page 275-280.
2. *Nature and man;*

A common opinion seems to be that gene technology is an unnatural manipulating with life and a crime against the laws of nature. This shows that the debate about the gene technology is not only about the possibility of the technology and its risks, but also about nature and how human interaction with nature is acting together.

3. *Insight, participation and influence;*

Opinion polls have shown that only a quarter of the Swedish population considers that they have a chance to control the development of gene technology. Three-quarters consider that the control of GMO food is inadequate. Not having any insights and not being able to influence the development can be important reasons to the suspiciousness towards gene technology.

During 2002 there has also been published two doctoral thesis concerning public perception of biotechnology and GM food in Sweden, namely Victoria Wibeck’s *Genetically Modified Food in Focus* and Susanna Öhman’s *Public Perceptions of Gene Technology*.49

Wibeck’s conducted eleven focus groups.50 Eight of the focus groups had the common theme that the participants where ‘lay people’ i.e. the participants should have no professional experience of gene technology. The other three groups where consisted with decision-makers. In her focus group discussions the most central theme dealt with fear of gene technology.51 Related to the theme of biotechnology and fear were issues such as “the view on nature, technology and humans, the view on knowledge, information and experts, and the view on agents and agency.”52 But two different implicit assumptions were also discerned which are of interest. The first was concerning gene technology and the view of nature and humanity’s place in nature. According to Wibeck, “[t]he view on nature underlying the discourse was normative, which in this case means that nature was conceived of as inherently good.”53

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50 A focus group consists of a small number of people led by a moderator that discuss a certain topic determine by the researcher.


52 Ibid.

53 Ibid. emphasize in original.
argumentation the participants stated that they felt it was an “importance of not disturbing nature’s balance” and that they believed that gene technology “might eventually threaten the positions and life condition of humans.” The other implicit assumption which were discerned dealt with the “...importance of having control.” In the issue on the possibilities of having control of the gene technology Wibeck comes across three different aspects that crystallise from the focus group discussion. The first was that the human being was regarded as “neither morally nor intellectually mature enough to handle the rapid changes evoked by gene technology.” Secondly, the technology was believed to have potential negative consequences that are unknown, could lead to irreversible ecological catastrophes and the technology was also regarded of having an inherent power that would be dangerous if unleashed. Finally, gene technology was considered an “invincible technology,” meaning that it is a small and hidden technology with the consequences that humans can not perceive when they lose control of the technology or when the moral boundaries are trespassed. As we can see, Wibeck’s empirical findings are not so different from the committee’s report from the Swedish committee of Biotechnology. In these investigations we find people expressing fear, anxiety and suspiciousness in areas such as confidence, relation to nature, insight and participation.

Susanna Öhman also finds that Swedes relatively are negative towards modern biotechnology and especially food production. She argues that “this resistance is mainly based on moral/ethical values and not on assessment of physical risks.” As in the Swedish committee of Biotechnology and in Victoria Wibeck’s research she also finds similar attitudes towards nature. She says:

Many Swedes think genetic engineering constitutes an inappropriate tinkering with life, and more specifically with the meaningful order and ecology of nature. Genetically technology is seen by many Swedes as having existential, far-reaching, unknown, and not easily observed consequences. Many do not perceive genetic engineering as doing very much good for the average citizen (except for the medical applications), but it is rather regarded as a top-down technology.

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54 Both quote from Wibeck, Victoria, 2002, page 220.
55 Ibid. emphasize in original.
56 Ibid.
57 Ibid.
58 Ibid.
59 Ibid.
In the above quote we find similar attitudes towards nature as in Wibeck’s research, we also find attitudes that are in line with what Wibeck called the “invincible technology” and also the problem of not having control. But here we also find expressions that genetic engineering is not doing very much good for the average citizen. In all the three investigations concerning the public perceptions towards biotechnology we find fear, anxiety and suspiciousness mingled together. People express a lack in the confidence towards politicians and companies and have difficulties to see any real benefit for the people that are consuming the products. Together with the lack of confidence and what was stated above concerning people expressing fear, anxiety and suspiciousness in areas such as confidence, relation to nature, insight and participation we have encircled the sources of the widely spread resistance against GMO.

Experience of earlier, unintentional as well as intentional introduction of foreign, not genetically modified, species in our flora and fauna shows the importance of that intended exposure of GMO is preceded by accurate risk valuation. It has been argued that risks are a normal part of technological advancement. It is true that we accept risks as a normal part of life, but most of the risks we accept are defined by experience and are understood before they are taken. Some risks are also taken because the rewards are perceived to outweigh any prospective harm or drawbacks that one might suffer. Many are not yet prepared to accept the risks of GMO technologies. This is part due to a lack of understanding of the risks, the minimal benefits of the current crop of GMOs, and a mistrust of the motives of those selling the technology. Given the current state of our knowledge of the technology and the nature of the GMOs currently available, this lack of public trust is entirely reasonable. Public acceptance will require convincing demonstration of safety and the development of crops with a more direct benefit to the consumers. The concerns expressed by many are further validated by the current generation of GMOs that have been incorporated into the food system without adequate public consulting and scientific scrutiny. The current generation of GMO crops does

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61 See also Susanna Öhman’s articles *The structure of Public Perceptions* and *Sweden* which are included in hers Ph.D. thesis.
62 Ibid.
63 See also Durant, John, Bauer, Martin W and Gaskell, George (eds.), 1998 and Gaskell, George and Bauer, Martin, (eds.), *Biotechnology 1996-2000: the years of controversy*, Science Museum, London, 2001. These two publications are bringing a comprehensive assessment of European public opinion about biotechnology. They also bring analysis from major European (the ‘Eurobarometer’) surveys of public perceptions that have been conducted in 1996 and 1999.
not provide any tangible public benefit, have not contributed to reduced food costs, and have no confirmed ecological benefits.

2.3. The Legal Regulation of GMO

On a global scale there are two different trends. On one hand there is the apprehension that gene technology is just a further development of an existing technology and therefore the current legislation should be used. The other trend emphasizes that the gene technology is a new technology that needs a legislation that must be specified separately for it. The USA represents the first trend and the European Union (EU) represents the other trend. Here a conflict arises about how GMO should be handled in the political sphere. I will here briefly present the legislation concerning GMO outgoing from three different geopolitical areas, namely the Swedish, EU, and the international legislation.

2.3.1. GMO and the Swedish Legislation

In Sweden, gene technology is legislated in the Environmental Code, specific in chapter 13 but also in chapter 1, 2 and 14. It concerns three area of use concerning gene technology: containment use, market use, and deliberate use. The purpose with the regulation is to promote a sustainable development and an ethical use of the technology. The Environmental Code emphasizes in a rather strong way that a specific ethical consideration shall be taking under consideration in these three areas of use.

The Swedish laws and regulations about biotechnology are based on the Community law. There is no overarching legislation about biotechnology, and concerning the release of genetically modified organism, the two most important acts are the Swedish Environmental Code (1998:808) and the legislation of foodstuffs (1971:511). The Environmental Code chapter 2, generally rules of consideration, section 2, says that everyone that is running or have the intention to start with an activity must get the knowledge that is necessary to protect human health and the environment. It is argued if this section can be carried out under present conditions with the scientific uncertainty in the field. In chapter 13 is the ensuring for ethical consideration.

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65 Miljöbalken 1998:808, Chapter 13, § 10
2.3.2. GMO and the European Legislation

In EU, the main piece of legislation regulating the release of genetically modified organism (GMOs) was the EU Directive 90/220/EEC. The European Community adopted directive 90/220 in 1990 to address the fact that there was no law to control new techniques in agriculture resulting from genetics engineering. Although the European Community recognized that this novel technology could have benefits, it also acknowledged that it posed potential risks for human health and the environment. The GMO Deliberative Release Directive (90/22/EC) has been under revision since 1997 and where finalised in early 2001. The new directive (2001/18/EC) has recognised a number of areas where improvement is needed. There is no demand for ethical consideration in EU directive 90/220/EEC but the new directive emphasise the respect for ethical principles and that Member States may take into consideration ethical aspects when GMOs are deliberately released or placed on the market as or in products.

The directive can been seen as a response to the problems mentioned above concerning lack of confidence, relation to nature, and the problem of insight. As well as protecting the free market by homogenise the Member states regulation. The first paragraph in the directive states that “the objective of this Directive is to approximate the laws, regulations and administrative provision of the Member states and to protect human health and the environment […].”66 In this quote the directive express an underlying tension, a tension that is the result of an attempt to meet different interests. This applies particularly to the interests of companies and the public interest. The public interest is focused on the issues that I mentioned above and the companies are focused on the development and the possibility to sell GMO products in Europe. In order to acknowledge these interests they are combined in the directive’s objective. This tension proceeds through the directive where the directive has to do a delicate balance act. Because of the lack of confidence and the sceptical attitude towards GMO among the public it is important for the directive to strengthen the protection of both nature and people. If this gap of confidence can not be ‘tighten’ and people continue to mistrust GMO products it will undermine the possibilities for a market of GMO products. Building confidence is strongly needed for the companies as well as financier as an incitement to put money into the business of GMO technology.

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2.3.3. GMO and the International Legislation

On a more international level the problem with GMO legislation is even more serious. At the beginning of this millennium, 85% of the states in the world were missing national regulation for genetically modified organism (GMO). This number is probably unfortunately still accurate because most of these countries are developing countries. But also EU or other industrial countries that has developed a good deal of legislation around GMO has not any regulation for how the international trade should be regulated. To help countries without their own GMO legislation the biosafety protocol was established. The biosafety protocol is a global protocol for regulating the international transport and trade with GMO. The biosafety protocol is a part of the convention on biological diversity (CBD) and was approved by the world’s countries in Montreal at January 29, 2000. Just a year earlier at Cartagena in Colombia the negotiations failed. The Miami group (USA, Canada, Australia, Argentina, Chile and Uruguay) turned down the proposed compromise from EU and a decision about a biosafety protocol failed.

At the resume negotiations in Montreal there where some questions that remained and needed to be solved before an agreement could take place. The conflict was about how imported GMO that should be used as food, forage or in industrial processes could be regulated, and how these GMOs should be, or not be, marked. Another problem was how the relationship between the protocol and other international agreement was to be described in the agreement, -especial the relations with WTO. There were also discussions about how the precaution principle could, or could not, be used to make decision about import of GMO.

The agreement on the Cartagena protocol has been seen as a major step towards an international regulation of GMO. First, the protocol gives the developed countries a legal foundation to decide for them selves if they want to import GMO into their countries. Second, the protocol harmonizes the global trade and for the third, it strengthens the global environmental cooperation. The disadvantage of the bio-safety protocol is that it is only concerns so-called “living organism” and not processed products, which in GMO products is the most common case. But a more important question is how the Cartagena protocol will stand against the GATT-agreement. The problem is that they are contradictory to each other when it comes to imports of GMO. One example is that the precautionary principle does not exist in the GATT-agreement and it will not accept a trade stop based on that. So which has

67 It goes also by the name, the Cartagena protocol.
the final word? The Cartagena protocol lacks mechanism for disputes and does not have the same practice as the GATT-agreement. Because of these conditions, the significance of the Cartagena protocol is decreased.

### 2.3.4. GMO and the Permit Process

Before a company can get a GMO product on the market, they need to make a permit examination of the product in question. In a Swedish context, there are four different steps that they need to take under consideration. The first is the duty to make an investigation and a risk estimating of the product. The second step is to see if the product fulfils the Environmental Code’s general principles. The step by step principle is also used which means that it is not allowed to directly release a product on the market before having done any estimating of the product. At the next level the product must be ethically justifiable. For a product to be ethically justifiable means that the product is not allowed to cause any unnecessary suffering. For me it is not clear how judgements between unnecessary and ‘accepted’ suffering are made. It seems that a pragmatically choice in a utilitarian way is made between benefit and disadvantage. Unfortunately, there is no account on what should be considered or even what it means to take ‘specific ethical consideration’ in the Swedish Environmental Code. The result is that it leads to confusion in the lawmaking process. In the last step the long-term effects of the product should be taken under consideration as well as the societal benefit. In the valuation there should also be an acquired counselling from the committee of gene technology. The permit is often valid for five years but shorter and longer terms exist also.

There are different possibilities to influence the market adaptation of GMO products. These possibilities to affect can be discussed on two different levels, the individual level and the national level. If we start with the individual level there is two ways to affect, either by

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68 For a definition of the precautionary principle see page 41 in this paper.
69 Chapter 1, 1998:808.
70 The expression of confusion are also mentioned in interviews with people involved with lawmaking processes in Sweden concerning GMO issues, that I carry out in 2002, see Johansson, Anders, The Politics of Biotechnology and the Transformative Power of Narratives. Master of Science Thesis, Linköpings universitet, 2002. Depending on the personally importance given to ethical issues the respondents valued and choose different actions when confronting ethical issues. Some could see ethical consideration as obstacles where the only intention is to adjust to a public opinion. Other interprets ethical consideration as valuations between risks and benefits, which is a utilitarian understanding in the positivistic sense of the meaning of ethical implications. This proceeding would be the easiest way of making ethical considerations because it is based on empirical data, which are more easily to reach consensus on as the data are ‘objective’. Other understands ethical consideration as responsibility of management related to sustainability.
choosing other products or by the permit process. There is no demand that the permit examination needs any consultation with authority or announcement, so it is not easy for individuals to get involved in the permit process. With the new directive, 2001/18/EG, the public are supposed to be part in the decision-making process. How this will be put into practice in Sweden is under consideration. Anyhow, if a citizen wants to appeal against a decision on an authorisation, he or she must be a plaintiff, and it is not enough just to be a consumer, or by going through an environmental organisation. The environmental organisation needs of course to have more than 2000 members and must have been active for more than three years.71

When it comes to the possibilities to effect on a national level there are some things that need to be taken under consideration. First, the E.G. directive about deliberative release of GMO is a market directive which means that a state in EU can not have any stricter claims then what the directive prescribes. Second, the new directive is strengthening the ethical demand, but only in the beginning of the directive, in the preamble, and not in the operative part of the directive. The effect of this is that, from a legislative perspective, there is no need to take any consideration of the ethical aspect. Considerations of ethical aspects are only optional. For the third, deliberative release of GMO is a part of a clause of free trade and that has the effect that if a product gets approved in an EU state all other countries in EU must approve it as well. From my point of view there is a risk that the East European states that are participating in the expansion can not live up to a acceptable level when it comes to permit examination of the GMO product. The reason for my misgiving concerns two subjects. The first is that risk assessments is expensive on the companies side and also that these permit examination are costly for the state in order to have a staff and a working institution. The other reason concerns if the knowledge base is sufficient. This matter is of course also about money. The knowledge issue concerns both companies and government. The companies must provide a certain level of knowledge in order to do a satisfactory risk assessment and the government must provide enough knowledge in order to do satisfactory permit examination.

If they not can live up to a acceptable level it can lead to market releases of GMO products that had not gone through a satisfactory risk assessment, which put consumers and the environment at hazards. Standardised norms of risk assessments as well as the permit examination should be constructed in the same way as the ISO standards have been developed

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71 Another possibility is to join a body to which a proposed legislative measure is referred for consideration. This could be done through universities and does not need to be approved by the authorities.
and with recurrent supervision on a regular basis for maintaining a high standard of these issues. Because a GMO product that gets approved in an EU state has the effect that all other countries in EU must approve it as well, it is reasonable to demand a satisfactory level of knowledge in all member states. Here I do not talk only of certain knowledge concerning gene expression but also about incorporating the public and other related areas of knowledge for decision-makers. As mentioned above, the goal of the new GMO directive (2001/18/EC) is to approximate the laws, regulations and administrative provision of the Member states and to protect human health and the environment. In order to fulfil this, EU should raise funds in order to reach the same standard in risk assessment and permit examination across EU. An exception from the clause of free trade is that in specific cases a state can stop a product temporary. But if the state wants to make the stop to last, they need to prove that there is some distinguishing quality that makes the specific GMO product a threat for that specific state.
PART III

3. Responsibility in the GMO Discourse

3.1. The Nature of Responsibility

3.1.1. Three Categories of Moral Responsibility

The concept of moral responsibility can be divided into at least three categories. (1) As a virtue, when we are recommending someone as a responsible person, meaning to say something morally favourable about his character. (2) As a duty, the prospective responsibility, when we say that X is responsible for Y, where Y is something still to be done, meaning that X has the responsibility to assure it will be done. (3) As a ‘property’, the retrospective responsibility, when we say that X is responsible for a past action and thus are subject to blame or praise regarding to the character of the ‘property’.

(1) When referring to responsibility as a virtue we are denoting a quality of character and mind. A responsible person is a person that take care of anything that needs to be done and is ready to put things right if anything goes wrong and in generally gives thought to the situation. The person has a more or less defined sphere of responsibility depending on his role but a responsible person does not act thoughtlessly, or on impulse. Thus, we want to have responsible people in positions of authority, performing their duties reliable and well. We can also say that a responsible person is one that can be counted to carry out his prospective responsibilities and to accept their retrospective responsibilities. To be irresponsible is not one who has no responsibility but one who does not take their responsibility seriously. Responsibility in this sense is thus a virtue that we should try to cultivate.\(^72\)

(2) If someone has a duty, that person has some kind of obligation to fulfill. It could be an obligation against an office that he upholds or some other commitments to do certain things, and hence is a normative judgement of obligation. If someone takes on an office - from the Latin officium, a duty - that person accept the prospective responsibilities that follow with the

\(^72\) William K. Frankena refers to responsibility as a second-order virtue. The first-order virtues are the cardinal such as benevolence and justice and non-cardinal such as honesty and fidelity. But there are also other virtues, such as responsibility, with Frankena words: “… there are certain other moral virtues that ought also to
office. But in order to be answerable, it presupposes that with the office it come some power. A ‘ought’ implies a ‘can’. To justify critique against someone’s exercise of office it must be against things that are in that persons power to have done otherwise. As J. R. Lucas put it:

Responsibility and duty are correlative: if I am to have responsibility for something, I have to have the authority and power to act so as to discharge it. Responsibility thus implies, and is almost the equivalent of, ‘power’ or ‘authority’ in modern usage…

In the case of responsibilities in office, the responsibilities are caused by the obligations that are attributed to that certain office service. Those obligations are in the same time giving authority to act in line with the right of office, but are in the same time restraining my action in the meaning that I can not act totally free. The role in upholding a specific office is embedded in social norms that have been developed by time, as well as specific interest regarding the position of the office. An office confers of a complex bundle of authorities, duties, and responsibilities. There can also be value conflicts for persons that uphold public office. Civil servants must sometime weight different interest, such as public and corporation interests, under decision-making. In the GMO context there has been a debate concerning labelling of GMO products as an important information carrier for the public but in the same time it has been seen as a obstacle for companies to sell their GMO products. Thus my prospective responsibility are often tied to specific roles but those roles do not have to be related to any profession, we have also prospective responsibilities in more or less diffused ways. Those could be as friends, citizens, as human being (to pay attention to the interest of other human being) and as inhabitants of this planet (to have some practical concern for its future). If I fail in my prospective responsibility I can be hold responsible to do whatever needs to be done or could be obliged to have an answer to the question “Why did you not…?” We have in this case moved into the sphere of retrospective responsibility.

(3) In the last category, we say that X is responsible for a past action (Y). My retrospective responsibilities are those I have after the event, for causes or outcomes which can be ascribed to me as an agent. I am responsible in a retrospectively way for what I do, or fail to do, in discharging my prospective responsibilities. We are responsible for at least some of the results

be cultivated, which are in a way more abstract and general and may be called second-order virtues.” See Frankena, K William, Ethics, Second Edition, Foundation of Philosophy Series, Prentice-Hall, 1973, page 68.


Ibid, page 183.
of our action, most obviously for those we bring about intentionally. But to say that X is responsible for Y is not the same as saying that X caused Y. There is not a causal relationship between X and Y, but a moral. In the same way as ‘desirable’ does not just mean the ability ‘can be desired’ in the same way as ‘audible’ means ‘can be heard’, but rather means something like ‘good’ or ‘ought to be desired’. Following from the example, we can say that it would be right to hold X responsible or we ought to hold X responsible for Y under certain condition. When it is then justified to hold X responsible for Y and which are the conditions when we ought to hold X responsible for Y? Well, it presupposes that there are agents and that they act for reason, and that it is up to an agent whether he acts or not. Other conditions are that he should be able to do it and that he in fact did it.

Aristotle (384-322 BC) was concerned with responsibility rather than with freedom. For him, the issue of freedom was not a problem. He did not doubt that adults were free agents and if they were not physically constrained, they were free to decide for themselves how they wanted to act. I will return to the question of freedom later. It is fascinating that Aristotle’s view of personal responsibility is not, in practise, very different from our own, despite the distance in time. We still have much in common with Aristotle regarding our thoughts about responsibility. We absolve children, mentally handicapped and mentally ill from responsibility and we assume that ordinary people are capable to make decision on how to act correctly in normal circumstances and that they are responsible for any actions they decide upon. His deliberations on moral responsibility are not irrelevant and can be most helpful even behind those common thoughts. His discussion on the circumstances in which a free agent can be held responsible for his or her actions will give us considerable insight into the nature of freedom.

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75 Frankena, 1973, page 72. This issue has a parallel in Mill’s notion of desirable. Mill’s critics have often criticised his argument that the way to prove something is desirable is to show it is desired, just in the same way as the way to prove something is audible is to prove it is heard. As Frankena points out, the suffix ‘able’ do not always indicate an ability, they may have a normative meaning (ibid.). We can thus understand desirable in two ways. Normatively as ‘ought to be desired’ and then the validity claim in order to be a legitimate claim of what should be desired must respond to a moral norm, i.e. it must respond to our shared understanding of the good life. Considering this, it is not enough that it is desired, it must also be intersubjective recognised as morally right for legitimating is as something that should be desired in order to be general recognised. Descriptively we can see desirable, as Mill, as something that are empirical showed to be desired in the meaning that we recognise something that are a subject for people’s desire. Here Mill have been accused for committing ‘the naturalistic fallacy’ meaning that he recognise a ‘is’ as a ‘ought’. But Mill probably understands desirable as something that each person desire for his owns happiness and that this pursue is intrinsically good. Hence, if my pursuit of happiness is intrinsically good everyone else’s pursuit of happiness must also be intrinsically good if I believe that my own happiness is objectively good.

76 Ibid.
In *The Nicomachean Ethics* Aristotle separate between voluntary actions and involuntary ones regarding moral responsibility. It is only voluntary actions that we can be holding responsible for. He mentions two conditions that an action that is considered involuntary must fulfil. When (a) the action is done under *compulsion* and (b) when it is done through *ignorance*.\(^7\) That (a) is done under compulsion means that the cause of the action is external to him. As Aristotle puts it, “an act is compulsory when its origin is from without, being of such a nature that the agent, who is really passive, contributes nothing to it…”\(^7\) When the action (b) is done through ignorance it is said to be involuntary. Here Aristotle separates between acting *through* ignorance and acting *in* ignorance. Acting *in* ignorance is the case when the agent is ignorant concerning of his true interest, for example someone that is mentally retarded.\(^7\) Aristotle means that

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\text{[the ignorance that makes an act blameworthy is not ignorance displayed in moral choice …/… but particular ignorance, ignorance of the circumstances of the act and of the things affected by it; for in this case the act is pitied and forgiven, because he who acts in ignorance of any of these circumstance is an involuntary agent.} \quad ^8
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Thus an involuntary action is one that is done under compulsion or through ignorance and a voluntary action is an action that is intentional by the acting agent and that he also knows the particular circumstances in which he act. G. E. Moore and P. H. Nowell-Smith have also stated that a man is not responsible for an action unless he could have done otherwise if he had chosen to do otherwise, or if his character and desires had been different.\(^8\) To be responsible for Y is then to hold X answerable for it. It means that I can be called to account for it by explaining, justifying or admit my actions or the failing of my actions. Retrospective responsibilities may also bring liabilities. If I am responsible for the harm that I caused, I may be liable to censure or punishment for causing that harm and maybe to compensate for it.

Earlier I said, in a little careless way, that for keeping anyone responsible it presupposed that there are agents and that they act for reason, and also that it is up to an agent whether he


\(^{8}\) Ibid.

\(^{7}\) Aristotle also mention drunk or in rage concerning action done in ignorance.

\(^{8}\) Ibid. my emphasize.

\(^{8}\) As Frankena points out so is this standpoint just a restatement of Aristotle’s position. Frankena, 1973, page 72.
acts or not. This statement is far from being obvious. I will now investigate how responsibilities are related with the issues of free will and determinism.

3.1.2. Free Will, Determinism and Responsibility

One usually conceives that the will is the faculty of choice or decision, by which we determine which actions we want to perform. As a faculty of decision, the will is naturally seen as the point as which we exercise our freedom of action, our control of how we act. It is usually regarded that it is within our control which actions we perform just because we possess this capacity to decide which actions we shall perform. We exercise our freedom of action through freely taken decision about how we shall act.

It is often argued that to be able to hold someone responsible for an action, that person must have the possibilities of multiple choices of action. But the multiple options are not enough; he must also be able to choose any of these choices. Thus the choices could not be determined as a result from previous causes, such as his belief, character, desires, heredity, and environment. In other words, a moral responsibility seems to be related to the subject’s possibilities of making use of a free will. But it has been argued that the free will is an illusion, that our choices and actions are determined beforehand and thus I could not be responsible for any consequences of my choices or actions. Before we go any further, I should define what I mean with determinism since it might not be obvious in what sense it is used. According to J.L. Mackie,

…the determinist thesis is that for every event there is an antecedent sufficient cause, that is, a temporally prior set of occurrences and conditions which is sufficient, in accordance with some regularity, for just such an event and which leads to it by a qualitatively continuous process.

For the following discussion it could also be worth mention that determinism should not be confused with fatalism. With determinism one could separate between two distinctions, on the one hand weak determinism, which means that determinism necessitate a certain effect

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82 Ibid.
84 Fatalism is the view that what we do is entirely controlled by something independent by our choices and desires. In other words should human action have no influence on events, but this idea is not included in determinism.
and on the other hand strong determinism, which means that determinism necessitate fixed chains of causal relationship between cause and effect.

If determinism shows itself to be true it significantly undermines our moral ideas. We would have to reconsider our notion of choice, responsibility, praise and blame and even more central notion such as goodness, justice and obligation. In the literature there are three different aspects on moral responsibilities and determinism. (1) Strong determinism is the view that moral responsibility is *incompatible* with determinism mainly because of the reason that a “ought” implies a “can”. (2) Weak determinism is the view of determinism being *compatible* with moral responsibility. (3) Moral responsibility *presupposes* determinism, meaning that it is indeterminism that is incompatible with moral responsibility.

(1) The question of moral responsibility springs from the question ‘Why did you do it?’ and enjoins the person whom has been asked to elucidate his or her motives or causes. But for the question to be legitimate it is generally agreed that the agent possesses some power or ability to have done, or not have done, the deed in question. If I could not have done it, there is no question that I *ought* to have done it and there is no question that I *ought not* to have done it. Advocators of causal determinism suggest that if the thesis of causal determinism is proven to be true it will have far-reaching consequences. We must thus abandon the concept of moral responsibility and also rethink what it means to be a person. This notion of determinism refers to the strong apprehension of deterministic causal relationship.

(2) Another notion of determinism is the weak determinism which means that determinism necessitates a certain effect, meaning that something is determine if there is an external or internal “coercion”. The definition of determinism decides how we can answer the question of responsibility, see table 1.

<table>
<thead>
<tr>
<th>Definition of determinism</th>
<th>Strong</th>
<th>Weak</th>
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<tbody>
<tr>
<td>(necessity of causal relationship i.e. every events has a cause)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Responsibility (be able to blame or praise)</td>
<td>No</td>
<td>Yes</td>
</tr>
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Table 1. The relationship between strong and weak determinism and responsibility.

With the weak notion of determinism it is possible for determinism and responsibility to be compatible. The argument here is that for an agent to be responsible he must be free from compulsion and constraint, not from causal necessity. But Lucas argues that in the argument we must understand compulsion and constrain in a very wide sense. A kleptomaniac is not under any compulsion or constraint in the strict sense of the words, but nonetheless it could be argued that in the wider sense of the concepts the person is constrained to steal by some neuroses or a trauma. By stretching the concepts, Lucas means that we “can no longer argue that in its stretched sense it may not turn out, in the light of new discoveries, to cover all cases of human decision-making.” Others have argued that even if strong casual determinism is true, so everyone’s behaviour is in fact the result of past states of the universe and the laws of nature, we do not have to give up our conception of ourselves as persons. They mean that the belief of ourselves as persons is so fundamental that we can not abandon it because of a new scientific discovery. Whether we are moral responsible agents who can have deep personal relationship and friendship, should not depend on whether causal determinism is true or not.

A slightly different argument put forward is that the question concerning if determinism is incompatible with moral responsibility is built on a misunderstanding. Frankena argues that it is not whether determinism is logically compatible with responsibility but if it is morally compatible with it. In a utilitarian way it would still be reasonable to talk about responsibility. In this view, holding someone responsible is to disengage from the question of determinism and finds its justification if and only if holding someone responsible makes for the greatest balance of good and evil. The concept of responsibility is then disengaged from the question of determinism because it does not matter if the agent was not free in the way of causal necessity but only if holding him responsible will or will not have certain results.

(3) Indeterminism is the opposite of determinism meaning that some event, including human choices, happens without any causes or explanation. If indeterminism were true then it would be impossible to predict any human actions or choices. It would also be pointless to try to influence and reasoning with people. Thus, we can not hold anyone responsible if our acting is at random and moral responsibility is therefor inconceivable without determinism.

88 Ibid. page 15.
90 Frankena, 1973, page 73.
But it seems to me that indeterminism stands in incongruity when we look at the society. It does not seem that the society consists of humans that act at random. It does not seem that a functional society would be able at all if indeterminism would be true. Another argument is that an acting agent would not be able to give any reason for his acts if they were at random. But of course we can often give adequate explanation of many of our actions. ‘I went to the seminar because the topic was fascinating’ is a perfectly good explanation, showing that it was not a random one. We could therefore agree on that indeterminism is incompatible with moral responsibility, but we have reasons to believe that indeterminism is not true. This standpoint does not mean that in the case of indeterminism not being true, induce that moral responsibility presuppose determinism.

Let’s conclude the discussion on free will, determinism and responsibility with saying that so far we have not seen any convincing proof for abandon our concept of moral responsibility. In order to be able to hold anyone moral responsible we must assume that people are under normal circumstance free to do as they choose and that people have reasons for doing so.

### 3.1.3. Responsibility and Technology

As already stated, the rapid growth of the modern forms of technology under the post-war era has brought both threats and promises for liberal democratic societies. As we grapple to understand the implication of new technologies in biotechnology, and in any other technological development in the contemporary society, we feel anxiety concerning that these changes conceivably threaten the existence of a sets of fundamental values. Those values are primary goods that we connect to the modern world and to the occidental transition of modernity and the development of social freedom, individual autonomy and personal privacy. Those values are a moral, social and cultural heritage of the western society and make us insecure of how we should estimate technological development. The confusion of our feelings concerning the development in nuclear-, information- and bio- technology grows with our recognition that technology holds forth the promise of creating expanded opportunities and a greater realm of individual freedom. The questions here are; how should the society and our relation to technology be constructed and understood, so that we limit the threat to society, nature and ourselves and instead becomes the platform where we can proceed towards our desire of the good life?
We can not escape the fact that with the technological development an increment in our burden of responsibility has appeared when our possibilities to alter our environment and our future have increased. We do not need any divine capacity of insight to realise this statement. Some has also expressed worries that certain technologies undermine or deprive human beings of responsibility. For example, Henryk Skolimowski has raised a charge against the development of computers. He says that:

Responsibility and technology must, at this time of history, be considered vis-à-vis each other. Technology which systematically deprives us of responsibility (by delegating everything to experts), represents the victory of evil. For if everything is done for us, if we cannot exercise our responsibility, we are no longer human.\textsuperscript{91}

One can not help to think of Aldous Huxley’s \textit{Brave New World} when reading the quote above, concerning how a future high-technological society could be if our ability to exercise responsibility was taken away. But it is not clear if computer technology, as it has been developed so far, have led to any depriving of our responsibility. In fact it could be argued the other way around, i.e. that the computer technology has made possible certain responsibilities. But what the above quote does point out, is that there might be a difference between what the technology brings at a material level and at the ideal level. We could also see the quote as a warning for letting technological progress be disconnected from democratic governance. Those issues address not only the computer development but are even important for the biotechnology and GMO development as in any other high technology sector.

In contemporary society the technological progress influences people’s ordinary life in more and more extensive ways. When the affect of technology enhances in our everyday life, the more we need to reflect on what the development of technology means for the society and for human beings as such. The society must find ways of controlling the technology in some way by legislation in order to protect individual’s social freedom, individual autonomy, and personal privacy and also find ways to benefit from the positive effects of the technology. On the other hand, we must on the personal level know what we want with the technology. In other words, we must steer the development of technology so it reflects our purpose and our goal of giving rise to a good life. In order to benefit from a technology and avoid the negative consequences one must try to exert an influence on its use and its development in a
responsible way. The question is how it can be done if one cannot survey and determine the possible consequences of a certain use or a certain development in technology. For we can not determine the future or even the long-term effects of mapping the human genome or developing technologies for transferring DNA. But we can develop and foster a responsible practise with regard to the problems that we are facing. With T. M. T. Coolen words:

> Responsibility is an essential characteristic of being human. If the fundamental possibility of being responsible is taken away from humans, they are deprived of freedom and self-determination. That holds true for all our deeds – so also for our actions in connection with technology.\(^{92}\)

The quote express that responsibility is an inherent part in being human and to exercise responsibility is also an act of making use of our own freedom. In order to take a responsible attitude towards technology, normative guidelines have been introduced. Concepts such as sustainable development and the precautionary principle have become important when we realise our technological potential of transforming the environment and our human condition. Those concepts, among other, have been international recognised as necessary steps for being able to handle the side-effects of the modern society and in order to keep certain lifestyles. The environmental damage, which threatens our planet and the immense waste of resources, are among the most urgent problems facing humanity today. Advocators for the GMO-technology address that those issues are what the technology will help us to overcome. Adversaries on the other side think that GMO-technology will add to the environmental damage and have no impact on the famine in the south or neither to overcome the waste of resources. But at least the different camps could agree on the important of normative guidelines such as the above mention, sustainable development and the precautionary principle. Actually, it is not true to call the concept of sustainable development a normative guideline, as it is more of a vision or something worth striving for, a condition where the striving itself is inherent good. The precautionary principle could be seen as means to sustainable development and thus it is inherent good.

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The Bruntland report defines sustainable development as the attempt “…to meet the needs and aspiration of the present without compromising the ability to meet those of the future”. If we agree in the quote above we lay a prospective responsibility in order to achieve it. But whom should we lay this responsibility on? It is generally agreed that everyone has his or her part of responsibility. But concerning our actors (science, companies, society, and consumers) in the GMO context, we could argue that there are different areas and degrees of responsibilities in relation to the goal of a social, economical and environmental sustainable development depending on which role we have. The precautionary principle, which was a principle finally agreed on in the 1992 Rio Summit, reads:

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

The quote addresses the decision-makers and emphasises their responsibility for taking action, even when there is no full range of scientific knowledge. But one might ask what kind of responsibility we can demand when the decision-makers are forced to take action on uncertain grounds? We could argue that the decision-makers can not be held entirely answerable and that we can not demand full liability for their actions in the same way as if the decisions were made with a higher certainty. But as the quote emphasises, the importance here is to take action, or what is the more common case, not to take a certain action, in order to prevent eventual harm to the environment or people’s health. It could seem to be contradictory, but to take “measures to prevent” something could both be action-orientated, for instance an extended risk-assessment of a certain GMO-product, but could also be a non-action, such as not introduce a certain GMO. The precautionary principle has more and more been discussed in terms of not taking certain action. When it comes to principles in the international environmental discourse there is a tendency to accept a principle by name but give it a different content depending on the parties’ interest.

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In this chapter I have argued for a responsible attitude towards the development of technology. I also stated that such an attitude might be a necessary standpoint in order to protect social freedom, individual autonomy and personal privacy. So from this point of view it seems to be reasonable to take a responsible and maybe even a little humble stance towards the possibilities in biotechnology and GMO applications. It seems to be rational to act responsible and that we can give good reason for doing this. But before giving any certain answer in this matter, let us investigate the rational premises for acting responsible.

3.1.4. Why Act Responsible? Reason and Responsibility

I have been arguing that in the most cases we are answerable for our action. We purpose that we can give our reasons and justify what we have done in terms of reasons, which issued through our agency into actions. The world is occupied with agents who are free to do as they choose and that they act for reasons. It is because there are rational agents operating in the world that the power of reason is effective, and is capable of influencing the course of our events. Here I understand an operating agent as someone that has different interest. In order to purchase these interests I give different reasons for those claims. Of course my reasons can be apprehending in different ways, judged on a scale with the extremes of ‘completely unreasonable’ and ‘definitive reasonable’. But in what order do we judge reason in such a scale? Two components can be asserted in our judgement of reason.96

- For judging reasons, we use presumably universal standards of rationality, i.e. standards that I (have reason to) think is valid for any and every being simply in virtue of its being a rational evaluator.
- Furthermore, we draw on all standards that are presumably relevant for an adequate or sufficient evaluation of the concrete issue at hand.

In the risk context our judgement becomes our ‘instrument’ for balancing between our values and the risks at stake. Let us recall what I said in 2.2.1 concerning the logical structure of risks.

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(1). A person (P) has different values V₁…Vₙ.

(2). Some consequences (Q) means that those values or some value of V₁…Vₙ are being affected.

(3). A certain action X can cause Q, given certain circumstances (C).

In order to either argue for restraining or to carry through the action X, one would use both the universal standards of rationality and those standards that are relevant for the specific action. Here the domain of moral responsibility begins to enter the picture. As in order to win agreement for a specific argument, there are some attributes involved in order for the argument to be recognising as legitimate. A free will and freedom of action must be possible, as I have mentioned before. Also a capacity of realising foreseeable outcomes of the action, i.e. that the actor understands that X can cause Q which can affect some values V. But there is also a need for another capacity. In decisions about actions that are in one way or the other connected to risks the decision can never leave the domain of moral responsibility. Thus, moral responsibility leaves a powerful tool that can be used to confront the decision-makers with the critical question of whether they manage to live up to the degree of moral responsibility that are expected from the decision-maker. So the capacity needed is that one must be able to take serious how one’s conduct, of possible action or omission, affects others. Consequently, the decision-maker must not only balance his or hers own interest’s and values but must also recognise all other affected persons P’s values and interest’s.

In order for my reasons for action X to be regarded as reasonable instead of unreasonable my claims should be able to be defended outgoing from the concept of moral responsibility. It means that there are good reasons for acting in a responsible way when taking decision on risk if one is in a situation where he or she might be called upon to justify the reasons for a certain decision.

This concludes the chapter on the nature of responsibility. I have in this chapter illustrated different categories of moral responsibility, namely prospective, retrospective and as a virtue. With Aristotle I discussed which action I can be hold responsible for. Here we find a useful distinction between voluntary actions and involuntary ones and it is only voluntary actions that we can be holding responsible for. The second chapter in part three relates the concept of responsibility to the different actors concerning GMO.

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97 Ibid. page 36.
3.2. The GMO Actors and Responsibility

In this section my purpose is to outline a discussion concerning how responsibilities are related to the main actors in the GMO discourse. The over-arching purpose in this study, as been mentioned earlier, is to relate risk and responsibility to each other in the context of deliberative release of GMOs. The ‘landscape’ of this context is inhabited of four important actors. These are the society, which in this case stands for the decisions-makers, regulators, legislators and politicians, the citizens are another group which I sometimes refer to as public or consumer, the third group is the scientific community with scientist as knowledge producer either in universities or at private companies. The last group is the companies, sometimes referred to as industry.

These actors have all different interests concerning the development and the market release for GMO products. Briefly, scientist has an interest of keeping a certain freedom in their science. They are also interested to receive funding in order to carry out research project. Concerning the companies in the GMO business, they are closely related to the scientific development in these areas, which are related directly or indirectly to GMO. Except the scientifically interest from the GMO industry, they also want a legislation that does not turn out to be too much of an obstacle in order to put the products on the market. But the companies are also depending on the public perception of GMO products. If there is a strong resistance towards GMO, a ‘strong’ legislation can be preferable in order to reduce the resistance. The interests of the consumers are more complex and dispersed. But generally I think we can say that the top priority in their interest would be that GMO products are safe for consuming. Other interest could be that the products should be cheap, better tasting, and contribute to sustainable development, longer lasting, and so on. Finally, we also have the society that have some kind of mediating task in order to find some balance in those interest that I have stated here. Of course, the most common way, which also is necessary, is to stipulate some kind of legislation.

3.2.1. Science and Responsibility

In the domain of responsibility in science there is a vast area that I can not discuss here. For example the purely scientific responsibility and everything that comes with that. This kind

98 When I use the term “scientist” without specification in this paper I refer to the community of scientists doing basic natural science.
of responsibility refers to that the scientifically craftsmanship is made with some degree of quality. Scientists must also obey the law and therefore has a legal responsibility as everyone else. There can also be specific laws concerning their responsibility for the performance of research project and for people or animals that are participating in research. They also have a social responsibility regarding their activities. But what can be regarded as more fundamental than these responsibilities are the moral one, which comprises the scientist to take moral responsibility for the product, the result and the consequences of the result. These three areas can be caught in the following questions:99

- Who is responsible in science?
- For what are scientists responsible?
- To whom and to what are scientists responsible?

The first question could be answered, when regarding risk and responsibility, that all that are involved in science and gene-technology have some kind of responsibility even if there are different degrees of responsibility. Here I would determine the degree of responsibility concerning the form of knowledge producing research that one is taking part in. When going from basic research towards more applied research I find it reasonable to argue for an increasing of responsibility because one could better apprehend what the result of the produced knowledge would be. The same is true concerning research that is performed at private companies. This is because the produced knowledge concerning a specific GMO-application or some other genetically modified application or new knowledge of some certain method that are developed, are more likely to reach the market and with a shorter time period than research that are carried out at the university. The reason for this is that the company has to make a profit on the invested capital. Because of the complexity in biotechnology it is also heavy expenses connected to the development of products. So the companies have investor that demand quick profit for the invested capital. This leads to that the products developed in private companies are more likely to be consumed and used in a milieu where it is more likely to do some harm. If the time-scale of the research concerning for example a GMO product is further away before it is going to the market, the more likely it is that the additional

knowledge would appear which could increase our understanding of the products capacity for causing any harm.

The above discussion leads us to another question namely, what are scientists responsible for? As mentioned earlier, the scientists are responsible for that his or hers research are made with some degree of quality. We assume, if we are not given any reasons to think otherwise, that scientifically research is carried out with honesty and respect regarding all the different stages that are involved in research, from choosing the topic for research to the publishing of the completed work. I do find these statements uncontroversial. Of more interest is the question if scientists are responsible for their findings? Anders Nordgren asks whether the scientist truly have responsibility for application of the results that other people make.100 Nordgren means that, “If one assumes responsibility for other people’s action, then one can also reasonably be held responsible for them by other people.”101 But as he also points out, which I agree on:

It seems reasonable to argue that the degree of responsibility depends on intention, predictability, and conceivability. If the applications made by other people are foreseen and intended by the scientists doing basic research, they have indirect but nevertheless almost full responsibility for them. If the applications are foreseen but not intended, they have great but not full responsibility. If they are unintended and unpredicted but conceivable in principle, the responsibility is more limited, but perhaps not zero. Perhaps the scientists could have and should have tried to get the information needed to be able to envision them? If no applications can be conceived at all the basic researchers have clearly only a very indirect causal responsibility for them if they nevertheless would come. It can be argued that they have no or almost no moral responsibility for them. They should neither be blamed nor praised for these applications.102

But even if there is a varying degree of responsibility according to the relation of intentions and applications, one could argue for a more far-reaching responsibility when one are discussing the research field of biotechnology. It seems to me that it is a right conclusion that scientists only have indirectly causally contributed to the applications by their research and therefore are only partially moral responsible for these applications. Nordgren means that the question is not if scientists should be blamed or praised for the application made by other

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100 Ibid.
101 Ibid. page 78.
102 Ibid. page 78-79.
scientist, industrialist or politicians. The important thing is that scientists should actively take responsibility for trying to affect other people’s application. This suggestion is in line with my own, and a good start for risks minimising. Scientists that promote such involvement are not only acting upon the moral responsibility as is given in their role as scientists; I here refer to the prospective responsibility, responsibility as a duty, of the scientist. They also engage the category of moral responsibility as responsible agents.

I have now discussed the question of ‘who is responsible in science?’ and ‘for what are scientists responsible?’ Let us now turn our interests to the last question, namely ‘to whom and to what are scientists responsible?’ This responsibility indicate the responsibility to other parties involved or affected by the scientifically research that are carried out. Some of the parties those scientists are responsible to are uncontroversial and I will not devote must space to deliberate about these issues. Those parties that I count as uncontroversial are human subjects participating in research as well as other scientists. Here I also include different organisations, institutions, universities and private companies that the scientists are involved in. To these we have a legal and economical responsibility against the institutions and companies but a moral one according to the people that we interfere in our research. What is more controversial, regarding the responsibility to other parties is issues concerning future generations, the environment, and when our moral responsibilities are in conflict between the general public and private companies. These conflicts might be more common as research in the biotechnological era is more and more moving out from the universities to private companies.103

How should we then deal with these conflicts of moral responsibility? Nordgren argues that in order to understand the nature of these conflicts one must understand the intimate relation between values on the one hand and organisation and communities on the other.104 These conflicts between values can be seen in the same way as I have described values in risk decision. That is, when a certain action can cause consequences that is threatening certain values. But what kinds of values are then affected in a conflict? If we proceed from the case of risk in the GMO discourse, the scientist in case of value conflict concerning moral responsibility can be facing different values that arise from the company she or he works at, the society, and the scientific community. Those values are related to different interest that

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103 Political decision such as been carried out by the Bush government according to forbid stem cells research regarding new stem cells lines under government auspices but allowing it in the private sector contributes to that more and more research are being done in the private sector.
these parties have. The biotechnological company has the goal of making profit out of the result from the scientist. The society has the interest of the public good and the scientific community, which the scientist belongs to, has the interest of the producing knowledge itself in order to gain understanding of the complex field of genetics. Often these values and interests never comes into conflict with each other, but if they do one could argue for that the scientist should give priority to the public good. Nordgren also come to this conclusion and justify it with that the scientist is the societies ‘trustee’ and therefore the scientist owes this to society. He also recognises that when the scientist takes the role of ‘whistleblower’ he or she could receive serious personal problems.\textsuperscript{105}

A prediction about the scientists choice of action would, I guess, be that the person, which have own values and interests, will act according to those values and interest that synchronise with his or her own. But I also agree that it is plausible to talk about that the scientist owes to act in line with the public good in mind. Acting according to the interest of the society is a recognising of being a member of a community, which the private companies and scientific communities only are belonging to as spheres of producing profit and knowledge. Therefore acts that share the values of the public good are responding to an over-arcing goal, beyond profit and knowledge, namely the good life in just institutions.

Let us now turn to the other two controversial questions, namely whether scientists are responsible to future generations and to the environment. It can be hard sometime to argue for a responsibility that is not only horizontal regarding human generations, which can be hard enough some times, but also are vertical. The fast development of biotechnology makes this important question more and more crucial as our capacity to affect future generations is increasing. Those who argue against that one should take any consideration against future generations are often using arguments like; we do not know the need of future generations, or their interests and values or how they will be and so on. These arguments can be more or less intricate and intellectual accounted for. But in being human ourselves, I would say that we have quite a good idea about the need of a future generations. Being human ourselves means that we have a good understanding of ours needs as humans and we can in all probability presume that future generations should also want to have the opportunity to satisfy those needs. Because we do not have a moral responsibility toward any particular future person and his or hers interest but a moral responsibility towards the interest for them to have the possibility to achieve a good life. In order to do so they must be preserved from far-reaching

\textsuperscript{105} Ibid.
pollution of the environment and an over use of natural resources in order to have the possibility to achieve a sound and flourishing life.

According to the discussion above, there must be some kind of connection regarding moral responsibility to the environment at least in an in-direct and anthropocentric way. Let me briefly reflect upon the connection between responsibility and nature. The debate concerning the morally status of the environment is an emerging subject in the academically field of ethics. The central debate concerns which properties are relevant for entities to possess in order to be regarded as ‘worthy’ of being included in the sphere of moral responsibility. In the field of environmental ethics, argument has been put forward concerning that the environment has an intrinsic value. If the environment possess an intrinsic value it would also be reasonable that we regard the environment with moral responsibility due to this intrinsic value. Different opinions of what are to be regarded as intrinsic in the environment have been diligent argued. Some of them argue that all living things should have intrinsic values (biocentrism), other that ecosystem has (eco-centrism) or that only sentient being has (pathoscentrism). But even if the environment does not have any interest in the same way as sentient being has, for example the interest in avoiding pain, our acting and treating of the environment is not amoral. The moral responsibility towards nature could be justified in other ways. For example, by referring to the harm that sentient being as humans might experience because of a destructive behaviour towards nature. As mentioned above, our responsibility for future generations does incorporate a responsible attitude towards nature.

In research on GMO the problems regarding the scientists moral responsibility towards nature must be determine. I have argued for that there are good reasons for a moral responsibility towards our nature and future generations. But maybe this is not a question of the order; to whom and to what are scientists responsible? Instead we should ask the question; for what are scientists responsible? I answered the question whether if scientists are responsible for their findings by saying that it was reasonable to argue that the degree of responsibility depends on intention, predictability, and conceivability. The same could also been said about the scientist responsibility towards nature. If a certain research on a product has the intention of being put in a milieu there is could be causing harm and has a fair predictability of doing so, the scientist has a great but not full responsibility for it.

3.2.2. Companies and Responsibility
The commercialisation of the GMO technology raises certain issues regarding the responsibilities for companies. One issue is the conflict of interest that can arise between the company’s goal of profit and the geneticist involved in the work. Another issue regarding responsibility concerns the quality of the product. We assume that GMO products that are introduced to the market are safe. This quality of the product can be seen in the same way as we assume that the scientifically craftsmanship is made with quality. The questions that we used in order to investigate the responsibility in science are also fruitful when discussing responsibility in companies. But here I formulate the question in the following manner:

- Who is responsible in companies?
- For what are the companies responsible?
- To whom and to what are companies responsible?

Regarding who is responsible in companies I find it fruitful to talk about three different levels of responsibility, namely individual, team, and collective responsibility. The individual responsibility lies at the geneticist working with GMO application. For scientists that work in private companies may face a conflict of responsibility. The conflict rises from that the scientist has two (at least) interests to consider. On the one hand the scientist has a responsibility towards the company that are funding the research and paying the scientist wage. On the other hand the scientist must also consider the public good. The primary goal for private companies is to make profit, not the public good. Certainly, making a good profit is of course often compatible with the public good, but nevertheless there might be conflicts of interest regarding whom the scientist should put in the first place. The scientists have a responsibility to their company as well as to society and the weighing between these interests must be settled by the scientist own judgement.

When considering the team responsibility I refer to those groups of researcher that work close together with a common goal. Modern science is to large extent teamwork, and therefore it is justifiable to talk of a team responsibility. One might ask if not the individual responsibility and talk of a team responsibility a tautology. The advantage as I see it is that it could foster norms and attitudes and thus overcome the problem regarding the difficulties for a scientist to take the role of a ‘whistleblower’. The shared responsibility in research team may vary regarding which position the different scientist has. More experience scientists higher up in the hierarchy should be regarded as having more responsibility than less
experience scientists has. But as I indicated above, the shared responsibilities are not only concerning actions and omissions but also to foster attitudes and social roles in the team. “Within research teams and the scientific community at large certain manners and customs are cultivated. It is obvious that the individual scientist have a shared responsibility for this ‘climate’ or ‘morals’ of research.”

But in order to create such a ‘climate’ or ‘moral’ in research teams and among the employed the company should provide the foundation for it by taking a collective responsibility for their role in society. To foster a ‘climate’ of responsibility and avoiding the interest conflicts, there should be some guidelines and directive in the company. Those directives should also be made public. It could be argued that this is a utopia, that the companies do not have any interest in such public agendas. But regarding the development in biotechnology companies often works close with universities. In such scientific collaboration with the industry it would be possible to demand a public agenda and explicit guidelines to avoid interest conflicts. This demand could also concern companies that are funding their research from the government. The effect for companies that has these public agendas could be that the public regards them as more trustworthy.

Let us now turn to the next question, namely, for what are the companies responsible? Let us consider two examples.

1. One fear that has been expressed is that commercialisation of GMO might lead to premature introduction of new products. There exists a risk for pressure from biotechnological companies to introduce new GMO products even when data and knowledge are insufficient.

2. Another risk is that some GMO products will be introduced even if people may not want them. It might lead to pressure from biotechnological companies to use them anyhow.

In both these cases it is clear that the companies have responsibility for their products but the question is if this responsibility stretches beyond the quality of the product and the manufacturing of it? In the first example it is quite clear that the company act immoral and does not take responsibility for their product as the product might possess hazards for the

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106 Ibid. page 62.
environment and for the consumer. Companies have a responsibility to possess sufficiently knowledge so that the products and the use of it do not possess any hazards or danger to the health of humans, animals and to the environment. This responsibility does also concern the manufacturing of the product. Therefore the responsibility for burden of proof lies at the company and not at the consumers. Thus, when data and knowledge are insufficient the product should be taken away from the market.

In the other case it is not so clear if the companies act in an irresponsible way or not. Has a company any responsibility to only develop products that are consisting with the values of the majority and their norms? The contemporary society is pluralistic with different values mingled together. It is not difficult to find a product that some adore and some find it repulsive. It is of course a difference between that one would argue for that GMO as such, should not be used because it could threaten common shared values of autonomy, dignity, integrity and vulnerability. But here I was more referring to the issue of the responsibility for companies to develop products that are consistent with some particular moral values in society. In this case the consumers could exercise their power as consumer and pursue campaigns for making people buy other products. Another way is to effect by getting involved in the permit process as described in 2.3.4. Example number two seems to me to be an inevitable result of accepting the technology. If we not can accept this we should consider if we should use the GMO technology at all. Mankind might not need another tin can of tomato purée but to produce it would not be an irresponsible act in itself.

The two above examples could however be regarded as risk-inducing actions in terms of that those actions are threaten different values in the public sphere. The GMO industry should serious consider the consequences of such actions. In the long term they might lose more than they benefit if they add fuel to the public perception regarding the lack of confidence for companies and the lack of real benefit with GMO food.

This leads us to the last question. To whom and to what are companies responsible? The same as to whom and to what are scientists responsible also goes for the companies. I said before that it is plausible to talk about that the scientist owes to act in line with the public good in mind. In the same way as it is justified for the scientist to act in such a way as it respond to the public good, the same goes for the company. The private companies are also members of the community and should take responsibility for the good of the community. In taking a greater social and moral responsibility, as the example with the public agendas I mentioned above, the companies are participating in a communication as their acts are
interpret in the context of risk and responsibility. Therefore a more active participating in showing that the companies are ready to take their part of the responsibility in order to access the market is necessary. The biotechnological industry are also responsible for future generations and for the environment in the same way as the scientifically community is.\footnote{107}

Companies thus have a prospective responsibility towards future generations and for the environment and also a retrospective responsibility that the products do not possess any hazards or danger to the health of humans, animals and to the environment. But in order for the public to trust the companies to fulfil their responsibility they should have some liability for their products. It does not seem to make any sense that the GMO industry are arguing that their products are safe and in the same time refuses to have any liability to pay any damages caused by their products. This of course contributes to people considering GMO to be risky. It seems reasonable to argue for some kind of insurance as a liability, considering the possible consequences of GMO technology and the public perception of it.

### 3.2.3. Consumer and Responsibility

In what way is the consumer responsible regarding GMO applications? One might wish that the public would take a more active part and more room in the GMO debate. This could be done either by choosing other products or by the permit process, which I discussed briefly in chapter 2.3.4. One could also wish for that the public were more interested in trying to get a more profound understanding of GMO technology. Even if this understanding would not decrease the public suspiciousness against scientists and the industry in biotechnology, even if it might do that, it could as least reduce the opinion that people are powerless and are not involved in the process. But in order to change attitudes and values the government has more of responsibility than any individual consumer does. We can not hold any consumer responsible for not taking any interest in the development of GMO products. The consumers could be seen as a ‘target’ for GMO products and like the environment they are also a receiver for any negative outcome of these products. As the public not is contributing to the knowledge of GMO and neither to the manufacturing of this knowledge to the market, they can not be blamed nor praised for any consequences regarding GMO.

### 3.2.4. Society and Responsibility

\footnote{107 See page 52-53.}
In the sphere of responsibility regarding the society, interests from different parties must be taking under consideration. In the GMO context, politicians have the delicate task to balance the interest from the public as well as the industry. Regarding GMO, responsibility and the society we should focus on the political perspective of responsibility. What kind of responsibility has the politicians? The aim for politicians is the public good. Governments and politicians are representative for the citizens and must therefore act upon the responses to the wants, needs, and preference of its citizens. Concerning risk and responsibility, these wants and preferences could be argued to be, at least partly, morally based preferences. It is also plausible to hold the government responsible for upholding a certain moral quality in society. Because of the characteristic of biotechnology the decision-making concerning this subject must rely upon knowledge, experience, and scientific evidence. Without a dialogue with the scientific community, there will be no such input into the political decision-making. The politicians must also be involved with dialogue with the public in order to incorporate attitudes and values in the decision-making. Here we find one of the responsibilities in politics. The decision-makers should take into consideration all parties that are directly or indirectly affected of the decision or at least provide for the possibilities for all parties to speak. In achieving this, decision-makers also stand up for the protection of the values of autonomy, dignity, integrity and vulnerability. Even if decisions-makers should consider a vast among of interest we could hold them responsible for make use of established decisions rules such as the precautionary principle. Since the mid-1980s, this principle has appeared in policy documents, legislation, and international declaration such as the Rio Declaration. The principle has been designed to deal with the scientific complexity and uncertainties typically associated with environmental problems. In decisions connected to risks it is justified that the precautionary principle has an influence.

In order to allow values and attitudes to be expressed in order for admission to different ‘horizons’ and opinions there is a need of a dialogue in the society. But a societal discussion will be impossible as long as different societal groups are not prepared to exchange views in order to deliberate about possible actions. Here rest a responsibility upon the decision-makers to create an open forum where insights and arguments can come from different sources and different perspective. When the means for this forum of biotechnological communication are established, the government can expect the other GMO actors to take their responsibility and actively take part in the dialogue. The scientific community can also be hold responsible for
communicating their research to the public so they also have some responsibility that a forum are established.

There are of course some obstacles in creating a biotechnological forum consisting of divergent perspective. One obstacle is the language. Scientists must be able to communicate with decision-makers and public without a scientific-technical language but not fall to the temptation to just tell the decision-makers what they might want to hear.

Other obstacles are the different time aspects the scientists, the public, and the decisions-makers are relating to. Here we can separate between the scientists, who often have quite a long perspective on their time frame, the politicians with often a very short time perspective, and the public, which vary between these perspectives of time. The problem here is that the decisions-makers have a tendency to see the reality simpler than it is. In order to keep up with the time frame they want to avoid scientific finding that are making matters more complex. The result is that they often ask the scientific community about issues that are complex and not possible to answer with a yes or no. Biotechnology is such a complex matter and another example is climate changes, both these areas suffer from divergent perspective on knowledge regarding decisions-makers and scientists.

Power can also be an obstacle for dialogue. There is de facto an uneven distribution of power between the actors in the dialogue of biotechnology. A bad example of making use of power can be when it is prestige in the picture. A good example would be when it is used in order to achieve mutual understanding.

But even if there is obstacles for a forum of biotechnological communication the benefit must been seen as greater than the problems. The dialogue in such a forum benefit the public good because peoples anxiety could be expressed and thus a common share perspective on risk might take place. With a common shared perspective I believe that it would be easier to find solutions concerning future implications of biotechnology. The dialogue could also benefit lawmaking and legal decision because of the relationship between the democratic procedures of lawmaking which relies on those citizens makes use of their right to participate in the discussions and thus open up sources for legitimisation in the discursive value- and opinion-formation in a biotechnological forum.
PART IV

4. Conclusion of thesis

4.1. Concluding Remarks

The over-arching purpose in this study was to relate risk and responsibility to each other in the context of GMO. The point of departure was the questions presented in 1.1.1. The purpose with these questions was to elucidate on the one hand the areas of risk and GMO and on the other hand the areas of responsibilities regarding GMOs. I will here briefly summarise the findings regarding these questions.

The first question was easy and straightforward formulated but as usual these questions are often the hardest to answer. I asked ‘what is a risk’ and in section 2.2.1 some different definitions are brought into question. I argued that it could be useful to separate the term risk from the term hazards. One useful way of separating risk from hazards is to describe hazards as a set of circumstances, which may cause harmful consequences while risk then would be described as the possibility of its doing so. For the very essence of risk is not that it is happening but that it might be happening. In other words, risks are brought forth and are nourished when the trust in our security is doubted upon and when our belief in progress starts to dissolve. But as risks are defined as a possibility, it also ceases to exist when the potential harm actually occurs. Regarding risk in such a way, we can then understand the concept of risk as characterised by a peculiar, intermediate state between security and the actual harm, where the perception of risks determines different thoughts and actions. Ulrich Beck argues that “it is cultural perception and definition that constitutes risk.”¹⁰⁸ I asked earlier (page 10) what the perception of risk mediates, and by separating risk from hazards it becomes a mediator of values as cultural perception are constituting risk and thus bringing our values to the ‘surface’ when we are determining the risks. On page 27 I tried to point out the relationship between risk and values more systematic. The conclusion here would be that to fully understand the concept of risk we must develop our knowledge from the prevalent genre

of articulating risks from one based on calculation and also include the mediation character in risk perception.

The second question was regarding how the consequences of risks can affect people and the environment (see chapter 1.2 and section 2.2.2). This question has not been a main focus for the study. Instead it is more of a background relating to possible consequences of risks. But nevertheless, it is important to have some understanding of these consequences. I separated these consequences in two subgroups, namely harmful consequences for people and harmful consequences for the environment. The hazards regarding GMO concerning people, is the risks for allergies or that it is cancer inducing because of some unwanted gene expressions activated by the transferred genes. The main arguments concerning the hazards for the nature is the possibility for GMO-crops to damage ecosystems by eliminating or by intersect with natural species. In this case GMO-crops are considered to be a risk towards the biological diversity. GMO technology is also seen as a risk towards sustainable development. The argument here is that when using GMO applications in farming, the GMO-crops gets resistant against the insecticide which could lead to those farmers has to use more or stronger insecticide.

The third question could be said to be evolving from the first two questions. The question concerns the public perceptions of GMOs and was discussed in section 2.2.3. In this section I summaries the results from two doctoral theses concerning public perception of biotechnology and GM food in Sweden, namely Victoria Wibeck’s *Genetically Modified Food in Focus* and Susanna Öhman’s *Public Perceptions of Gene Technology* which where published under 2002. They have conducted focus groups (Wibeck) and public polls (Öhman) and on the whole they received the same response. The respondents expressed lack of confidence for politicians and companies and could not see any real benefit with GMO food. They also expressed concern over that the biotechnology could not be controlled because of unknown side effects and that human beings did not possess the capacity of enough maturity regarding the intellectual or moral capacity to handle with a technology such as GMO. Views concerning that GMO technology could disturb the balance in nature was also expressed. Through Wibeck’s and Öhman’s work we have good arguments for saying that many are not yet prepared to accept the risks of GMOs. This is due to a lack of understanding of the risks and hazards, the minimal benefits of the current crop of GMOs, and a mistrust of the motives of those selling the technology. Given the current state of our knowledge of the technology
and the nature of the GMOs currently available, the lack of public trust must be considered entirely reasonable.

I have now discussed the results concerning how one should understand risks, how the consequences of the risks affect people and the environment, and the public perception of GMO. It is now reasonable to ask ourselves what we can do in order to avoid risks. The legal regulation of GMO can be seen as such attempt, which I described in chapter 2.3. EU has come furthest in making an adequate legislation concerning GMO. I mentioned on page 36 that the lack of confidence and the sceptical attitude towards GMO among the public make it important for the directive to strengthen the protection of both nature and people. If this gap of confidence can not be ‘tighten’ and people continue to mistrust GMO products it will undermine the possibilities for a market of GMO products. Building confidence is strongly needed for companies as well as financier as an incitement for raising capital into the venture business of GMO technology.

Legislation is an important tool for protecting the integrity and vulnerability regarding individuals and nature. But legislation is not the only course we could take in order to avoid risks. In section 3.1.3 I discussed the next question regarding in what way we should understand the concept of responsibility regarding modern forms of technology such as GMO. With the development of biotechnology we start to be aware of that the technology might threaten certain values that we connect to the contemporary society and to the occidental transition of modernity with the development of social freedom and individual autonomy. With the realisation of side effects concerning our technological progress and the influence it has on our daily life, we feel hesitation and anxiety because we also recognise the promise of expanded opportunities and a greater realm of individual freedom with the technological development. Therefore, I argue (page 48), that we should steer the development of technology so it reflects our purpose and our goal of giving rise to a good life. In order to benefit from a technology and avoid the negative consequences one must try to exert an influence on its use and its development in a responsible way. In order to do so I mentioned concepts such as sustainable development and the precautionary principle, which have become important when we realise our technological potential of transforming the environment and our human condition.

The two last questions ‘Whom has responsibility for risks connected to GMO?’ and ‘What are the arguments for claiming responsibility?’ are argued in chapter 3.2. I discuss these questions related to the four main GMO actors i.e. science, companies, consumer, and the
society. Regarding science and companies I discussed their responsibility outgoing from three different questions. Namely ‘who is responsible in science/companies?’ and ‘for what are scientists/companies responsible?’ and also ‘to whom and to what are scientists/companies responsible?’

Concerning the first question, I argued for an increasing in responsibility the more ‘applied’ the research is. This is because applied science is closer to the society and it is easier to see what the application will lead to. There is also a different relationship between knowledge and intentions regarding basic and applied research. In basic research the intention is to gain knowledge for the sake of knowledge, i.e. that an increasing in our knowledge concerning a specific matter is intrinsically good. In applied science the intention is different. Here the knowledge is considered a second-hand priority and the use of the knowledge a first-hand priority. Applied research is often done in private companies and in companies there are three different levels of responsibility, namely individual, team, and collective responsibility. On an individual level the scientist can get into conflicts when regarding theirs responsibility towards the society contra the company. Therefore it is important that a responsible ‘climate’ is foster in the research team so that the social responsibility regarding the public good does not become the burden of an individual. There lies a shared responsibility (the team level) among scientists to actively take part in and promote such a research ‘climate’. This ‘climate’ of responsibility has of course the best chances to be fulfilled when the company provides the necessary conditions for it. This is the collective responsibility of companies. It could be fulfilled through creating public agendas and explicit guidelines for actions and omissions regarding the public good.

The next issue is to determine what we can hold scientists/companies responsible for. I asked whether scientists have any responsibilities for their findings in research. There are two kinds of responsibility regarding this question. The first is that scientists have some kind of responsibilities for the applications done by other people but the extent of the responsibility depends on how difficult the application could have been to foreseen and if the application was intended by the scientist. If the scientist intended the application then he or she also has full retrospective responsibility for it, but if the application was not intended neither predictable then the scientist could not be hold responsible. The other aspect is that we almost assume that a scientist is a responsible person. Concerning biotechnology and other technological advances that has great impact on society and/or the environment there is reasons to talk about a prospective responsibility of engaging in public debate and in other
ways in order to try to affect how one’s scientific results are being used. Concerning the responsibility for companies I argued that they have a responsibility to possess sufficiently knowledge for their products so it not possesses any hazards or danger to the health of humans, animals and to the environment.

Concerning to whom and to what scientists/companies are responsible, they seem to have the same target group. They have a social responsibility and should therefore act in line with the public good. They also have a responsibility to pay regard to future generations and the “integrity” of nature.

Concerning the consumer and the public and their responsibility in the GMO discourse they are not contributing to the knowledge of GMO and neither to produce and selling to the market. They can not be blamed nor praised for any harmful consequences regarding GMO. To be responsible citizens they could nevertheless have some responsibility to inform themselves and to participate in dialogues in order to express themselves for decision-makers. But the responsibility for them is less than for scientists that are producing knowledge concerning biotechnology. But scientists that are not involved in such kind of knowledge producing activity could nevertheless be argued to have a greater responsibility to participate in public discussion than other people. The reason for this is that upholding an office such as scientist, researcher or any other position which may justify anyone as an intellectual, they can reasonable be called upon to participate in public discourse.

Politicians and other decisions-makers have a responsibility to assure that they have sufficient knowledge and understanding for the issue at hand before taking any decision. They are also responsible for ‘steering’ the society towards sustainability and taking consideration to the precautionary principle in decisions making. Dialogues should be emphasised in order to allowed values, attitudes and knowledge to be deliberate more extensively. According to me, the dialogue benefits the public good because people’s anxiety could be expressed and thus a common shared perspective on risk might take place.

The politics of biotechnology should open up new discursive ‘spaces’ where a societal responsibility could be fostered. In these discursive ‘spaces’ different values and interest would collide over definitions of risk as different actors meet for deliberating risks and hazards. Then the concept of risk could be an opportunity for fostering a moral and social responsibility which in turn could ‘dissolve’ risk conflicts through communication and defining risk management in a shared value- and opinion- formation.
Literature


