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POLITICAL ECONOMY OF AGRICULTURAL BIOTECHNOLOGY IN GREECE; THE CASE OF GMOs

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Abstract

Biotechnology can be characterized as multidisciplinary since it has its foundations in many disciplines including biology, microbiology, biochemistry, molecular biology, genetics, chemistry and chemical and process engineering. This thesis focuses especially on agricultural biotechnology and particularly on the case of Genetically Modified Organisms (GMOs).

The creation of GMOs - any living organism that poses a novel combination of genetic material obtained through the use of modern biotechnology- is considered as the beginning of a new agricultural revolution. Due to diseases global production can be reduced by almost 13 percent, insects destroy another 15 percent and weeds can also reduce production by 12 percent. Therefore, through biotechnology scientists can increase plants with high resistance to pests and disease, plants tolerant to environmental stress and they can also enhance food qualities, such as flavour, texture, life on shelves and content in nutritious components.

Worldwide 25 countries that have officially accepted the growth of GM crops and only 6 of them belong to Europe and are also members of the European Union. In 2008 the global area reached 125 million hectares with the most important transgenic crops being GM soybean, maize, cotton and canola.

Since the mid- 1990's, GMOs were accused of harming both the environment and the human health in long terms. Unintended harm to other populations, unintended effects on biogeochemistry, gene transfer to non-target species are some of the potential impacts of GMOs on the environment while, allergenicity and toxicity are some of the potential risks to human health. However, the European regulation allows the cultivation transgenic maize and potato, under the scientific assessment of the European Food Safety Authority (EFSA), and disapproves the ban that some countries have imposed on them as long as it is not sufficiently scientifically supported.

Greece has always been against the cultivation of GMOs and the Greek government does not permit the cultivation of GM crops, although it has been studied that there would be economic benefits from allowing the cultivation. Therefore the main objective of this thesis is to analyze the political economy of biotechnology in Greece and particularly to find the reasons and analyze the negative position of Greek society towards GMOs. Both the private and the public sector in Greece are firmly opposed to the cultivation of GM crops, each sector for different reasons. For the analysis of the economic and political factors that influence the biotechnology policy in Greece political economy theory is used.

Greek public is one of the strongest opponents of GMOs; 88% of the Greek consumers voted against GM foods and refuse to buy them. Greek retailers avoid using GM products due to the low demand, while Greek farmers are not ready to leave the traditional subsidised crops and invest in new technologies and the development of agricultural sector. Environmental groups and all political parties in Greece are also protesting against GMOs, showing that Greece at least for the coming years will not step back from its denial of GMOs.

1 Introduction

1.1 Background information

Modern Biotechnology emerged in the early 1970s and is considered one of the fastest growing areas of scientific, technical and industrial innovation of recent times, as well as, one the most prominent in public discussion (Bauer & Gaskell 2002). Biotechnology based on the development of recombinant DNA techniques has contributed to the growth of several areas including “pharmaceuticals, diagnostics and testing, cloning and xenotransplantation, genetically modified seeds and foods and environmental remediation” (Bauer & Gaskell 2002). Because of the multiple different definitions that exist in the literature, a broad definition that could be used is the following:

“Biotechnology is the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services” **(Mckelvey et al. 2004)**

Although biotechnology’s innovations in the medical field were globally accepted and applauded, in agriculture a global doubt around genetically modified organisms (GMOs) has limited the diffusion and scope of this technology. Debates on the labelling of genetically modified foods, biodiversity, potential environmental risks appeared in different countries and in different times in Europe and the United States, showing that modern biotechnology has become increasingly important, socially and politically.

Despite global controversy, among several innovations applied in agriculture, transgenic crops are considered one of the fastest spread innovations. According to the most recent data, for 2008, 25 countries have officially approved of transgenic crops growing in fields (Herring 2008). Half of these countries do not belong in the category of “high income economies” and in descending order of acreage these are: the United States, Argentina, Brazil, India, Canada, China, Paraguay, South Africa, Uruguay, Bolivia, the Philippines, Australia, Mexico, Spain, Chile, Colombia, Honduras, Burkina Faso, the Czech Republic, Romania, Portugal, Germany, Poland, Slovakia and Egypt. Since 1996 that the commercialization of transgenic crops began, the global area of biotech crops kept on growing at a rate of 12% when in 2007 it reached the 114.3 million hectares and in 2008 the 125 million hectares (James 2008).

Greece showed interest in biotechnology for a first time in the early 1980’s. Before that time, neither politicians nor the Greek public were concerned about biotechnology. In addition, compared with the other European countries, the Greek state was rather late in promoting research in biotechnology. While in the early 1980's the Greek scientists were instigating debates over biotechnology, always in an informal level, the Greek public remained absent from any technological innovation and largely uninformed about modern biotechnology and its applications until the mid 1990's. After that period in the advent of GMOs, controversy by several NGOs like Greenpeace organized their first protests against genetically modified foods while the Greek public was increasingly concerned and anxious about the GM food production and cloning (Botetzagias A.I. et al 2004).

Greece is the only inactive country among all the EU members as it is the only one that has not any biotechnology start-up companies, despite the worldwide increase in research programmes and high interest in the applications of biotechnology. What is more, the Greek society is generally opposed to GMOs and in 1998 among seven counties, Greece demanded for a moratorium on GMOs. In 2003, Greece refused to reverse the moratorium while it has signed the Cartagena Protocol on Biosafety in 2000. Although there are some proponents of transgenic products, Greek governments along with the local authorities, scientific cycles and social organizations have strongly supported the traditional cultivations (Tolios Y. 2009).

The firmly negative position of Greece and its persistent ban on GMOs, while many other countries have approved and even benefited from them and despite the study by Wesseler et al. which has indicated that Greece would also benefit from growing GM maize, arouses the interest to unveil the incentives of the most important NGOs involved. Political economy is the key theory to explain the economic and political factors that influence biotechnology policy and the political and economic incentives to corporate interests in biotechnology behind countries' position on GMO's.

1.2 Objectives and research questions

The objective of this research is to analyze the political economy in biotechnology in Greece and particularly to find the reasons and analyze the negative position of Greek society towards GMOs.

General research Question

Why does Greece ban GMOs and how likely is it that they may change their policy?

Research Questions

1) What can the political economy framework contribute to understand agricultural biotechnology policies?
2) What is the Greek regulation about GMOs and how does it differ from the regulation in other European countries?
3) What is the perception of the Greek society towards GMOs and how does it differ from the perceptions of societies in other member states?
4) What possible recommendations for the management of GMOs can be indentified based on other countries' experiences?

1.3 Outline of the thesis

In chapter 2, background information, definitions and applications of biotechnology are introduced. How important biotechnology is to scientific evolution and of what subdisciplines biotechnology is composed of are also revealed in Chapter 2. Apart from the contribution of modern biotechnology to many scientific fields, in this chapter are also listed the main areas of consideration for safety aspects of biotechnology.

Chapter 3 introduces the application on biotechnology in agriculture and specifically the genetically modified crops. An introduction of what is a GMO, how is produced in general lines and what are the main improved characteristics of transgenic crops are described. Potential environmental and health risks from transgenic crops are also listed. The final section of Chapter 3, presents an overview of the global cultivation of the main transgenic crops and how they are distributed in European countries.

Chapter 4 introduces the theory of Political Economy used as the theoretical framework of the thesis. In this Chapter is described how the theory of Political Economy was born, evolved and how is used today. Questions like, why Political economy is the appropriate theoretical framework for this thesis and what are its key elements are answered in this Chapter.

In Chapter 5 is presented the political-economic interpretation of the situation in Europe; how the private sector (life science companies, food manufacturers/retailers, farmers, consumer groups/public opinion, media, environmental groups) and public sector (government agencies, scientific community) deal with GMOs, what their profits are and what is the interaction amongst competing interest groups.

In Chapter 6, an overview of the European regulation for the last decade on GMOs is developed. The final section of this Chapter lists the European countries and describes the reasons that led them to ban the cultivation GMOs at a national level.

Chapter 7 introduces the Case of Greece. The first section of this Chapter provides a historical and physical background of Greece while the second section provides information about the current situation of agricultural sector in Greece like, production, agricultural income, imports for crops cultivated as transgenic in other countries. Later this Chapter, introduces the biotechnology policy in Greece and the major authorities competent for imports and planting of GMOs. In this chapter there is also information about the research conducted in Greece and the stakeholders involved in the investment in biotechnology. Some results from the potential economic benefits and costs of introducing GM maize in Greece are also presented. Finally, the last section of this Chapter interprets the political and economic reasons for the ban on GMOs. Chapter 8 provides the discussion and conclusions.

2 Introduction to Biotechnology

2.1 The nature of Biotechnology

Throughout man's history, technology played a catalytic role in bringing him out of the Stone Age, while in the nineteenth century the Industrial Revolution sparked off the creation of advanced and massive machinery along with increasingly larger cities. Modern biotechnology emerged in the early 1970s and is considered one of the fastest growing areas of scientific, technical and industrial innovation of recent times, as well as, one of the most prominent in public discussion (Bauer & Gaskell 2002).

The twentieth century can be characterized as the age of chemistry and physics, setting off the emergence of huge industrial activities such as "petrochemicals, pharmaceuticals, fertilizers, the atomic bomb, transmitters, the laser and microchips" (Smith 2009). However, the twenty–first century can be characterized as the age of biology and its associated technologies as man is getting more and more persistent in searching and understanding the fundamentals of life processes.

Biotechnology can be characterized as multidisciplinary since it has its foundations in many disciplines including biology, microbiology, biochemistry, molecular biology, genetics, chemistry and chemical and process engineering. Therefore, because of its multidisciplinary character, biotechnology has many different types like microbial biotechnology, agricultural biotechnology, animal biotechnology, forensic biotechnology, bioremediation, aquatic biotechnology and medical biotechnology. While biotechnology has offered and will keep on offering major opportunities to human development (nutrition, medicine, industry), still there are some potential risks for humans, animals and the environment that cannot be ignored.

2.2 What is biotechnology

Biotechnology is the most diversified of all the natural sciences, composed of several subdisciplines such as: "microbiology, plant and animal anatomy, biochemistry, immunology, cell biology, molecular biology, plant and animal physiology, morphogenesis, systematics, ecology, genetics and many others" (Smith 2009).

While biotechnology has been defined in many forms (Table 2.1) in literature, a broad definition that could be used is the following: “Biotechnology is the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services” (McKelvey et al. 2004).

As it is also mentioned before, biotechnology has its roots in the distant past referring to the conventional techniques that have been used for many centuries to produce beer, wine, cheese and many other foods, and it is known as the ‘traditional or old’ biotechnology, while the development of recombinant DNA and cell fusion techniques along with the evolution of ‘traditional’ biotechnology consistitute the ‘modern’ biotechnology. Although mankind has been using genetic modification for over 10,000 years to improve plants and animals by selective breeding -“in selective breeding, organisms with desirable features are purposely mated to produce offspring with the same desirable characteristics”- new methods like polyploidisation, mutagenesis and X-rays have been found to accomplish changes in genetic composition (Thieman & Palladino 2004). For instance, selectively moving genes within the same species or between species through genetic manipulation/modification/engineering is a modern method, using the techniques of molecular biology (Smith 2009 [a]).

One the most widespread and commonly understood application of biotechnology is the use of antibiotics when Alexander Fleming discovered penicillin in 1928. Since the 1960’s, scientists began to penetrate into the secrets of DNA structure and function, and along with the technological innovation that led to gene cloning, “the ability to identify and reproduce gene of interest”, and genetic engineering, “manipulating the DNA of an organism” (Thieman & Palladino 2004).

Genetic engineering contributes to the process of recombinant DNA technology, which is used “to produce many proteins of medical importance including insulin, human growth hormone, and blood-clotting factors”. Among the hundreds of applications of recombinant DNA are also the creation of crops resistant to diseases, more productive plants, the “golden rice” engineered to be more nutritious, and genetically engineered bacteria used for the degradation of the environmental pollutants.

Since the 1980’s, biotechnology was established as the strategic technology by the majority of the industrial nations. Replacing the conventional procedures with the use of microorganisms could make the industries more efficient and friendly to the environment. For instance, the use of biotechnology, or ‘white biotechnology’ as it has been termed by the European Union (EU), by industries can reduce the waste disposals, lower the energy consumption and greenhouse gas emissions and make a better use of renewable raw materials.

Table 2.1 *Some selected definitions of biotechnology*

A collective noun for the application of biological organisms, systems or processes to manufacturing and service industries.
The integrated use of biochemistry, microbiology and engineering sciences in order o achieve technological (industrial) application capabilities of microorganisms, cultured tissue cells and parts thereof.
A technology using biological phenomena for copying and manufacturing various kinds of useful substances.
The application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services.
The science of the production processes based on the action of microorganisms and their active components and of production processes involving the use of cells and tissues from higher organisms. Medical technology, agriculture and traditional crop breeding are not generally regarded as biotechnology.
The use of living organisms and their components in agriculture, food and other industrial processes.
The deciphering and use of biological knowledge.
The application of our knowledge and understanding of biology to meet practical needs.

Source: John E. Smith, 2009 [a]

2.3 Biotechnology: an interdisciplinary science

One of the most challenging and interesting things in biotechnology is the need to gather complex information from many other different scientific disciplines. Actually, there is no point talking about biotechnology without taking into account the contributions of the different fields of science.

Figure 2.1 provides the diagrammatic view of the many disciplines that biotechnology consists of. Starting from the bottom of the diagram in the base are placed the basic sciences, showing the research into fundamental processes of living organisms at the biochemical, molecular, and genetic levels. After gathering the basic science from many areas, with the help of computer science can lead to genetic engineering approaches. The upper part of the diagram shows the many different organisms, technologies and applications that stem from genetic engineering and bioinformatics, central aspects of most biotechnological approaches (Thieman & Palladino 2004).

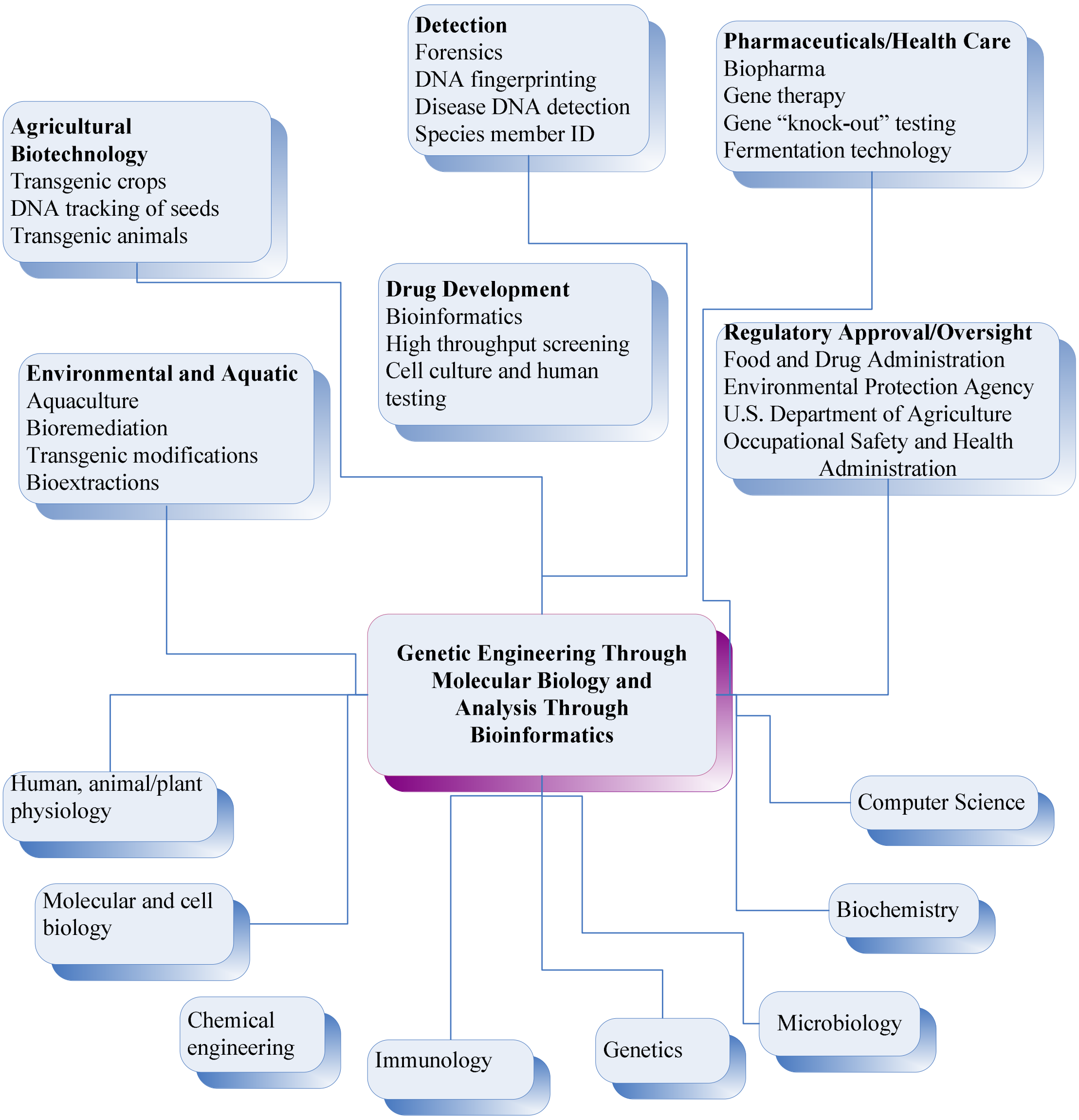

Figure 2.1 Diagram of biotechnology; *at the bottom of the diagram, fundamental sciences lead to Genetic Engineering which is applied and used in many fields shown in the upper part of the diagram.*
Source: Thieman & Palladino 2004

2.4 Types of Biotechnology

Because of the multidisciplinary character of biotechnology, it is of great importance to know that there are many different types of biotechnology.

Microbial Biotechnology

As it has also been mentioned before, one of the oldest applications of biotechnology is the use of yeast for making beer and wine. Microbial biotechnology is specializing in the manipulation of microorganisms such as bacteria and yeast so as to create new enzymes and organisms for making the process of manufacturing and production simpler and also leading industries to more efficient and sustainable methods of decontaminating the industrial waste. An example of microbial biotechnology's action is microbes. Few people know that very important proteins used in human medicine like insulin and growth hormone are produced and cloned by the use of microbes.

Agricultural Biotechnology

Agricultural biotechnology deals with a vast amount of topics, like genetic engineered plant, plants that are resistant to pests where the use of chemical pesticides is unnecessary or even "foods with higher protein or vitamin content and drugs developed and grown as plant products" (Thieman & Palladino 2004).

For over 20 years biotechnologists manipulate plants in order to produce genetically engineered plants that are resistant to drought, they can tolerate cold temperature, and their yields are greater. What is more, plants can also be engineered to produce a great variety of pharmaceutical proteins which is commonly called molecular pharming. A good example is the tobacco plants that are usually engineered to produce recombinant proteins in their leaves. More detailed information about genetically modified organisms in agriculture will be given in a later chapter.

Animal Biotechnology

This type of biotechnology is considered one of the fastest growing and changing types. It specializes in the production of medically valuable proteins such as antibodies-proteins that recognize the foreign materials and help body cells to destroy them-using animals as "bioreactors". Antibody treatments are mostly addressed to patients with disorders in their immune system. Apart from antibodies there are many other human therapeutic proteins produced from animals that are needed in quantities that exceed hundreds of kilograms. Scientists in order to accomplish this "large-scale production can create female transgenic animals that express therapeutic proteins in their milk. Transgenic animals contain genes form another source. For instance, human genes for clotting proteins can be introduced into cows for the production of these proteins in their milk" (Thieman & Palladino 2004).

Moreover, animals are also used for the basic research. For instance, gene "knock out" experiments are used to understand gene function in humans. These kinds of experiments are done on mice and rats that many of their genes are also found in humans, by disrupting a gene and then looking at what functions are affected in an animal due to the loss of a particular gene, and thus identifying the role and the importance of a gene.

In 1997, the news for the cloning of the now-famous sheep Dolly aroused public's and scientists' surprise and excitement but it also elicited fears for the potential of human cloning. In fact, according to scientists the main reason for producing Dolly was the prospect of "cloning animals that contain genetically engineered organs that can be transplanted into humans without fear of tissue rejection" (Thieman & Palladino 2004).

Forensic Biotechnology

DNA fingerprinting-a collection of methods used for detecting an organism's unique DNA pattern- is the one of the most common tools that forensic biotechnology specializes in. DNA fingerprinting basically is based on using trace amounts of blood, tissue, hair, or body fluids. That is why this type of biotechnology is such a powerful tool for law enforcement showing the criminal based on DNA evidence left behind at a crime scene.

In addition, DNA fingerprinting is also used for identifying a child's father in parenting cases. Another application is the arrest of poachers through the analysis of the DNA fingerprints of their "catch", protecting this way the endangered species. Studying the resurgence of some vaccine-preventable diseases such as whooping cough and rubella, or finding food-born pathogens like Escherichia coli in contaminated meat, or even tracking diseases such as AIDS, meningitis, tuberculosis, Lyme disease, and the West Nile Virus are some examples of DNA fingerprinting's applications (Thieman & Palladino 2004).

Bioremediation

"Bioremediation is the process of cleaning up environmental sites contaminated with chemical pollutants by using living organisms to degrade hazardous materials into less toxic substances" (Thieman & Palladino 2004). One of the most well-known examples of bioremediation was the case of the Exxon Valdez oil spill in Prince William Sound, Alaska in 1989. Scientists successfully managed to contribute to the growth of oil degrading bacteria, already existent in the Alaskan soil, resulting to the cleaning of many miles of shoreline almost three times faster than cleaning up only by the use of chemical agents. On the contrary, the harsh treatment of chemical agents would have caused further damage to the environment.

Aquatic Biotechnology

Aquaculture is one of the oldest applications of aquatic biotechnology. Trout, salmon and catfish are the most common species raising in controlled conditions, especially in the United States. In the developing world aquaculture is becoming more and more popular and according to recent estimations almost 30% of all fish consumed are now produced by aquaculture.

In recent years aquatic biotechnology has developed significantly, using genetic engineering to produce oysters resistant to diseases and vaccines against viruses that affect salmon and other finfish. In addition, there has also been engineered a salmon that is growing faster so that the time and the costs required to grow for the market sale are reduced.

Aquatic organisms because of their uniqueness and the harsh conditions under which they grow up -high pressure because of great depths, high salinity, cold, etc.-are very attracted to biotechnologists. Such organisms are considered to be rich and valuable sources of new genes, proteins and metabolic processes that may have important applications with human benefits. For instance, anti-cancer and anti-tumor molecules have been found in certain species of marine plankton and snails.

Medical Biotechnology

Medical biotechnology and its applications has helped over 325 million people worldwide, involving from the preventative medicine to the diagnosis of human diseases. Drugs, recombinant proteins and vaccines are some of the products of medical biotechnology designed to improve human health.

Almost every week, media report news of a genetic breakthrough like the discovery of new genes. New technologies, like *gene therapy* approaches, “in which genetic disease conditions can be treated by inserting normal genes into a patient or replacing diseased genes with normal genes”, are expected to become more and more common (Thieman & Palladino 2004). In addition, other new and very promising aspects of medical biotechnology, but also one of the most controversial is *stem cell technologies.* Stem cells are cells in a primal stage of development that will specialize later into nerve cells, blood cells, muscle cells, and nearly any other cell type in the body. Through biotechnology, stem sells can be grown in a laboratory and under the treatment of different types of chemicals, can be changed to develop into different types of human tissue that can replace a damaged tissue in a transplantation.

2.5 Safety in biotechnology

As it has already been mentioned, the new biotechnologies include production and use of genetically modified organisms for a vast range of activities. However, more activities within the research laboratory, the process plant, the final product and in many cases the environment are within the responsibilities of biosafety. The main areas of consideration for safety aspects of biotechnology are listed in Table .2.2.

Table 2.2 *Safety considerations in biotechnology*

Pathogenicity: the potential ability of living organisms and viruses (natural and genetically engineered) to infect humans, animals and plants and to cause disease.
Toxicity and allergy associated with microbial production.
Other medically relevant effects, e.g. increasing the environmental pool of antibiotic resistant microorganisms.
Problems associated with the disposal of spent microbial biomass and the purification of effluents from biotechnological processes
Safety aspects associated with contamination, infection or mutation of process strains
Safety aspects associated with the industrial use of microorganisms containing in vitro recombinant DNA

Source: Smith 2009 [a]

2.5.1 Risks of organism pathogenicity

There are many microorganisms that humans, animals and plants can be infected by and get diseased. Most microorganisms used by industries are harmless and in fact lots of them are used directly for the production of human or animal foods like yeasts, filamentous fungi and several bacteria. Nevertheless, a small number of potentially harmful microorganisms have been used by industry "in the manufacture of vaccines or diagnostic reagents, e.g. Bordetella pertussis (whooping cough), Mycobacterium tuberculosis (tuberculosis) and the virus of foot-and-mouth disease" (Smith 2009[a]). That is why the use of containment practices is very common when these types of organisms are used.

Despite the risk assessment (Table 2.3) studies failing to prove observable hazards of biotechnology, care must always be adopted when using recombinant DNA molecules. Although, many international mechanisms are already dealing with the potential safety issues concerning genetic engineering and through a large amount of evidence they have proved that the applications of genetic engineering are safe and the biotechnologies related to plants and animals are safely and responsibly applied, there are still some bodies that ask for more austere biosafety protocols. In fact, their opinion is more or less arbitrary, as it is not based on adequate evidence and besides technology of biotechnology is one of the most thoroughly scientifically scrutinized (Smith 2009 [a]).

Table 2.3 *Risk assessment*

Elucidate the capacity of the microorganism to have an adverse effect on humans, animals or the environment.
Establish the probability that microorganisms might escape, either accidentally or inadvertently, from the production process system.
Evaluate the safety of the desired products and the methods for handling by-products

Source: John E. Smith, 2009 [a]

2.5.2 Risks of biologically active biotechnology products

Biologically active products are commonly referring to vaccines and antibiotics, which can be damaging when their use is indiscriminate and excessive. Sometimes contaminants may produce toxic molecules that could become incorporated into final products and cause food poisoning or in some other cases product formulations can cause allergic reactions. Undue use of antibiotics in agriculture could penetrate the human foods, and possibly lead to development of antibiotic resistance in human disease organisms. This is one major reason that many countries are trying to curb the use of antibiotics in agriculture.

2.5.3 Bioterrorism and biowarfare

As it has already been discussed the products of biotechnology are used worldwide and for many purposes. Nevertheless, all this knowledge, technology and equipment can be used for the production of biological weapons. Therefore, in biological warfare or even bioterrorism certain microorganisms or derived toxins that can cause disease in humans, animals or plants can be used to fulfil political and military purposes. One big issue with biological weapons is that they are much cheaper and easier to produce compared with the nuclear and chemical ones so that even small countries and terrorist organizations might easily acquire biological weapons.

In addition, in 1972 it was signed the Biological Weapons Convention (BWC) the first agreement among nations "not to develop, produce, stockpile or acquire biological agents, toxins and weapons-delivery mechanisms of types and qualities that have no justification for prophylactic properties and other peaceful purposes" (Smith 2009 [a]).

3 Genetically modified crops

Although genetically modified organisms in agriculture have been available for just a few years they became popular very soon and their commercial use keeps on expanding at a rapid pace. The first commercial use of GM food product was the Flavr Savr tomato, a delayed ripening tomato which took place in US in 1994, by Calgene (Nelson 2001). However, a little earlier, in 1992 China was the first in growing plantings of GM tobacco, but officially China started to commercialize GM corps in 1996 (Nap et.al. 2003).

The development of biotechnology, as it has already been mentioned, signalled the beginning of a new agricultural revolution. Due to diseases global production can be reduced by almost 13 percent, insects destroy another 15 percent and weeds can also reduce production by 12 percent. To sum up, before harvest some 40 percent of production is lost and after harvest another 10 percent is lost or spoils due to pests (Clay 2004). Through biotechnology scientists can increase plants with high resistance to pests and disease, plants tolerant to environmental stress and they can also enhance food qualities, such as flavour, texture, life on shelves and content in nutritious components. In fact, until the development of agricultural biotechnology sexual reproduction was a barrier for desirable gene combinations. Only with the advent of genetic engineering did scientists manage to move genes between sexually incompatible organisms. Nowadays, plant scientists use "thermal neutrons, X-rays or ethyl methane sulphate (a harsh carcinogenic chemical) that can damage DNA – to generate artificial mutations in crop plants, especially cereals" (Smith 2009 [a]). For that, a general definition of GMOs could be the following:

"A genetically modified organism (GMO), otherwise referred to as a living modified organism (LMO) or transgenic organism, means any living organism that posses a novel combination of genetic material obtained through the use of modern biotechnology" (FAO 2001). In table 3.1 five categories of crop characteristics undergoing genetic modifications are summarized.

But how can GMOs be created? Actually, the process of creating a GMO is painstakingly slow and difficult. In a nutshell, in order to make a transgenic crop, it is needed to insert one or more genes of interest – in fact, the primal efforts of genetic engineering included the insertion of only one gene - from another species along with promoter and marker genetic material into a plant cell and this part is quite hard as the cell wall is designed to exclude foreign material. The role of the promoter material is to influence the locations and the levels in the plant at which the desired trait is

Table 3.1 *Improved characteristics of transgenic crops*

Characteristic	***Rationale***	***Examples***
Herbicide tolerance	More efficient herbicide use and/or safer herbicide use	Glyphosate-tolerant soybeans, canola, corn
Disease/insect tolerance	Reduction in pesticide use and/or more efficient pest control	Bt cotton, corn, potatoes; virus resistant papaya, tobacco, melon
Quality improvements	Development of new foods or sources of new products	Ripening-delayed tomato; soybean oil quality; carnation quality
Tolerance to biological stress	Improved resistance to droughts, easier production in marginal areas, easier nitrogen fixation	Research on drought-tolerant corn
Productivity enhancements	Higher output per unit of land	High-yielding rice and corn

Source: Overseas Development Institute, 1999; James, 1998.

produced, while the role of the genetic marker is to contribute to the identification of successful transformations. However, in these kind of experiments very few of the recipient plant cells recognize the novel genes and many desirable traits are detectable only when the plant has fully developed. For that the genetic marker is introduced to identify the transformation by causing the plant to produce a substance which is detected only after the transformation (Nelson 2001).

When a transformation is successful is called “event” and depends on the components of the genetic package and the site that the novel DNA is inserted as the insertion site is possible to have an effect on the desired trait and on other functions of the plant (Nelson 2001).This inserted DNA, which now presents in the host cell’s chromosomes, will reproduce itself with the existing genes that surround it and through the reproduction of the organism it will be passed to next generations (Weirich 2007).

Apart from gene transfer genetic modification also involves in gene ablation, “where an undesirable trait is removed from the genome of an organism rather than added” (Weirich 2007). For instance, the genes in nuts that are responsible for potential allergies can be identified and theoretically be eliminated from cultivars.

Genetic modification techniques are also applied for the protection of intellectual property rights. That is, the creation of a new genetic material that could be activated only under the application of an external agent. One potential application of this technique and which has been criticized by the press is the production of sterile seeds by a GM plant.

After the creation of a GM crop plant what may happen next is “to cross the modified plant with an elite, high-producing cultivar and select for lines suitable for field testing within a few growing seasons” (McHughen 2000, found in Weirich 2007). When a new cultivar is about to be sold to farmers or gardeners regardless if it is genetically modified or not, it has to single out from other cultivars for its new traits, there has to be a homogeneity among the plants of the new crop and it has to be able to maintain its characteristics over time.

3.1 Potential Environmental risks

Through decades, studies based on environmental impacts suggest that the real impact of new biological elements on ecosystems may take years or even decades to be understood. So, based on scientific research so far the environmental impacts of introduced GMO’s can be either ecological or genetic and may include:

- *Unintended harm to other populations* as a result of impacts on non-target species, which may occur either directly by predation or competition, or indirectly by changes in farming practices or land use.
- *Unintended effects on biogeochemistry,* mostly by harming soil microbial populations that are responsible for the regulation of the flow of nitrogen, phosphorus and other essential elements.
- *Gene transfer to non-target species*, that is, the transfer of introduced genes to other domesticated or native populations, especially through pollination, mixed matings, dispersal or microbial transfer.

Because all these potential risks on the environment are not arbitrary, but have been documented in fields with non-GMO species, and because their effects could be seriously harmful for the environment, they constitute the main topic of a lot of debates and research (FAO, 2001).

3.2 Potential health risks

Most environmental NGOs, religious organizations, public interested groups, several scientists and governmental agencies have expressed their doubts about the potential hazards of GM foods to human health (Whitman 2000). Furthermore, scientists cannot guarantee the long term safety of consuming food containing GM ingredients. Therefore the WHO considers as indispensable the continued safety assessments on foods containing GMOs before placing them on the market (IUCN 2007).

Some of the potential risks to human health are the following:

- *Allergenicity.* The possibility of creating a new allergen when introducing a gene into a plant is considered one of the main suspected health risks. In US and Europe many children have developed allergies to peanuts and other foods (Whitman 2000). While, in the mid-1900s scientists discovered that soybean plants engineered with a gene from Brazil nuts created beans that some people were allergic to them (IUCN 2007).
- *Toxicity* is considered by the opponents of GMOs as another potential risk to humans and animals. For instance, the transgenic maize MON 863, has been suspected of causing toxicity. In January 2006, the European Commission approved MON 863 for food use. However, findings from France's Commission on Genetic Engineering, CGB, showed that MON 863 may cause potential pathological changes to internal organs and inflammation (IUCN 2007). Nevertheless, EFSA after reviewing the results of the experiments, observed no differences between the rats fed MON 863 and those fed conventional maize and any differences were not attributed to biological factors. Therefore, EFSA based on this results regarded MON 863 as harmless for both human and animal health (GMO Compass 2006 cited in IUCN 2007).

3.3 Global Status of GM crops

Although at least 300.000 plant species are known only a few hundred have had considerable impact on agriculture with wheat, maize and rice being the most significant (Smith 2009[a]). Technology has particularly focused on improving production in non-tree crops such as corn, cotton, rice, soybeans and wheat as trees need more time to develop and they take longer to improve through breeding programs (Clay 2004).

According to the most recent data, for 2008, 25 countries globally have officially approved of transgenic corps growing in fields, with soybeans, cotton, maize and canola as the main types (Table 3.2). More than a half of these countries belong to the category of developing countries, while the minority of them belong to the category of industrial countries. In descending order of acreage in million hectares these are: the United States (62.5), Argentina (21), Brazil (15.8), India (7.6), Canada (7.6), China (3.8), Paraguay (2.7), South Africa (1.8), Uruguay (0.7), Bolivia (0.6), the Philippines (0.4), Australia (0.2), Mexico (0.1), Spain (0.1), Chile (<0.1), Colombia

Table 3.2 *Dominant Biotech Crops cultivated worldwide in 2008*

GM Crops	Million Hectares
Herbicide tolerant Soybean	65.8
Stacked traits Maize	24.5
Bt Cotton	11.9
Bt Maize	7.1
Herbicide tolerant Canola	5.9
Herbicide tolerant Maize	5.7
Stacked Traits Cotton	2.6
Herbicide Tolerant Cotton	1.0
Herbicide tolerant Sugar beet	0.3
Herbicide tolerant Alfalfa	0.1
Others	<0.1
Total	***125***

Source HGCA, 2009; Bonny, 2009.

(<0.1), Honduras (<0.1), Burkina Faso (<0.1), the Czech Republic (<0.1), Romania (<0.1), Portugal (<0.1), Germany (<0.1), Poland (<0.1), Slovakia (<0.1) and Egypt (<0.1) (James 2008). Remarkably, the first eight of these countries grew more than 1 million hectares each setting the foundations for future global growth of transgenic crops (James 2007).

In 2007, two new countries adopted the biotech crop production. Poland produces for the first time Bt maize while, Chile produces over 25,000 hectares of commercial biotech crops for seed export. And in 2008, another 3 countries adopted the cultivation of biotech crops with Burkina Faso planting Bt cotton, Egypt planting Bt maize and Bolivia planting 600,000 hectares of soybean which makes it the eighth largest grower of soybean in the world (James 2008).

Since 1996 that the commercialization of transgenic crops began, the global area of biotech crops kept on growing at a rate of 12% when in 2007 it reached the 114.3 million hectares and in 2008 the 125 million hectares. Table 3.3 and figure 3.1 present the global area of biotech crops from 1996 to 2008. Moreover, 2007 was the first year that the genetically modified crops growing in EU exceeded the 100,000 hectares as they increased by more than 75% between 2006 and 2007. Notably, 43% of the global biotech crop area (49.4 million hectares), was grown on developing countries with India, China, Argentina, Brazil, and South Africa being the most principal (James 2008).

In addition, in 2007, the number of farmers turning to the production of transgenic crops increased to 12 million from 10.3 million in 2006 and in 2008 they reached the 13.3 million, of which the majority of them, 90%, were small and resource-poor farmers form developing countries.

Table 3.3 *Global Area of Biotech Crops, 1996 to 2008*

	Hectares (Million)
1996	1.7
1997	11.0
1998	27.8
1999	39.9
2000	44.2
2001	52.6
2002	58.7
2003	67.7
2004	81.0
2005	90.0
2006	102.0
2007	114.3
2008	125.0
TOTAL	**815.9**

Source: James 2008

In fact this high rate of adoption of crop technology indicates the growing rate that farmers in both industrial and developing countries accepted biotech crops implying at the same time the economic and social benefits for them. Out of the 12.3 million small farmers (most of them Bt cotton farmers), 7.1 million were in China (Bt cotton), 5 million in India (Bt cotton) and the rest 200,000 in the Philippines (biotech maize), South Africa (biotech cotton, maize and soybeans usually grown by women) and the other eight developing countries (James 2008).

Among the 25 countries that have officially accepted the growth of GM crops only 6 of them belong to Europe and are also members of the European Union. The EU has only approved the cultivation of two transgenic crops, BT maize in 1998 and very recently Amflora potato in 2010, while a few GM maize, soy, rapeseed and sugar beet varieties are imported as animal feed or food products (Wager & McHughen 2010)

Spain is the only country in European Union that grows a significant area of GM crops. In 1998 it planted approximately 22,000 hectares of Bt maize out of a total national area of maize of 500,000 hectares. Since 1998, Spain has risen the area of Bt maize up to 75,148 hectares in 2007, 79,300 hectares in 2008 and 76,057 in 2009 (James 2008; Smith 2009[b]; GMO Compass). That qualifies it as one of the 13 biotech mega-countries worldwide. Being a feedstock deficit country, farmers in Spain are strongly motivated to adopt innovative and cost effective technologies so that they can be more competitive and more productive. According to estimations during the period of 1998 to 2006 there has been an increase in farm income from Bt maize by US$40 million. While, PG Economics reported a 6% average increase in yields (James 2007).

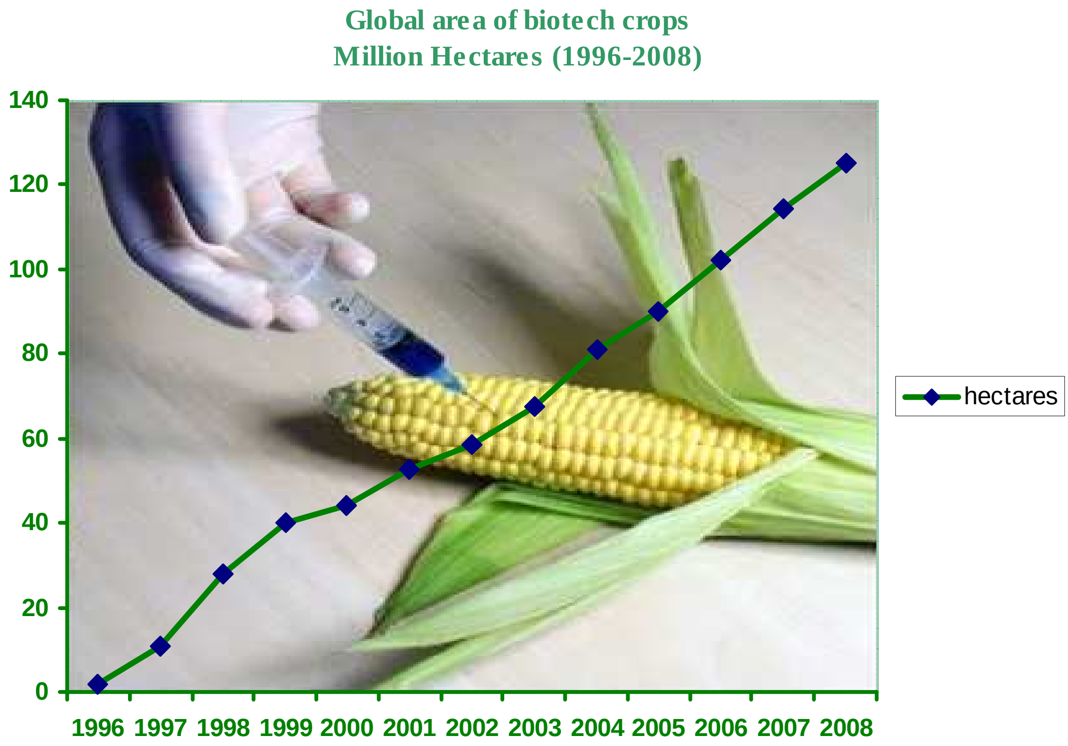

Figure 3.1 *Global cultivated area of biotech crops for years 1996-2008*
Source: James 2008.

France, the major maize growing country in the EU (1.7 million hectares) showed a sharp increase in Bt maize planting during the period of 2005 to 2007, as it reached approximately the 22,135 hectares in 2007 from only 492 hectares in 2005. The benefits in France from Bt maize were an increase in yield form 5 to 25% accordingly to the level of infestation and equivalent to the rise of farmers' income of US$150 to US$200 per hectare. With regard to the environmental benefits, mycotoxin levels were up to 10 times higher in conventional maize crops than in Bt maize, leading to the reduction of insecticides (James 2007). In 2008 though, France issued a decree to ban the planting of MON810 maize [1](Smith 2009[b]).

The Czech Republic, the third in the rank of European countries growing GM plants, approved to commercially produce biotech crops for the first time in 2005 and grew 150 hectares of Bt maize, while in 2007 it increased its Bt maize area to 5,000 hectares and in 2008 to 8,380 (Smith 2009[b]). According to the estimates of the Phytosanitary Service of the Czech government, maize yields showed an increase of 5% to 20% equivalent to an increase of about US$100 per hectare for 2007 (James 2007). Portugal also grows Bt maize the cultivation of which increased form 1,250

[1] MON810 is an insect resistant maize, developed by U.S. biotech company Monsanto.

hectares in 2006 to 4,263 hectares in 2007, 4,851 in 2008 and 5,094 in 2009 (Smith 2009[b]; James 2007; CMO Compass).

Germany starting in 2000 and for the next 6 years it officially grew from 300 to 500 hectares of Bt maize and particularly Bt176, until 2003 when MON810 was introduced. In 2007, Germany more than quadrupled the area of officially approved Bt maize (2,685 hectares) (James 2007), which in 2008 increased to 3,173 hectares (Smith 2009[b]). In 2009, the German minister of Agriculture imposed a ban on MON810, the most widely GM crop grown in Europe, for constituting a danger to the environment (Connolly 2009). However, in April 2010, after the EU Commission approving the cultivation of GM Amflora potato for producing starch for industrial use, in Zepkow in Germany 15 hectares were cultivated with transgenic potatoes (GMO Compass 2010).

Slovakia, another member of European Union that has accepted the cultivation of GM crops, in 2006 grew for a first time 30 hectares of Bt maize which in 2007 increased to 900 hectares and in 2008 to 1900 hectares, while in 2009 cultivation fell to 875 ha (Smith 2009[b]; James 2007; GMO Compass). Due to European corn borer (an insect pest of maize), Slovakia sustains a severe damage in maize yield but measures regarding Bt maize have shown yield gains at 10% to 15%.

Romania the third largest European country in soybean production after Italy and Serbia Montenegro grew for a first time herbicide tolerant soybean in 2001 planting 14,250 hectare of RR soybean and up until 2006 it grew more than 100,000 hectares of RR soybean. Under the use of RR soybean, the increase in yield ranges from +15% to +50% indicating the effective weed control and the less use of herbicides, while through estimations for the period 2001-2006 the farm income has been enhanced by US$93 million. Despite biotech soybean being a very cost-effective technology for both producers and consumers, Romania after its entry to the EU in January 2007 had to cease RR soybean production as its commercialized planting is not permitted within the EU (James 2007). Conversely, after the EU-accession Romanian farmers turned to the Bt maize planting starting in 2007 with planting only 325 hectares of MON810 which in 2008 increased to 7,146 hectares and in 2009 fell to 3,244 hectares (Smith 2009[b;] GMO Compass).

Poland grows approximately 600,000 hectares of maize but due to European corn borer, which is now endemic in all regions of Poland, it sustains extensive damage to its maize yields. In 2007, Poland planted for the first time 327hectares of Bt maize for commercial use, in 2008 it reached the 3000 hectares and in 2009 it reached 5,000 hectares (GMO Compass 2009; James 2007; GMO Compass).

4. Political economy theory

4.1 Introduction

In this thesis the theory of political economy is considered as the most suitable theoretical framework to explain the economic and political factors that influence biotechnology policy and the political and economic incentives to corporate interests in biotechnology behind countries' position, in particular on GMO's. The political economy theory is regarded as one of the most comprehensive theories worldwide which can be used as a tool to successfully explain "the relationships, bargains and shifting balances of interests between social groups, transnational, non-state actors, firms, international organizations and state authorities" (Hayward 1998)

Generally, political economy can be defined as "the study of mechanisms used or useable by society to operate the social economy, understanding the social economy to be comprised of the tools, institutions and human energies that produce goods and services" (Tabb 2002). It is true that if the theory of political economy is applied properly it can help with the solution of several issues such as, environmental degradation, immigration, the control of AIDS, trade liberalization and other developmental issues concerning Third World countries.

4.2 The history of Political Economy

Political economy term was used for a first time in France in the early seventeenth century. Until that period, the words economics or economy (derived from the Greek word oikonomia) were used to describe the management of household because household and the family by themselves were responsible for the satisfaction of their needs and wants (Jones 2001). With the flourish of trade though, during the seventeenth century new schools of economic thought appeared in order to explain the economy beyond the single household in a nation-state level. More specifically, Mercantilism which emphasizes the role of State regulation and physiocracy which emphasizes the role of agriculture in generating economic surplus, developed the first concerns about nature, reproduction and distribution of the wealth of nations and also about the improvement of the management of the affairs of the state so that the wants of population should be addressed (Jones 2001).

Adam Smith, one of the most important economists defined political economy as "a branch of the science of a statesman or legislator whose twin and distinct objectives were first, to provide a plentiful revenue or subsistence for the people or more properly to enable them to provide such a revenue by themselves; and secondly, to supply the state or common wealth with a revenue sufficient for the public services. It proposes to enrich both the people and the sovereign" (Jones 2001). Adam Smith with his works *An Inquiry into the Nature and Causes of the Wealth of Nations (1776)* opened the way for the classical political economy which ended when John Stuart Mill published *Principles of Political economy* in 1842, and whose other principal authors included David Richardo and Thomas Malthus. Malthus was doubtful about the endless progress towards a utopian society due to the dangers of population growth, and supported the agricultural protection. For these ideas of him, he was viewed as a heretic and his theories were ignored for more than a century. Karl Marx, the last of the classical economists and known as a socialist author, believed in the replacement of capitalism with socialism leading to stateless, classless society the so called communism (Moss 2001).

In the latter decades of the nineteenth century, 'political economy' was substituted with the term of 'economics' and at the end of this century the neo-classical school emerged, which did not deny the separation of politics and economics but it also added the theory of utilitarianism and therefore the intervention of politics was possible only under the failure of the market to maximize individual satisfaction. Thus, for the neo-classical political economy 'economics' refers to private transactions in pursuit of utility maximization, and 'politics' to the use of public authority in the same cause" (Jones 2001).

Around the 1930's, and while the neo-classical political economy kept on considering political economy as a synonym for economics a new economic thought emerged and that was by John Maynard Keynes. Keynes disapproved of both classical and neo-classical schools assuming that free markets would necessarily provide full employment as long as there was flexibility in the wage demands for the workers. On the contrary, he supported the interventionist government policy, where governments could use monetary and fiscal measures to sustain a high level of employment (Dillard 2005). After World War II Keynes's new ideas regarding political economy inspired a repoliticization of the market and its management and were adopted by leading Western economies. However, in the early 1970s the time that political economy was becoming more and more popular and was transforming into international political economy (IPE), ironically Keynes's ideas began to wane both in international and national level (Jones 2001).

At the international level the partial collapse of "the post-war international Bretton Woods international economic order of fixed exchanged rates", of which

Keynes was one of its supporters, the oil crisis of 1973-4 and the demands from the developing countries for a new international economic order, synthesized a new generation of scholars, whose main work was the expression of intense dissatisfaction towards the inefficiency of pure economic theory to cope with the unemployment, environmental degradation and poverty of that time (Jones 2001). At the national level, the diminishing external opportunities for world trade and growth intrigued the New Right ("an amalgam of liberal and conservative ideas, but liberalism is paramount") to dispute Keynes ideas (King 1988). The New Right attributed the inadequate economic performance and state authority partly to the state intervention and to the insufficient foreign policy abroad in a period that communism was resurging. However, during the 1990s, despite the emergence of social democratic governments the ideology of the New Right has intensely affected the discourse of contemporary political economy.

Susan strange is considered one of the most prominent pioneers of international political economy, who tried to "identify a way to synthesize politics and economics by means of structural analysis of the effects of states – or more properly of any kind of political authority – on markets and, conversely, of markets on stages" (Jones 2001). In addition her main goal was to create "a framework of analysis, a method of diagnosis of the human conditions as it is, or as it was affected by economic, political and social circumstances (Jones 2001).

4.3 Political economy as a theoretical framework

In this section a political economy framework to analyze the policy of agricultural biotechnology is developed. Searching for the different interests within society and the interactions among them, an effort to shed light on how the different policies of GMO's have emerged in European countries is made.

But why is the theory of political economy important to use as a framework? In 2002, under a food law it was created the European Food Safety Authority (EFSA), an independent body aiming at helping to set the 'science based' standards for risk assessment. When EFSA was established the European Commission included representatives of industry and several NGOs as an effort to gain public confidence (Levidow et al. 2005).

EFSA's major role is the scientific evaluation of GMOs from a panel of experts on genetic engineering, but the final decision is made by the European Commission and the Member States. As long as GMOs either as seeds or as GM derived products receive authorisation made by the European Commission they can enter the market. Despite the approval of several GMOs by the European Commission and the EFSA after continues assessments, Greece and some European countries still ban the growing of GMOs. Based on the theory of political economy this project will try to unveil the political-economic reasons that Greece is so firmly opposed to genetic modification.

Although biotechnology's innovations in the medical field were globally accepted and applauded, in agriculture a global controversy about genetically modified organisms for environmental, health and ethical reasons has limited the diffusion and scope of this technology. There are few studies though, that have analyzed the perceptions and interests that stimulate a state or non-state actor to accept or oppose the use of GMOs in European countries.

After a quick review of the global regulatory environment on GMOs it is obvious that those opposing the insertion of biotechnology in agriculture have been more influential in biotechnology policies worldwide than supporters (Cohen and Paarlberg 2004). More specifically, several NGOs opposing GMOs are inclined to have more political success with the public than the actors that are in favour of GMOs mostly because of their main principle that they act for the sake of public good. This political situation is prevalent in Europe where NGOs are capable of convincing governments to persist in their preventive policies towards GMOs or even pressure other countries to do so. This general hostility against GMOs in Europe has had an adverse effect on the amount of funding and investments even on further research for the improvement of genetically modified crops (Aerni n.d.).

4.4 A Political Economy Model with Interaction Amongst Competing Interest Groups in the Formation of Expectations

Economists and political scientists have come up with several theories in order to account for the behaviour of regulators and the shape and strength of the policies that they make (Hochman et al. 2009). These kind of theories intend to present how different actors, like consumers, producers etc., influence regulators under new regulations.

One such theory is the political economy model which explains the interaction amongst competing interest groups in the formation of expectations. In order to capture the key elements that form the political economy of agricultural biotechnology a three-stage theory is introduced:

1. In the first stage it takes place an initial deliberation of the welfare conditions of the several state or non-state actors, such as consumers, food retailers,

farmers, major biotechnology suppliers, new biotech innovators, competing input suppliers, academic institutions/scientists, activist organizations, environmental organizations. Actual or potential environmental and health benefits may be considered as unknown or uncertain.

2. the second stage includes a public debate in which each group can affect and be affected by the perceptions of members of other groups. For instance, various groups like environmentalists, industry and scientific community pass information that are related to their own welfare, like potential health risks or health benefits, regardless of the actual levels being uncertain or unknown. Similarly, perceived levels of environmental risks might be the results of information provided by different groups serving their profits.
3. the third and last stage, includes the choice of the policy that maximizes the regulators' objective function, taking into account the perceived welfare and benefits of the different groups updated in the second stage and the weights of influence of each group (Hochman et al. 2009). In regulatory processes though, usually concentrated interests are dominant over diffuse interests and as extended the regulations "tend to reflect the preferences of the concentrated interests". Therefore, it is quite common that most regulations benefit the producers rather than consumers (Bernauer 2003).

Hence, the policy maker's objective could be equal to the maximization of the sum of the perceived well being of the various groups mentioned in stage one. Specifically, consumers' perceived welfare (CPW), assuming that they are risk averse due to lack of initial knowledge about GMOs, can be defined as the "sum of consumer surplus from purchase and consumption at market prices minus the corresponding value of their perceived risks of doing so" (Hochman et al. 2009). Regarding the perceived risks that are subtracted from consumer's surplus, they are based on other groups' information and are weighted by the influence and trustworthiness that exert on consumers. On the other hand, producers', activists' and regulators' well being, assuming that they are better informed and more risk neutral, is "more close to its actual or objective value" (Hochman et al. 2009). Consequently, each group in order to maximize its well being is trying to switch the others' perceptions Badinard & Josling 2001; Herring 2008; Hochman et al. 2009). For instance, groups that are not prospered by the introduction of GMOs may provide consumers with deceitful information. In addition, according to empirical studies assessing consumer attitudes especially in Europe, have shown that there has been a deliberate effort of informing and shifting public opinion (e.g. Brossard, Shanahan & Nesbitt, 2006; Gaskell et al., 2006 cited in Hochman et al., 2009).

The interactions between the various groups can be multi directional. For instance, one group's perceptions may be affected by the welfare of another group due to a potential impact on their own welfare. To be more specific, a retailer's producer surplus is greatly reliant on the reputation of his brand, which is itself affected by the consumers' perceptions. This has been clearly proved by accounts from the retail sector in Europe that indicated the magnitude of influence that consumers' attitudes towards GM foods have had on retailers' positions in policy (Kane, 2001).

Non-governmental organizations (NGOs), which have expanded markedly in some aspects the last decades, play a unique role in the flow of information as they have become "larger, more visible, better organized, and more sophisticated in their relations with the political institutions and the media" (Collingwood 2006). Most NGOs base their revenues on potential donors that expect from them to collect or share information that may be more objective and complete than those provided by official government or industry accounts and defend their donors' interests in the policy process or even change policy to serve their interests (Hochman et al. 2009). Consequently, this situation amplifies the conflicts of interests and sometimes economic incentives lead NGOs to provide misinformation with a view to undermining trust in government regulators. Furthermore, NGOs in order to be pleasant to their donators they have to "achieve high-profile but partial 'wins' in policy arena" so that their donators will not be reassured that their problems are truly solved (Hochman et al. 2009). In turn, in order to keep their donators vigilant and sustain their need for cooperation with them, NGOs resort to "high profile 'revelations' of ongoing governance failures" or publicize new risks that menace their donors' profits (Hochman et al. 2009). Consequently, the survival of successful organizations depends on the provision of reliable revelations and as extended on their relations with media. And according to several studies, media is highly economically interested in "repeating familiar stories, perpetuating stereotypes, playing on readers/viewers anxieties, and emphasizing on bad news over good news (Curtis, McCluskey, & Swinnen, 2008; Gaskell, Bauer, Durant, & Allum, 1999; McCluskey & Swinnen, 2004 cited in Hochman et al., 2009).

5 Political-economic interpretation of the situation in Europe

5.1 Introduction

After developing this model it can be used as a framework to analyze the regulations of GMOs in Europe in the last decade. It would also be justifiable to define the stakeholders that are involved in the GMO controversy and also to designate who owns the rights to the technology, who benefits from the sale of the GM products and who is responsible for the regulation of the production and sale of these goods. Hence, the main interest groups that weigh in on agricultural and food policy are in the private sector the life science companies, food manufacturers and retailers, farmers, public interest groups, consumer groups, environmental groups and in the public sector the government agencies, scientists and scientific establishment.

Stakeholders, opponents of GMOs, have tried to prevent GM products from market access, while the proponents have tried to promote it. This division in the views of various stakeholders is obvious through several attempts, like the blockage or even destruction of field trials of GM crops, bans on transgenic products despite their EU-wide approval, appeals to the court for the legal status of regulatory decisions and protests, pressures on food retailers for the labelling of GM products, public debates over the substitution of genetic modification in agriculture with other friendlier and safer methods for the environment and human health and encouraging R&D, the mass media coverage of such issues etc. (Levidow et al. 2005).

5.2 The private sector

Private-sector companies that produce and sale GM products are the groups with the greatest financial benefits under the use of biotechnology. Although, private companies have profit-maximizing goals do not always look for short-run gains, but many of them aim at establishing their position in the area of agricultural biotechnology. It is noteworthy the role that private companies play in the promotion of GMOs, since the adoption of the new technology presupposes major structural changes in the industry like in input supply systems, farmer acceptance, distribution networks, retail outlets. Although each part of this chain intents to gain from the adoption of the mew technology, there is no guarantee for that. It is well known "the competition for the consumer dollar and the share that goes to raw material suppliers as opposed to processors and marketers" (Nelson 2001).

5.2.1 The life science companies/producers

Life science companies are usually referred to companies created by the merger of chemical and pharmaceutical firms with biological and agronomic entities, with the most prominent being the Monsanto Company, DuPont/Pioneer, and Syngenta. These kind of companies are the leaders of much of the research, development and commercialization of GM crops and they mainly focus on a few crop/trait combinations that are of high commercial value and with high perspectives in international markets (Gregory et al. 2008). In particular, they focus mostly on producing genetically modified crops that are resistant to insects, viral pathogens and commonly used herbicides, such as Monsanto's Roundup. In addition, further experiments are conducted to produce crops with increased nutritional value ('functional foods' and 'nutriceuticals') and with the capacity to produce pharmaceuticals ("pharming") (Vergragt & Brown 2008).

Companies responsible for the production and distribution of GM crops, are usually defenders of the new technology and tend to doubt the threats posed by GMOs. A typical allegation is that GM crops are not only totally safe for both the environment and human health but also can benefit agriculture and food production and can play a catalytic role in dealing with famine (Nelson 2001). Therefore, these companies in their effort to convince farmers about the safety of their products and to turn them into new adopters of GM crops, they stress several positive benefits. For example, under the use of new herbicide- and insect- tolerant crops they will be able to spray anytime during the growing season without destroying their crops on the contrary, they can control insects and weeds under a limited use of chemical pesticides.

In reply to the consumers' concerns about human health and food safety, companies persist in their claims that transgenic crops "undergo a series of biochemical checks in which nutrient and protein levels are monitored and potential poisons and allergens are tested. In some cases, the crops are fed to livestock to check for normal weight gain and health" (Cohen 1998 cited in Nelson 2001). C

Consumer hostility in Europe constitutes a major threat especially for companies involved in the research and development as it may harness the expansion of their markets globally. Thus, biotech companies and especially the multinational ones have made significant efforts to convince consumers for the safety of their products. For instance, in June 1998 Monsanto launched a multimillion-dollar advertising campaign with a view to promoting GMOs and change its image in Europe. Nevertheless, this campaign had the opposite results; all this effort to convince consumers about its products shook their' confidence in Monsanto and provoked its backlash (Josling & Babinard 1999).

But what are the economic benefits under the adoption of the new technology for the producers of GM crops? To begin with, producers can benefit from the adoption of new technology either by cost reduction or by the quality enhancement. Cost-reducing technologies allow producers to produce a given amount of a crop at a lower cost, like the use of biotech plants developed to increase yields or reduce the use of more costly inputs (Caswell et al. 2003). Furthermore, quality-enhanced food products are likely to increase producers' income through increased demand for the better quality of food, on condition that consumers value the quality change and are eager to pay for higher prices. Higher prices though, are usually an incentive for producers to adopt new technology, even if there is no reduction in production costs or even if there is an increase (Caswell et al.2003). For example, improved flavour, texture, shelf life or nutritional content are some traits that have favourable response to consumers.

However, not all agricultural supply industries benefit from the introduction of biotechnology. Industries specializing in the production of chemicals and mechanical inputs to the farm sector such as Bayer and BASF have different economic profits than the life science companies. Particularly, industries producing chemical insecticides are likely to lose as the creation of GM plants resistant to insects has lessened the need for spraying with chemicals. Also, plants resistant to herbicides might also create a problem in the market. More specifically, the seed developer can control which herbicides the plant tolerates resulting in a potential decline in the range of herbicides on the market (Nelson 2001). It is quite indicative the fact that in 2001, sales of new genetic technologies in European companies were up by 2% while, sales of agrochemical pesticides where in decline (Hochman et al. 2009). As a result, major European chemical firms are expected to support a regulatory regime that would slow down the loss of market share to biotechnology, if not pause the losses at all (Hochman et al. 2009) or even exert market pressure (e.g. consumers' boycotts) (Bernauer & Meins 2003).

5.2.2 Food manufacturers and retailers

Food retailers' primal concern is the public acceptance. Until the late 1990s, most European food manufacturers and retailers had accepted to sell GM crops and products containing GMOs. However, these companies are now trying to eliminate GM products so as to align with the consumers' and pressure groups' demands. Therefore, some farm interest groups and food retailers started supporting more stringent GMO regulations (Bernauer & Meins 2003). For example, some British food retailers the time that the European Parliament voted for the labelling regulation, declared that they would be willing to exclude even labelled GM food from their stocks if customers asked them to. Hence, large retailers for fear of consumers protesting in front of their supermarkets if they would offer labelled GM food, are finally opposed to them.

The UK market has been the leader in this regard. In 1999, a major food manufacturer and retailer, Sainsbury's in order to allay consumers' anxiety about GMOs, the company introduced a policy of eliminating GM ingredients form all of its own brand products (Nelson 2001). "Very few GMO products can be found across Europe's 30 major retailers, nearly all of which have a non-biotech policy for the entire EU or at least in their main European markets" (Smith 2005).

Sometimes, major food companies are responsible for finishing off technology. For example, the Tesco supermarket chain, in the United Kingdom when it decided to stop selling tomato paste made in California from GM tomatoes, resulted in killing a delayed-ripening tomato technology. Furthermore, several major chains like Carrefour, Ahold and Tesco that have denied to stock food labelled as GM-derived product affected significantly the political debate about GM crops in Europe (Paarlberg & Pray 2007).

5.2.3 Farmers

Farmers are vitally involved in the production of GM crops and the majority of them are aware of the benefits provided by the cultivation of biotech crops. However, farmers are also very dependent on the public acceptance and consumers' willingness to buy GM products.

In Europe, where the majority of Europeans are opposed to GMOs (58%) and 9% say they have never heard of them (Eurobarometer 2008), farmers have often been hesitant to plant genetically modified crops. Generally, European farmers do not enter world markets with GMOs, unless they get export subsidies (Nelson 2001), but WTO exerts pressure on EU farmers for reduction in direct agricultural subsidies under the CAP (Graff & Zilberman 2004). Another concern of farmers' regarding the entrance of the new technology is the possible change in the relationship between the producer and the input companies in ways that may hurt their interests.

In some cases stricter regulation may yield some benefits for producers. For instance, in some areas regulation can be designed to protect import-competing domestic firms from foreign competition and protecting the environment and consumers' health is a justifiable reason to ask for import-restricting regulation and gain more political support.

In general, farmers are willing to accept transgenic crops, when affordable and available despite the fact that in the most European countries are limited by politics. In fact, some of the farmers have illegally adopted GMOs and obtained the technology when their traits have been proved useful, risking even to be prosecuted. Even COPA (Committee of Professional Agricultural Organisations), the most important farmer groups in Europe, have not dynamically lobbied regulators to impose restrictions on the applications of agricultural biotechnology (Bernauer & Meins 2003). Instead, opposition to biotech crops has not come from farmers but mostly from groups with less direct interests in agriculture (Herring 2008).

Another reason that kept key farmer groups away from actively lobbing regulators to impose restrictions on GMOs is the absence of economic competition between imported GM-crops and European farm produce (Bernauer & Meins 2003). However, both the low public acceptance and the campaigns of other interest groups may lead farmers to become "strong advocates of a general ban on GMOs" (Bernauer & Meins 2003).

5.2.4 Consumer groups and public opinion

Although the acceptance of GM food in Europe has been shifting over the years, consumers in Europe have generally argued against the introduction of genetically modified food products. From 1996 to 1999, a period of increasing scepticism led to a rise in support, observed in the study of 2002. But after 2002 consumers' support for GM foods started taking another downturn (Eurobarometer 2006).

Although European citizens seem to be interested and supportive of the applications of the so-called white biotechnologies (industrial), like the red biotechnology (medical), they are still suspicious about biotechnologies relating to food. Nevertheless, according to Eurobarometer surveys the possible reasons that Europeans would be willing to buy GM food are the reduction in pesticides, nutritional benefits and general environmental protection (Herring 2008).

An overview of European consumer polls on attitudes to GMOs makes it clear that the majority of European consumers are cautious about the positive effects of gene technology in agriculture and food products. In the Eurobarometer survey of 2005, only 27% of Europeans were not opposed to GM food while in the 2002 Euroberometer only 21% were positive. Nevertheless, according to the latest Eurobarometer survey of 2007 in some member states the percentage of the proponents of GM food is relatively high, like the Czech Republic (46%), Portugal (38%) and Spain (34%). In contrast, only 14% of Greeks and 13% of Luxembourgers commend this technology (GM Compass 2009). In figure 5.1 is presented the average response of each European country to the question if they are in favour of or opposed to the use of GMOs. In addition, the Eurobatometer survey of 2005 has shown that GM food in comparison with other three applications of biotechnology (nanotechnology, gene therapy and pharmatogenetics) is by far less supportive.

With regard to consumers' willingness to buy GM food 56% would be eager to buy GM food if it was healthier and 51% would also buy it if it contained less pesticide residues. However, lower prices or approval by the relevant authorities seem to influence people's choice whether to buy it or not. As for the Europeans perceptions about food biotechnology, Eurobarometer's survey of 2005 shows absence of knowledge about genetics, and a tendency to believe that food biotechnology is associated with fears about adulteration, infection and monstrosities. Furthermore, according to the Eurobarometer poll in 2007 34% of respondents allude to the deficit of information regarding the "use of genetically modified organisms in Farming" (GMO Compass 2009).

Since 1999, according to surveys, "general scepticism towards gene technology is on the decrease" (GMO Compass 2009). While in 1999, only 10% of the respondents had believed in a positive contribution of gene technology to their lives in 2005, 50% considered biotechnology as positive and about 30% regarded gene technology as good (GMO Compass 2009). European consumers in the question to identify the environmental themes that they are most concerned about, 57% of the respondents cited the topic of "climate change", 42% "water pollution", 40% the "air pollution" and only 20% cited the topic of "GMOs in farming" representing a decrease of 4 percentage points in comparison with the results of Eurobarometer 2005.

But how have negative views emerged and grown? When the first imports of transgenic seeds from the USA arrived in Europe in 1996 and along with the heated debate about the authorization of Bt corn from the firm Novartis set off the discussion on GMOs that largely spread in the public. At that time, public was highly concerned about several issues, especially HIV virus, mad cow's disease, asbestos etc. (Bonny 2003). All these menacing news about people's health, shook public's faith in both

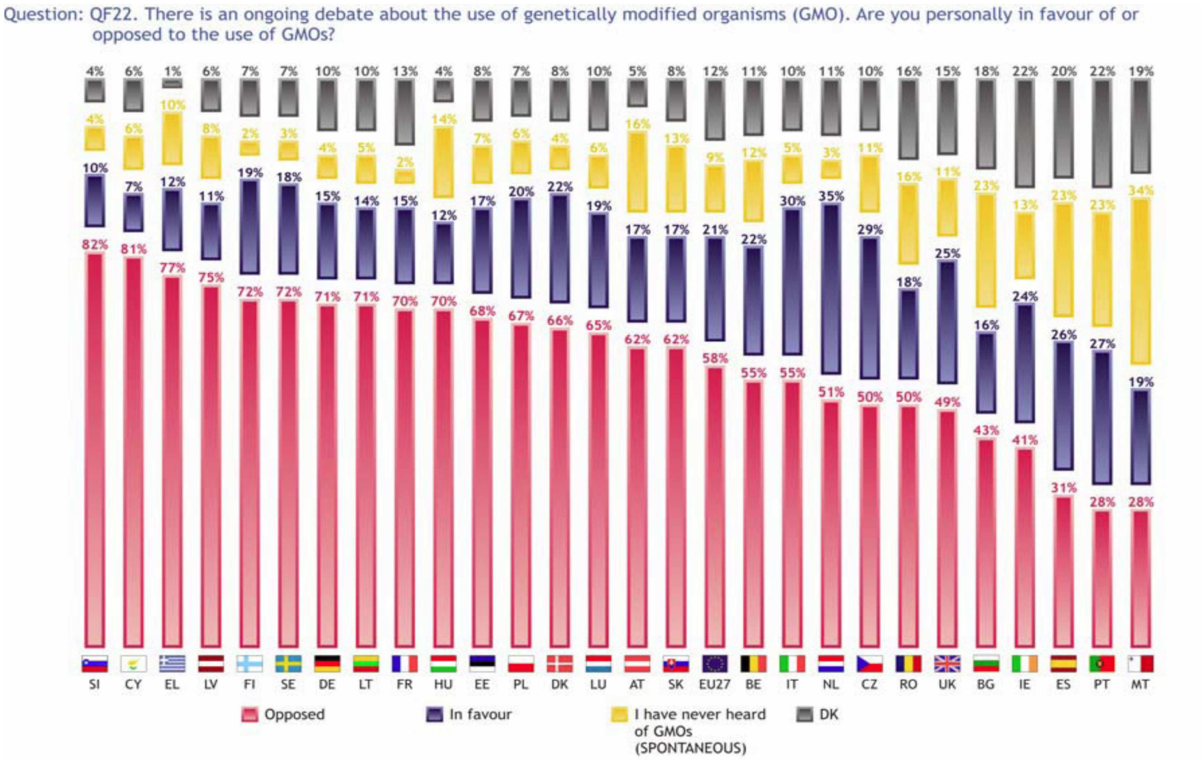

Figure 5.1 *The average response of EU countries to a question in Euro barometer 2007. Source: Euro barometer 2007*

firms' and public authorities' capability of taking into account health risks on the altar of certain economic and political interests. In the late 90's, the debate on GMOs (authorization, importation, labelling, etc.) started being influenced by the food safety issues (BSE, listeriosis, etc.) that had been of major concern and critics. Therefore, when safety and potential environmental risks came to the forefront, critics and opposing groups towards GMOs grew significantly.

Since the publication of the GMO issues, institutions and certain technological advances were discouraged and the centre of attention were the warnings of several organizations and the growing campaigns against GMOs. Even the media and the social debate had a critical position and as extended prevailing information and views on GMOs have been mostly critical or negative (Bonny 2003).

Generally, the way that consumers react to transgenic food is complex and has several aspects, like specific food-safety concerns, fear of the 'unknown' consequences of consumption, ethical concerns and environmental concerns" (Wesseler 2005). The main food-safety reasons that consumers are concerned about are the potential transference of allergens into foods and the use of marker genes resistant to antibiotics for fear of antibiotics becoming more and more resistant to humans and animals. Most of the consumers' fears about GMOs are not scientifically proved and along with the lack of the scientific identification of the long-run risks these concerns will keep on spreading. In addition, ethical concerns against biotechnology are related to consumers' uncertainty towards the dominant multinational firms and their real incentives (Wesseler 2005).

Understanding the fears and concerns of consumers about food safety is very important as they may influence the development of food safety policies and regulations, they can guide the production of products based on consumers' needs, they may be used to make informational programs or launch advertising campaigns (Baker & Burnham 2001).

Consumer activists in Europe have launched campaigns successfully against transgenic or "Frankenstein foods" and in relative surveys conducted at the beginning of 2000, 86% of them were in favour of labelling any food that contains GMOs (Nelson 2001). Consumer protest and boycotts have forced major retailers eliminate transgenic ingredients from their own brand-products. As a consequence, this has made governments and industry to set up stricter precaution measures for the cultivation of GM crops with a view to mitigating public fears about their risks.

Hence, the biotechnology industry has acknowledged stringent regulatory measures so that consumers will accept them. Policy makers in turn, had to take into account the widespread demands for more comprehensive labelling, for further risk assessment and even for a moratorium on the commercial use of biotech crops and food (Levidow et al. 2000). In response to these demands some governments have established more precautionary measures like the revaluation of GM products that they had primary approved, the prohibition of some other products, or the establishment of market-stage precautions. These pressures, to delay or even restrict the commercialization of GM crops were not originating only from consumers but also from various Directorates-General and the European Parliament (Levidow et al. 2000). Nevertheless, some proponents of GM crops claim that the delays in their commercialization are not an obstacle but an incentive for further scientific risk assessment.

5.2.5 Media

It is noteworthy that the media have played a catalytic role in the dissemination of the potential dangers of GMOs and also the critical views of the various associations. Although in the early 1980s media commended biotechnology as promising and revolutionary technology, from 1997-1998 onwards journals were openly opposed to GMOs and mainly focused on their potential risks.

This change in journalists' attitude can be explained by politico-economic factors. More specifically, in the first place biotechnology was a subject of interest for scientific journalists who were relatively positive, but as soon as GMOs became a politico-economic matter journalists also from other fields got interested in transgenic products.

Another explanation is based on "the characteristics of the journalistic profession and the increasing strong competition within the media sector" (Champagne 2001 cited in Bonny 2003). Shocking headlines, revelation of issues that may adversely affect peoples' lives or issues presented in a dramatic way has always attracted audience's attention more than moderate or qualified articles do. Hence, issues of technological risks has most of the times been a major topic of debates, especially in agricultural and food sector. Therefore, organizations opposed to GMOs are used to focusing on spectacular actions that have a strong impact on media. Pictures depicting extreme actions, like activists chained or climbing or even posing naked onto strategic or symbolic places, photos of huge protest banners and so on, succeeded in being attractive and almost always received media coverage (Bonny 2003).

Information provided by the media is not always neutral. In reality, most of the times organizations and institutions have internal incentives to provide certain information and sometimes exaggerate or even distort the truth. In addition, private sources provide information under their own profit-maximizing objectives and even if public sources intent to provide objective information, administrators and governments may have motivations to bias the information (McCluskey & Swinnen 2004).

As for the issue of GMOs, over the 90% of consumers are getting informed about food and biotechnology primarily through the popular press and television which in a way mould public's risk perceptions about GM foods and as a result can lead to decrease demand in these products (Hoban and Kendall 1993). The BSE outbreak is a characteristic example of the degree that media affects the quantity and quality of information and also influences the public opinion. Television coverage on meat safety had an adverse effect on demand for red meat.

While until recently, in Europe state broadcasting companies and companies publishing daily newspapers and journals responsible for television and radio broadcasting were often guided by the political parties, now commercial television and radio stations are dominant. Additionally, the written press nowadays, "is driven more by commercial than political objectives" (McCluskey & Swinnen 2004). Nevertheless, many media organizations are driven not only by their profits but also by their own attribute preferences such as their own ideological perspective of several issues. These attribute preferences usually reflect the preferences of the owners of media organizations or of journalists who have the power to influence the decision making of the media organization.

5.2.6 Environmental groups

In Europe environmental groups are most of the times allied with consumer groups as their main goal is to protect the environment from the unknown harmful effects of GMOs and also protect consumers from the potential health risks due to the consumption of GMOs and defend their right to choose whether to eat them or not (Schweiger 2003). Generally, the European anti-GMO movement launched a successful campaign against GMOs mainly for three reasons: (1) because it has relied on public opposition toward GMOs and pressures on regulatory authorities against GMOs; (2) because European consumer groups have allied with producer groups; and (3) because it has successfully influenced a few access points related with multilevel governance in Europe (Ansell and Vogel 2006).

Worldwide environmental groups generally argue that despite the biotech companies' efforts to reassure and affirm consumers about the safety of transgenic products little is known about the long term environmental consequences (Nelson 2001). Friends of the Earth (FoE) the world's largest environmental network, uniting 77 diverse national member groups and around 5,000 local activist groups on every continent, is campaigning and lobbying for stricter regulation on GMOs resulting in several EU regulations and EU Directives setting rules for the protection of the environment and the consumers (Villar et al. 2009; Schweiger 2003). Specifically, the Friends of the Earth accuse the agribusiness corporations, like Monsanto, of increasing their profits, although the global food crisis has increased the number of hungry and poor to 1 billion.

Because of the rise in commodity prices, big farmers growing export crops like transgenic maize and soy for international markets have increased their earnings. This motivated Monsanto and other biotech companies to raise exponentially the prices of seeds and pesticides, preventing farmers from gaining more from any price rises (Villar et al. 2009). Moreover, they argue that none of the GM crops on the market are engineered to increase yield on the contrary, GM crops have contributed to the increase in the use of pesticides and to the spread of herbicide-resistant weeds. As a result that led biotechnology firms to the development of new GM crops that are tolerant not only to heavier applications of chemicals but also to two herbicides rather than one, encouraging that way the pesticide use even further (Villar et al. 2009).

Greenpeace, an independent campaigning organization and present in 40 European countries, the Americas, Asia, Africa and the Pacific, says no to genetic engineering. It is opposed to the release of GMOs to the environment since there is not sufficient evidence of their safety on the environment and human health. And like the majority of environmental groups, Greenpeace asks for labelling of GM ingredients and the segregation of transgenic crops and seeds and the conventional ones.

Both the Friends of the Earth and Greenpeace are the most important environmental organizations that their activity overshadows that of any other environmental group. Especially, Greenpeace since it was founded in 1971 managed to build knowledge and experience that other organizations did not have when GMOs came to the forefront. In 2002, the total revenue for Greenpeace international was 37.2 euros, 26.1 of which spent on campaigns while FoE's total revenue was only 1.5 euros, 433,542 euros of which spent on campaigns. It is noteworthy that although Greenpeace is a large organization, most of its income is attributed to small donators who constitute its main support.

Furthermore, Greenpeace has multiple ways for protesting, "from symbolic grassroots demonstrations to institutional lobbying of governments" (Ansell and Vogel 2006). In addition, its success in capturing public attention across Europe is partially attributed to strong links between the international organization and its national chapters. Greenpeace's campaigns are promoted by an international coordinator under Greenpeace's global vision while assigning to regional and national campaigners the regional and national specifics (Ansell and Vogel 2006).

As it has already been mentioned, the most popular political economy theory of regulation, states that concentrated interests dominate over diffuse interests in the regulatory process, hence it would be expected that the European regulatory outcomes would reflect the preferences of the agrochemical and agri-biotech sector, as more concentrated. In the United States for example, the regulations for the permission of GMOs and the absence of mandatory labelling verifies the political economy theory's assumptions. In contrast, in the European Union the "agri-biotech sector has been overwhelmed by a very heterogeneous coalition of agri-biotech adverse interests" (Bernauer 2003).

The larger a group and the more heterogeneous is the more difficult is to mobilize (Olson 1965). Hence, environmental groups mainly focus on issues that provoke public outrage which frequently leads to maximum mobilization of membership and financial resources. Agricultural biotechnology has been an issue that provoked wide public outrage and the more critical or fearful a public has been the more successful environmental groups have been in mobilizing their memberships to protest for more stringent regulation on GMOs. As a result in countries that public fears are more intense, campaigns of environmental groups are more extensive and more successful (Bernauer 2003).

But what are the real incentives of consumer or environmental groups to oppose so fervently the new technology? Exaggerating their protests against GMOs and their interest in the environment, environmental/consumer groups have the opportunity to enhance their reputation as defenders of the public good, to activate their existing members, to attract attention by the media, to enlarge their members and increase their funds. In accordance with how active is the public participation and support, environmental groups are more effective in their actions against GMOs. For instance, they have the ‘power’ to boycott specific GM products, firms or even industries. Moreover, most of the times environmental/consumer groups are likely to influence producers’ attitude in the market place, resulting also in changes in policy-making (Bernauer 2003).

5.3 The public Sector

Apart from the private sector and the public interest groups the public sector is another set of stakeholders that has an important position in the political arena of GMOs. The public sector is referred to national governments and regulatory agencies, politicians and political parties and a large number of research institutions and committees that have any relation with any regulatory activity.

5.3.1 Government agencies

In contrast to the position of US government towards GMOs the EU suffered from a less integrated decision structure (Nelson 2001). Although some individual governments like the United Kingdom have taken a positive position towards biotechnology, at the EU level new technology and its potential trade opportunities were not a priority. In fact, environmental ministers exerted pressure on the European Commission for stricter standards regarding GM-derived products, resulting in a delay of all pending GMOs for marketing in the EU (Nelson 2001).

Since the mid 1990s, conflicts within the EU level regulatory committees, responsible for decision making on transgenic products, have been stronger. Some member states were looking for ways to ease public's fears for instance, through avoiding the use of relatively wider definitions of harm or trying to manage scientific uncertainties. However, these proposals were rejected by other member states and the European Commission as they were trying to facilitate approvals of GM products through narrow standards (Levidow et al. 1996). Therefore, in June 1998, several governments motivated by public protest against agricultural biotechnology blocked the EU regulatory procedure by imposing a de facto moratorium on the new releases of GMOs, which stimulated the EU institutions to develop a new policy framework (Levidow et al. 2005; Nielsen and Anderson 2001).

Member States within the EU play an important role in policy making regarding both environmental and consumer regulations, a role enhanced by the principle of subsidiarity. Especially in the case of GMOs, some of the most severe measures have been taken at the national level even under the opposition of the EU. "The dynamics of regulatory policy-making at the national level have created a race toward the top'', as governments are often competing either with themselves or the EU in order to act in response to public pressures by issuing standards that protect both the environment and human health (Vogel 2001). Furthermore, the influential role of the Member states in the regulatory policymaking has also given the chance of civic interests to place an issue on the European regulatory agenda, as any regulation issued by any Member State is placed on the agenda.

Generally, according to political economy approach, governments' decisions or policies are usually made in response to the pressures or incentives arising from various groups in society, like elections, campaign involvements, lobbies from pressure groups etc (Graff & Zilberman 2004).

5.3.2 The scientific community

Even in the scientific community, there are different views in the case of GMOs. While most of the scientists are in favour of genetic engineering as the most precise and fastest way of growing new crop varieties, there are also scientists that express their fears and doubts about the safety of transgenic crops to consumers and the environment. Despite the fact that some of the expected ecological changes are being tested, still the vast variety of outdoor environments cannot be accurately reproduced (Fincham and Ravetz 1990 cited in Nelson 2001).

Many research centres and international organizations face GM crops as the solution to the famine problem in developing countries. With the use of GMOs scientists are optimists of addressing nutritional deficiencies and improving food security in the Third World countries. In addition, according to what Gordon Conway, the President of the Rockefeller Foundation, had stated, 180 million children who suffer form vitamin A deficiency in developing countries would be benefited, 2 million dying each year from it would be save, and 2 billion people worldwide who suffer from anaemia would be relieved (Nelson 2001).

On the other hand, several scientists are concerned about the long term effects of transgenic crops on the food safety and the environment and suggest further assessment. For instance, the monarch butterfly has been an issue of much controversy about the hidden and potential risks of engineering crops.

However, a number of scientists are more concerned about patents or some economic aspects rather than the process of genetic engineering, and their assessments reflect their profits. Some other scientists for fear of losing their contracts with private firms do not dare to express their fears of the potential risks of transgenic crops (Bonny 2003).

Apart from scientists' contribution to scientific research, they also exert a significant influence on the policy making of GMOs, as in Europe policy-making usually reflects a scientific consensus between business and government experts. Moreover, according to SANCO, a Directorate of the European Commission responsible for the implementation of the EU laws on safety of food and other products, if decision making is based on science "protects against political indiscretion especially regarding precautionary measures" (interview DG SANCO 2002 cited in Smith et al. 2004). In addition, EFSA panels are supposed to act unbiased of any outside power and according to the DG-SANCO Commissioner, scientific advice is meant to be objective, independent of any policy considerations and with an aim to inform "a solidly science-based policy and increase consumer confidence" (Byrne 2002 cited in Levidow et al. 2005).

Nevertheless, some environmental NGOs accuse EFSA of being biased composed, as some of its members are publicly known as favourable and none has publicly criticised claims and concerns about transgenic products (Levidow et al. 2005). EFSA on the other hand, alleges that the choice of scientific experts is based on relevant prior experience. EU's policy framework for the agricultural biotechnology sector, gives emphasis to scientific evidence as the key to societal decisions. Furthermore, according to the Commission, risk regulation "is the expression of societal choices", control the market mechanisms so that unsafe products are not available to consumers.

6. EU regulations on GMOs

6.1 Introduction

In the early 90's the issue of regulating and governing GMOs at the EU level has been of great worry mostly because of the multi-level nature of the EU, the technical difficulties in the implementation of the policy because of the several existing policy domains (e.g. agriculture, research, consumer protection, environment and industry) and the fears regarding the potential risks of these novel organisms. Despite the initial efforts in establishing a regulatory framework, disputes became more intense under Directive 90/220/EEC regarding the reliability and accuracy of the measures for the release of GMOs into the environment (Borras 2006). More specifically, what was more controversial about the directive was its open-ended nature that allowed space to issues related to the approach to risk assessment, the broader explanatory area of the directive and the setting of the standards for the release of transgenic organisms to the market. All this disappointment and the disputes about this regulation among the member states ended up in a de facto moratorium in 1998 (Borras 2006).

Since then, the EU has been making great efforts to come up with solutions by revising the Directive 90/220/EEC. The new regulatory framework focused on specific GMO legislation, the precautionary principle and the creation of the European Food Safety Authority (EFSA). Directive 2001/18 provided more stringent and meticulous authorization procedure for GMOs than the last directive. Furthermore, Directive 1830/2003 amended Directive 2001/18 providing new rules regarding labelling and traceability. As for EFSA, it was created with a view to segregating the tasks between the risk assessment and risk communication (now taken on by EFSA) and the risk management (taken on by the Commission and the EU members) (Borras 2006).

6.2 Overview of the EU regulations on GMOs

Since the early 1990s, the EU[2] has been legislating on the authorization and the use of GMOs and the regulatory process has been highly politicized and contentious, with both the public and non-governmental organizations enjoying

[2] EU legislation is adopted under the cooperation of three main EU institutions: the European Parliament, the Council of the European Union (i.e the representatives of the EU Members at ministerial level) and the European Commission (Evenson & Santaniello 2003)

considerable access and influence (Vogel 2001). Initially, the EU attempted to create a uniform policy for all member states for approvals and trade in GMOs but this effort came apart very soon. The immediate spreading of anti-GMO views especially through mass media and the increased representation of the Green Party in both member state parliaments and the European Parliament brought the issue to the forefront of the political debate, which before long it became quite unpopular (Hochman et al. 2008).

EU supported transgenic crops under the Directive 90/220/EEC (in Table 6.1 some of the EC Directives and Regulations and their main points are presented), which granted eighteen authorizations for the commercial use of GM crops, cultivation, import and also the use of GMOs for food, feed and experimental purposes. Some member states though invoked the safeguard clause to prevent the use of the approved GM crops in their countries (Garcia 2006; Commission 1996). In fact, the opposition to GMOs was so strong that the Commission did not use the European Court to enforce its own laws. Before the Novel Foods Regulation, which was adopted in 1997 -under which Novel Foods [3] are subject to separate authorization and labelling- only one transgenic soy and one transgenic maize variety had been approved for use in food products under Directive 90/220 (Garcia 2004).

More specifically, in 1996, in spite of European Commission's approval of a variety of genetically modified maize Austria, Luxembourg and Italy banned the import and use of the maize in their countries, while France banned its cultivation for a small period (Barling 1997; Chataway and Assouline 1998 cited in Skogstad 2002; Seifert 2007). However, in June 1999 nine years after Directive 90/220 was passed, all new approvals of commercial GMOs were halted by the Council of Environmental Ministers (Skogstad 2002). In fact, it was established a de facto moratorium that meant to be maintained until the revision of the Directive 90/220. Denmark, Greece, France, Italy and Luxembourg announced to the European Commission that they would "take steps to have any new authorization for growing and placing on the market suspended" until the introduction of new legislation for the labelling and traceability of GMOs and GM-derived products (Sustainability Council of New Zealand).

In June 1997, under the Directive 97/35 the labelling of GMOs and the GMO-derived products becomes mandatory for the first time (Evenson & Santaniello 2003). Since then, labelling has been accepted by all companies although there were some objections in the beginning, and in 2004 new EU laws went into effect that

[3] "Foodstuffs consisting of GMOs or foodstuffs that are intentionally altered" (Evenson & Santaniello 2003).

established new requirements both for labelling and traceability (Hochman et al. 2008; Levidow et al. 2000). Thus, under the Regulation 1830/2003 requirements about labelling are set out for transgenic products, informing the consumer as well as the user of the product about the content of this specific product in GMOs. Generally, according to this regulation, all pre-packaged products made by or consisting GMOs should have the label: “This product contains genetically modified organisms” or “This product contains genetically modified [(name of organism(s)]” (European Commission 2006). For products, however, that are intended for mass caterers like quick service restaurants, hospitals, hotels etc. and are not pre-packaged “these words must appear on, or in connection with, the display of the product (European Commission 2006). Particularly, transgenic foods must be labelled, no matter if final products contain DNA or proteins derived from genetic modification. Highly refined products, such as oil deriving from genetically modified maize or soy are also subjected to the new labelling regulation. Similarly, these rules are also applied to animal feed when it includes any compound feed that contains GM crop (European Commission 2006). With regard to the conventional products that might be contaminated by authorised GMOs during the processing of cultivation, harvesting, storage or transport, these products are not subject to the labelling requirements unless they contain traces of GMOs more than a threshold of 0.9%.

In addition, Directive 1829/2003/EC under certain conditions allows the presence of some GMOs that although they have been approved of the EFSA regarding safety for the environment and health, they are not yet formally authorised. The content of a food or feed in these non-authorised GMOs, however, should not exceed a maximum of 0.5% and below that limit labelling is not mandatory (European Commission 2006).

In February 2001, the five countries (Denmark, Greece, France, Italy and Luxembourg) along with Austria, re-stated that they would persist in the moratorium regarding “new authorizations, pending the adoption of provisions on traceability, labelling and environmental liability” (Garcia 2006). At the same time, the European Parliament and the Council of the EU after agreeing on a compromise in December 2000, backed the text revoking Directive 90/220/EEC. That compromise ended in reconciliation which was endorsed by the Parliament by 338 votes for and 52 against and with 85 abstentions. Hence, in March 2001 the legal text was formally adopted as Directive 2001/18/EC (Garcia 2006).

The main differences between Directives 90/220/EC and 2001/18/EC are that the New Directive 2001/18/EC includes provisions for “assessing indirect effects of particular GM crops on the environment and the requirement for the post-commercialization monitoring of environmental impact” (Dale 2002). In fact, biotechnology companies were annoyed by the slow progress until the commercialization of GM crops while the regulatory process had baffled some of the public members (Dale 1999 cited in Dale 2002). Therefore, the EU regulatory system could be characterized as a process based rather than product based that is, the regulatory framework is determined by the way something is made. However, such process-based labelling might be more liable to deceit (Nap et al. 2003).

Directive 2001/18/EC includes some noteworthy provisions, such as:

- The gradual repealing of antibiotic resistance genes;
- The assessment of GMO possible risks under the ‘precautionary principle’;
- The inspections and the conduct of compliance measures by responsible authorities;
- The prerequisite for tracing GMOs at all stages
- The opportunity of a member state to restrict or abolish an already approved GMO in case that further information provides ‘detailed grounds for considering that a GMO… constitutes a risk to human health and/or the environment ‘;
- The fact that Member States can review GMOs taking into account also ethical aspects (Jaffe 2004).

The objective of this Directive is to protect human health and the environment, under the release of a GMO into the environment and in accordance with the precautionary principle (Garcia 2006). The “precautionary principle”, which is the basis of the risk management, has its origins in German environmental legislation of the 1960s and it “emphasizes a cautious approach to adopting a new technology when existing scientific understanding is incomplete or when there is not a consensus about the nature of the threat” (EU Briefings 2007). That is, according to the precautionary principle the technology developer is responsible of the safety of any new technology that emerges.

In addition, according to Directive 2001/18/EC, everyone who intends to place a GMO on the market is obliged to include in his/her application to the competent national authorities, a post-market monitoring plan so as to identify any possible impacts on the environment and human health caused directly or indirectly from the release of GMOs (Sanvido et al. 2005; Evenson & Santaniello 2003; EC 2007). Then, the national authority in order to make an assessment report that will next be considered by the Member States, it has to carry out its own research (Evenson & Santaniello 2003; EC 2007). In case that the national authority does not approve of the specific GMO, it will explain the reasons in its assessment report and reject it. If it approves of that GMO's placement on the market it is possible to face the objections of the competent authorities of the other member states or the Commission (Evenson & Santaniello 2003). In that case the Commission will arrange meetings so that the Member States, the Commission and the notifier will reach an agreement. But if there are no objections then the authorised product, whose authorization lasts for maximum ten years, can be placed on the market throughout the European Union and individual Member States cannot veto such approvals (Evenson & Santaniello 2003; EC 2007). Nevertheless, if there is a scientifically based assessment that the product may harm people or the environment then they might forbid the dissemination within the country but only temporarily (Evenson & Santaniello 2003).

Although Directive 2001/18/EC was adopted the moratorium did not come to an end mainly due to its lack in providing a complete framework for traceability. On the 7 November 2003 new EU laws went into effect in regard to the approval of GM crops, GM food and feed as well as the establishment of new requirements for labelling and traceability and became legally binding on 18 April 2004 under the Regulation 1829/2003 (Hochman et al. 2008; FSA 2005). On May 19th 2004 the approval of GM-maize for human consumption was a first indication that the moratorium was breaking up. Also labelled GM products, according to the new regulations, were possible to start appearing in the food shops in the coming months and years (EC 2008).

Generally, Regulation 1829/2003 includes all the rules concerning food/feed produced or containing GMOs and having as principles that GM food/feed must not:

- be harmful for humans, animals or the environment;
- mislead the consumer;
- be different from the food/feed that is meant to be substituted so that its normal consumption would be disadvantageous for the consumers/animals
- in the case of GM food and feed, "harm or mislead the consumer by impairing the distinctive features of the animal products" (Food Quality News 2004; EUROPA).

The GM food and feed regulation (1829/2003) "provides a harmonised procedure for the scientific assessment and authorisation of GMOs and GM food and feed" under the responsibility of the European Food Safety Authority (FSA 2005). In this procedure the role of the Commission is very essential related to the approval or rejection of the authorisation.

To be more specific, applications including a labelling proposal, a monitoring plan, a detection method and a reference material, are first submitted to the competent authority of the Member State which in its turn within 14 days has to inform EFSA. EFSA is responsible for both the scientific risk assessment of the environment and human and animal health and in a period of six months, which may be extended if supplementary documentation is requested, EFSA will publish its opinion so that the public will have the chance to make any comments. From the moment that the Commission receives EFSA's opinion it has three months either to accept it or refuse the authorisation. But Commission's decision will be adopted only after the majority of the representatives of the Member States composing the "Standing Committee on the Food Chain and Animal Health", give their consent. If they do not, then Commission's proposal is submitted to the Council of Ministers, which has three months to act and also reaching a qualified majority, or else the commission's decision comes into effect. In the event that the European Council of Ministers rejects the Commission's draft then the Commission must revise it. (EC 2007; GMO Compass 2006).

6.3 Coexistence regulation in EU

Since farming takes place in an open environment, it is quite possible that GM crops may be mixed with non-GMO crops triggering off economic implications as the two types of crops have different prices on the market. Therefore, the institution of sufficient and cost-effective coexistence measures is essential so that the GM and non-GM crop production will take place under the legal standards applicable at Community level (EC 2006).

The coexistence of GMOs with conventional and organic agricultural production refers to the ability of consumers and agricultural producers to "respect individual preferences and economic opportunities, in compliance with the legal obligations regarding the labelling of GMOs" (EC 2009).

After allowing the cultivation of only authorised GMOs in the EU and securing the safety of the environment and human health under the Directive 2001/18/EC on the deliberate release of GMOs into the environment and Regulation (EC) No 1829/2003 on GM food/feed, the issues that remain unaddressed regarding coexistence, are the economic aspects of the coexistence of GM and non-GM crops and the appropriate measures to sustain segregation (EC 2006).

In 2003, the European Commission stated that "no form of agriculture, be it conventional, organic or agriculture using genetically modified organisms (GMOs), should be excluded in the European Union" and on 23 July 2003, adopted Recommendation 2003/556/EC, a legal framework that would help Member States to develop national legislative or strategies in order to ensure the coexistence of GM crops with conventional and organic farming (CEC 2003a,p.1 cited in Beckman et al. 2006).

Table 6.1 *EU Directives and regulations (main points) for GMOs*

Title	Main Points
Directive 90/219/EEC (entry into force 23/10/1991) Contained use of GM Microorganisms	▪ Measures for limited use of GM micro-organisms. ▪ Not applicable to certain techniques of genetic modification. ▪ Measures for avoidance of adverse effects in human health and environment.
Directive 90/220/EEC (entry into force 23/10/1991) Deliberate release into the environment of GMOs	▪ Protective measures for human health and environment. ▪ Not applicable to certain techniques of genetic modification. ▪ Activities of Member States for deliberate release into the environment of GMOs for research, development and market placing purposes.
Directive 2001/18/EC (entry into force 17/4/2001) Deliberate release in to the environment of GMOs	▪ Measures of authorization of the release and disposal on the market of GMOs. ▪ Obligatory controls after the disposal of GMOs on the market. ▪ Consultation with the public and labelling of GMOs.
Regulation (EC) No.1829/2003 (entry into force 7/11/2003) GM food and feed	▪ Measures for human and animal health protection, Community procedures of approval, inspection and labelling of GM food and feed. ▪ Approvals are applicable for 10 years with the potential of renewal.
Regulation (EC) No.1830/2003 (entry into force 7/11/2003) Traceability and labelling of GMOs and traceability of food and feed products produced from GMOs	▪ Traceability of products consisting of, or containing GMOs and foodstuffs, feed produced from GMOs. ▪ Application for all stages of disposal on the market. ▪ Specific demands on labelling.

Source: Dona and Arvanitoyannis, 2009

Since then, Member States in order to ensure coexistence started implementing or developing ‘ex ante’ coexistence regulations and ‘ex post’ liability schemes (Devos et al. 2008). Ex ante regulations are considered the regulations that have to be followed by the farmers that want to plant GM crops and ensure that products that are supposed to be GM free may contain authorised GM material in compliance with the legal tolerance threshold (Beckman et al. 2006; Devos et al. 2008). Contrary to ex ante regulations, ex post liability is backward-looking. Specifically, it includes not only the possible costs that occur after farmers’ cultivation of GM crops but also the damages caused by the admixture with GM crops (Beckman et al. 2006). Most European countries being on non-GM farmers’ side, have adopted ex post liability rules making it easier for them to claim compensation for damages (Beckman et al. 2006). For example, in the case of Luxembourg GM farmers were fined with 750,000€ because they didn’t comply with the regulation.

6.4 Current Rules on genetically modified varieties and seeds

As for the legislation relevant to genetically modified varieties and seeds, Directives 2002/53/EC and 2002/55/EC regulate the “marketing of seed of varieties of agricultural plant and vegetable species” (EC 2007). Each variety of seed that national authorities have allowed for use in their territory must be accepted by the Commission and as long as it meets Community’s criteria it may also be included in the national catalogues. Furthermore, under these Directives GM varieties before they are placed on EU market, they have to be authorised particularly according to Directive 2001/18/EC (EC 2007). But if the seed is going to be used in food, then it also has to be authorised according to the GM food and feed Regulation.

In addition, European Commission is also responsible for inspecting whether an inclusion of a GM variety in a national list is in accordance with Community legislation. In case that the particular variety complies with legislation, it can be included in the Common Catalogue of Varieties and as extended the seed of such a variety can be marketed within the EU.

6.5 National Bans on GMOs

A number of countries in the European Union have invoked the so-called ‘safeguard clause’ under the Directive 2001/18/EC. As it has already been mentioned, in cases that Member States invoke this clause, they may temporary restrict or prohibit the use and/or the sale of GM products in their territory. Nevertheless, each

Member State that has decided to ban GMOs must present some proofs that justify its considerations that the particular GMO poses a risk to human health or the environment. Currently, the Member States that apply safeguard clauses on GMO events are: Austria, France, Greece, Hungary, Germany and Luxembourg (EUROPA).

Austria is the country that fought GMOs more intensively than any other country in the EU. Since 1999, Austria has been banning both the marketing and cultivation of MON 810 maize, as well as GM animal feed and it has also been banning Germany's Bayer AG's T25 GM corn (which is no longer authorised for cultivation in the EU)(Deutsche Welle 2009). The European Commission at the end of 2006 started exerting pressure on Austria to lift its ban as it was applied on products that had already been approved and sold actively. Finally, on the 27th of May 2008, Austria for fear of being prosecuted was compelled to lift its marketing ban. However, the cultivation ban is maintained and large supermarket chains "have entered a voluntary agreement not to offer GMO-derived food products" (Food & Water Europe 2008). The livestock industry of Austria's is also against the using of MON 810.

Furthermore, at the end of June 2009 Austria tabled a proposal at the Environment council in Luxembourg, which was also signed by Greece, Bulgaria, Hungary, Ireland, Slovenia, Malta, Latvia, Lithuania, the Netherlands and Cyprus and supported by France, Poland, Portugal, and parts of the German government, that although EU may continue to approve genetically modified plants under the existing regulations, each Member state should be able to ban the cultivation at a national level (GMO Safety 2009; European Biotechnology News 2009).

Hungary was the first post-Soviet country that decided to ban MON 810, in the beginning of 2005 and in November of that year, was as severe as to send six truckloads of GM corn from Croatia back to their land of origin (Rahn 2009). The Agriculture Ministry of Hungary alleged that more tests were necessary in order to verify the safety of MON 810 and expressed its concerns on the potential impacts on the soil biology and on target and non-target plans (GMO Compass 2008). The European Commission in its latest effort to force both Austria and Hungary to lift bans on GM maize was defeated. In fact the EC has attacked two times Hungary for refusing to grow GM maize (Natural Choices 2009). Nevertheless, EU Agricultural Ministers have voted three times to maintain the ban (Food & Water Europe 2008).

Greece is firmly and almost unanimously opposed to GMOs as genetically modified crops grown, sold or eaten are unwelcome. In 2004, the Greek Parliament set a national ban on GMOs, but it was not accepted by the European Union which characterised it as an illegal trade barrier (Rosenthal 2006). The Greek government to justify its decision invoked safety risks based on “scientific” evidence (Leonard 2007). In the early 2006, the EC forced Greece to lift the ban, but statements like: “The environment minister who gives in and allows GMOs into this country will never be minister again”, said by the head of the largest Greek farmer union, Nikos Lappas or “For farmers, forcing GMOs would be economic suicide, since our Market doesn’t want them”, showed that Greece were not ready to permit the introduction of GMOs (Rosenthal 2006; Food & Water Europe 2008).

The Table below, shows the results of a project about regulation and prohibitions of Greece on genetically modified crops and foods, conducted by the centre for food safety in 2006.

Table 6.2 *Greece’s regulations and prohibitions on GMOs*

Protocol on Biosafety	***Labelling requirements***	***Ban or Moratorium on commercialization***	***Ban on Imports***
Ratified	EU Compliant	Jan 2006: European Commission ruled article 18 was not applicable and ordered Greece to lift its ban (Commission Decision 2006/10/EC). Greece refused and instead placed an 18- month extension on the ban, expanding it to include 31 varieties of MON810. April 2005: Greece banned 17 varieties of MON810 using the safeguard clause (article 18 in directive 2002/53). September 1998: Greece banned a variety of GM rapeseed using the safeguard clause in EU legislation (article 16 in directive 90/220 or article 23 in 2001/18).	September 1998: Greece banned a variety of GM rapeseed using the safeguard clause in EU legislation (article 16 in directive 90/220 or article 23 in 2001/18).

Source: The Centre for Food Safety, 2006

France banned the cultivation of MON 810 for the first time in autumn 2007 however, the ban ended a year later in February 2008 and then it was renewed also by the consent of the French Constitutional Court. The government in order to justify its position it invoked the "safeguard clause" of the EU's Directive 2001/18/EC, under which each country has the right to impose a national ban on a GMO in case that it can provide scientific evidence for its harm to public health or the environment. According to the chair of France's Provisional High Authority on GM Organisms, there is evidence that MON 810 has an adverse effect on insects, earthworms and microorganisms (Food & Water Europe 2008).

European farmers and in particular farmers in **Germany** are more reserved towards GMOs. Recently, Monsanto, the world's biggest seed company, "has filed a suit against the German government's decision to ban GMO maize" due to the lack of new scientific evidence and the breaking of the EU rules. In fact, a Monsanto spokesman, Andreas Thierfelder, declared that member States that have imposed ban on GMOs "They are in conflict with EU rules" (Kuehnen 2009). The association of German seed producers accused the decision of being arbitrary and against Germany's future research prospects (Hogan & Severin 2009).

On the other hand, the German Agriculture and Consumer Protection Minister Ilse Aigner, alleged that the decision to ban MON810, which was also backed by BUND, a German environmentalist association, was based on scientific factors and not on political one (EurActiv with Reuters 2009; Hogan & Severin 2009). In addition, Greenpeace urged Aigner to work inside the EU to put an end to further approvals of GMO maize (Hogan & Severin 2009). Therefore, the EU Commission has vainly tried to lift the bans in other countries and promised to analyze Germany's ban based on sufficient scientific information and then decide on how will handle the situation.

Since 1998 the EU has not approved any modified plant, until March 2010 that finally approved the cultivation of the Amflora potato, developed by the German chemical company, BASF (GMO Safety 2010). Despite the pressure from several German environmental associations, the German representation in the EU Council voted for the cultivation approval, while Minister Aigner declared that "no safety concerns exist" (GMO Compass 2010).

Luxembourg figures among the most opposed to genetically modified plants countries in the EU. And until now no GMOs have been cultivated, not even as field trials (Hoffmann 2006). In addition, consumer organisations are not only opposed to GM foods in general, but also express their anxiety that the potential admixture of foods with GMOs to a certain extent would deprive them of their right to choose. Furthermore, both organisations of organic farmers and environmental NGOs share the views of the majority of consumers that is the exclusion of GM plants from Luxembourgish agriculture (Hoffman 2006).

After Austria, Hungary, Greece and France, the Grand Duchy of Luxembourg decided to impose a ban on Monsanto's GM maize. Luxembourg based its national prohibition on recent studies that "don't allow concluding that MON810 is completely innocuous" (Newsfood.com 2009). Furthermore, apart from the scientific and environmental reasons political reasons also contributed to banning MON810, as according to a recent survey 83% of Luxembourg people are against GMOs.

Although **Romania** had been very much in favour of biotechnology industry and before its entrance in the EU had been growing significant amounts of GM soy that were not approved by the EU, in January 2007 in order to comply with the EU regulation Romania had to ban GM soy. In addition, in March 2008 Romania surprised with its declaration that it will go GMO-free and that it will turn to organic production (Food & Water Europe 2008). However, the ban failed due to the lack of support from the Minister of Agriculture and the Biosafety Commission (Pelc 2009)

6.6 GMO-Free zones

In the EU more than 260 regions, over 4,500 municipalities and other local entities and tens of thousands of farmers and food producers have expressed their opposition to GMOs and do not permit the use of GMOs in agriculture and food inside their boundaries, declaring themselves "GMO-free" (EU Conference 2009). These regions include, for instance, all cities and villages in Greece and Austria and 90% of al land in Italy (Figure 5.1). However, in these GM-free zones farmers can still plant GM crops as long as they are legal, since they are not legally binding but they constitute mostly an expression of citizens' position towards GMOs (Food & Water Europe 2008).

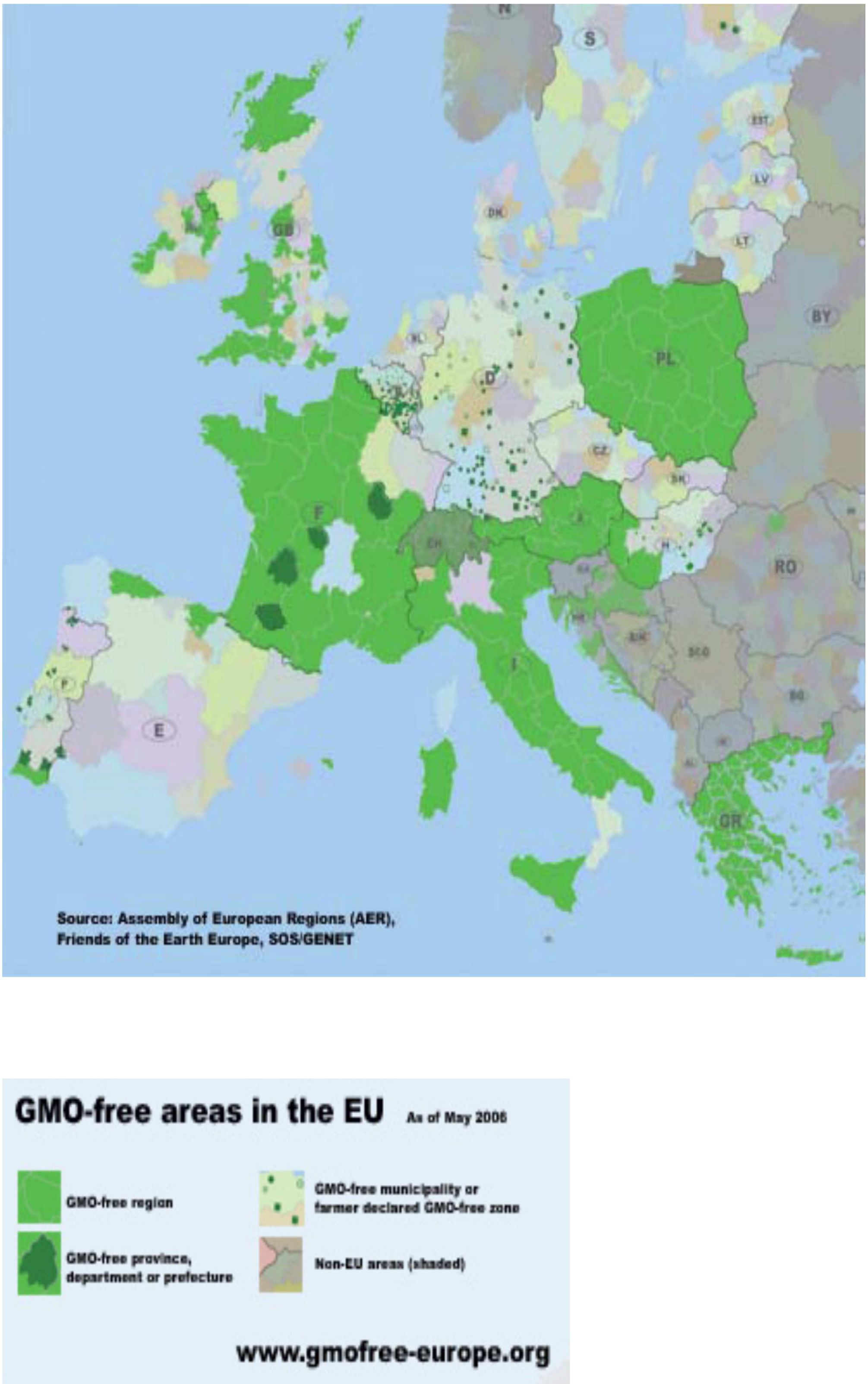

Figure 5.1 *The GM-free zones in the EU*

7. The Case of Greece

7.1 A physical and historical background

Greece with a total land of 132 thousand square kilometres, consists of a mainland and islands, that account for 81% and 19% respectively of its total land. All the inhabited islands are 217 and the coastline of Greece extends to more than 15 thousand kilometres, shaping a significant series of bays and head lands. The biggest part of the mainland in Greece is covered by mountains due to the extension of the Balkan peninsula, while on the western side of Greece the Epirus mountains constitute the mountainous backbone of the country. Most of the mountain summits range from 2000 meters and more, resulting in vary large altitude differences. From the eastern part of Greece in Thrace to the southern part in the island of Crete the central mountain range is crossed by smaller and bidder rivers basins, with the biggest rivers being Evros, Nestos, Strymonas and Axios which originate either from the Former Yugoslavia Republics or Bulgaria (Damianos et al. 1998).

The climate of Greece in areas with low altitude is Mediterranean characterized by dry and hot summers with strong maritime influence, as 90 kilometres is the biggest distance that each part of Greece has from the sea (Damianos et al. 1998; Livada & Assimakopoulos 2006). However, in mountainous areas of North, Central and South inland Greece, the climate is typical mountainous whereas, winters on the islands and along the west coast are mild. In Western and Southern Greece frosts are rare and usually they occur for no more than 30 days (Damianos et al. 1998; Livada & Assimakopoulos 2006). Summers are hot and dry with a mean temperature of 26º or 27º C and sometimes heat exceeds 40º C. During Autumn the average temperature is 23º C with sunshine. The mean annual precipitation in Greece is about 900 mm, but not evenly distributed among the places and especially among the western and eastern parts of the country. To be more specific, because of the alpine chain of Pindos and the mountains of the Peloponnese, the Western part receives more rainfall than the eastern part which receives annually at least 200mm less rainfall (Livada & Assimakopoulos 2006). However, even the valleys in the east of mainland Greece that are the largest and most intensively cultivated in whole Greece are in the need of irrigation and that of course constitutes a significant constraint to the agricultural development (Damianos et al. 1998).

As for the soils suitable for cultivation they consist only about the 30% of the country's area. Around 30% of the country's area is evidently eroded, due to the exposure of the steep slopes and hilly areas to summer drought, heavy autumn and winter rains, as well as the to more than 1,000 torrents. However, nowadays soil erosion is at large extent attributed to the numerous and wild land fires, overgrazing and not proper land use. Forests occupy 3.6 million hectares or about 25.5 % of the total land area of Greece with the main part of this being loosely spaced pine woods whereas the few tall forests survive on the most inaccessible and rainiest mountains of the country (Diamianos et al. 1998; Aperghis & Geathlich; 2006).

After Greece declaring the revolution against Turkey in 1821, the modern Greek state gained its autonomy in 1987. After the boundaries changed as a vast amount of land was added to the newly created Greek state. Under a persistent pressure from landless peasants, subsistence farmers and small tenants for land distribution, the state after 50 years of resistance finally succumbed. In 1871, an extensive land distribution took place, under which each Greek adult had the right to apply for a plot of national land and until 1911, almost 320,400 ha had been distributed to 387,137 appliers "with an average size of 1 ha for arable land and 0.3 ha for plantations and an overall average size of 0.82 ha" (Anastasiades 1911; Stefanides 1948; Vernicos 1973 cited in Damianos 1998). As a result of this land distribution around the 80% of the rural population became land owners of some kind.

Second World War and the following civil war had devastating results on the economic life as well as the population in many areas, especially Northern Greece that lost most of its resident population. Additionally, after the wars the levels of agricultural production fell significantly and the biggest part of the agricultural infrastructure had sustained severe damage. Only under the help of the U.S. in 1948, did the Greek economic recovery start, most of which focused on the agricultural sector. Along with large drainage, and irrigation schemes that came into effect near the largest rivers of the country, the 50,000 tractors and other agricultural machinery were introduces by the United Nations Relief and Works Agency (UNRWA) (Damianos et al. 1998). Consequently, after 1960 the agricultural production in Greece started growing gradually focusing on the cultivation of cotton, tobacco and citrus and fruit plantations. What gave a boost to the agricultural production was not only the adoption of the new technology and the introduction of fertilizers and pesticides but also the adoption of new agricultural policies like vast credit provisions or protective price policies (Damianos et al. 1998). Nevertheless, the post war period due to surplus labour, was accompanied by the exodus of around 1.5 million farmers, 60% of whom immigrated to western Europe, mostly in Germany, and the rest immigrated mostly to Athens (Carter 1968; Dicks 1967; Wagstaff 1968 cited in Damianos et al. 1998).

Since the early 1960s and until the entry of Greece in the European Union in 1981, national agricultural policy had adopted several measures like price supports, in order to deal with the inequalities between the various classes of the population and between regions. Additional measures had been taken to face the problematic farm structure with the main points being, an increase in the average size of farms and consolidation of the fragmented parcels of land (Damianos et al. 1998). Changes in the agricultural production focused on the creation of large-scale industrial orchards, the adoption of genetically improved varieties, the cultivation of new plants, like sugar beet or fodder plants that could also support the livestock sector and the reduction or at least the stabilization of cereals (Damianos et al. 1998).

7.2 The current situation in the agricultural sector

Out of the 13.2 million ha of the total land of Greece, 30% is devoted to crops, 40% to pasture and 20% to forestry (EAAP 2010). The last few years the agricultural production in Greece has exhibited an obvious decreasing trend. While in 1998 the contribution of agriculture to GDP was around 7.7%, in 2004 it was reduced in 4.3% and according to the National Statistical Service of Greece (NSSG) today the agricultural sector accounts for 5.6% of GDP (Alexiadis et al. n.d.; kathimerini 2010[a]). Additionally, in 2005 according to NSSG almost 30% of the total land of Greece was cultivated and the remaining being fallow land. The main products produced are sugar beets, wheat, maize, tomatoes, olives, olive oil, grapes raisins, wine, oranges, peaches, tobacco, cotton, livestock, dairy products (Bureau of the European and Eurasian Affairs 2009; Alexiadis et al.).

The percentage of people working in agriculture is continuously declining, as more and more young people prefer to move to civil centres and abandon rural areas. According to NSSG in 2005 the share of employment in agriculture in relation to the total economically active population was 12.4% while in services was 65.2% and in industry 22.4% (RSE 2006), while in 2004 the percentage of persons employed in agriculture was 15% (Central Bureau of Statistics 2004).

As for the livestock sector in Greece, it represents approximately one third of the total value of agricultural production. Dairy sheep (8 millions) and goats (5.5 millions) are considered the most important in the livestock sector with an also long continuity of the ancient tradition. “The self-sufficiency of the country in products of animal origin is 28% in beef meat, 40% in pork, 82% in sheep and goat meat, 76% in poultry, 50% in cow’s milk and milk products, 100% in sheep and goats milk, 97% in eggs and 87% in honey. Greece is also the European leader in aquaculture with high exports". (EAAP 2010).

7.2.1 Yields and production of major crops in Greece

Some of the most important crops in Greece that in other countries are grown as genetically modified are shown in Table 7.1. GM rice however, although it has not been used yet, it is on its way to fields in several countries. Cotton and maize production is a significant part for Greek farming and high yields were mostly attributed to irrigation facilities and wide use of chemicals (Katranidis 2002).

Cotton has been one of the most significant crops for Greek farmers mostly due to EU's subsidies, but since 2005 its production has declined after the new CAP. Both the cultivated area and the prices of cotton decreased significantly (Table 7.1). Regarding maize, also very important for the Greek agriculture, its cultivated area in 2009 seems to be on the average levels of the previous years, while there is an increase in maize gross production in years 2007 and 2008 due to rise in prices (Hellenic Ministry of Rural Development and Food).

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Table 7.1 *Area, yields and gross production of the major crops in Greece*

Year	*Rice area (1000ha)*	*Cotton area (1000ha)*	*Area maize (1000ha)*	*Rice yields (1000tons)*	*Cotton yields (kg/ha)*	*Maize yields (1000tons)*	*Rice gross production (1000euro)*	*Cotton gross production (1000euro)*	*Maize gross production (1000euro)*
2002	21.4	360.5	218.2	7,831.4	3,138.7	10,052.7	46,816	995,720	329,025
2003	24.6	367.1	262.7	6,796.7	2,647.7	9,197.3	49,410	1,001,160	338,248
2004	25.9	383.8	251.4	6,455.6	3,269.4	8,790.8	42,000	1,104,206	287,300
2005	23.1	363.0	241.0	7,238.1	2,606.0	9,000.0	30,702	851,400	281,970
2006	23.1	380.4	179.0	7,238.1	2,012.2	9,200.0	43,440	237,274	230,552
2007	25.7	338.7	190.5	6,505.8	1,972.6	10,120.2	50,175	280,636	424,138
2008	27.0	284.2	240.0	6,192.6	2,357.8	10,300.0	60,096	134,000	444,960
2009	29.0	233.0	240.0	5,765.5	2,575.1	9,800.0	-	-	-

Source: Hellenic Ministry of Rural Development and Food

7.2.2 Agricultural income

The agricultural income in Greece has been constantly declining the last 12 years. In 2006 it declined by 13.4% mainly due to the decrease in the value of crop production (-11%) and intermediate consumption (-14.7), particularly fertilizers (-10%) and pesticides (-11%). However, in 2005 agricultural income increased, resulting primarily from a reduction in agricultural labour input. Intermediate consumption eats up almost half of the agricultural output value (Kagkou 2008).

For the period 2004-2008 the cost of production increased twice as much as the prices of producers increased, resulting also in the decrease of agricultural income. According to the most recent data available from the Hellenic Statistical Authority (EL.STAT) (12.8.2009) for the period of July 2008- June 2009, it was noted a reduction in producer prices by 4.5%. On the other hand, the overall output, which reflects the cost of production, noted at the same time a further increase of 0.4% (Stampoglis 2009). Figure 7.1 shows the decline in the Greek agricultural income, indicated by the deflated net value added at factor cost divided by annual working units.

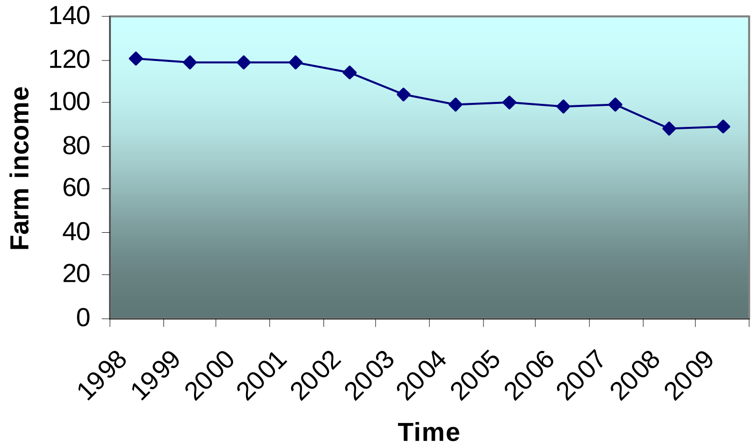

Figure 7.1 Agricultural income *indicated as a deflated net value added at factor cost divided by annual Working units for Greece the past 12 years*
Source: EUROSTAT

7.2.3 Imports and exports of maize and soybean in Greece

Although Greece produces large amounts of maize, it imports every year several amounts of maize not only from the EU but also from non EU countries. Figure 7.2 shows five of the biggest maize exporters to Greece during the last decade. Since 1998 and until 2004, France was the biggest exporter to Greece, while since 2005 Greece started importing from Hungary amounts that reached 524,002 tons in 2005 (FAOSTAT 2010). However, Greece prefers to import maize from the European countries rather than American. It is also obvious in Figure 7.2 the small amounts of imports coming from Brazil and even smaller from the USA (FAOSTAT 2010). Generally, since 2005 imports of maize seem to decline according to the latest data from FAOSTAT, as in 2007 the biggest amount of imports came from Hungary and reached 293,648 tons.

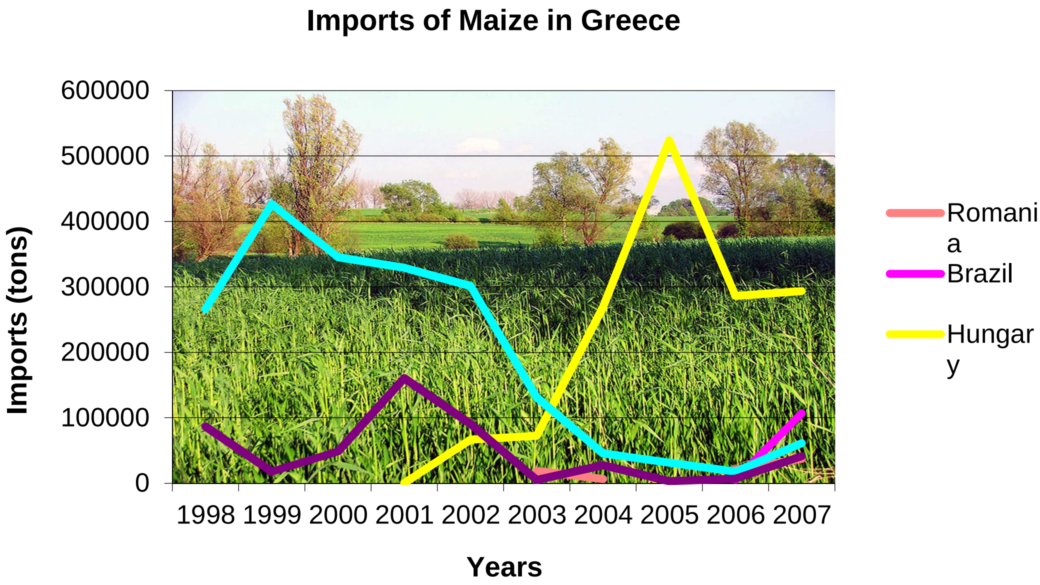

Figure 7.2 *Imports of maize in Greece the last decade (FAOSTAT 2010).*

In the 1990's the US was the sole supplier of Greek crushing and feed industries mostly with soybeans (GM and non-GM soybeans mixed) and soybean meal. In fact, in the 1990's the Greek imports in soybeans from the US were approximately 350,000 tons per year, while in 2003 and 2004, total soybean (and meal) imports annually, reached 390,000 tons, and only the 45% originated in the US, followed by Brazil and Argentina (Sekliziotis 2005).

Most of the needs in soybeans in Greece are covered by imports most of them coming from Latin America and the USA. Argentina, Brazil, Paraguay and Ukraine are some of the biggest exporters of soybeans to Greece. However, as it is shown in Figure 7.3 USA has been by far the biggest exporter. In 2001, the imports from the USA reached 187,541 tons but since that time they had some steep declines, one in 2005 (38,014 tons) and one in 2007 (1,600 tons), probably due to the rise in soybean prices since 2003. Imports coming from Argentina have been reduced since 2005, while imports coming from Paraguay started rising. Although, Latin American countries and the USA are well known for the large productions of GM maize and soybean, Greece seems to prefer to import these cereals from them.

Furthermore, Brazil the third country after USA and Argentina in growing GM crops is now the biggest exporter of soybeans in Greece. According to the latest data of FAOSTAT, in 2007 Greece imported 166,297 tons of soybeans. Ukraine, the only European country that Greece imports significant amounts of soybean is also raising its exports to Greece.

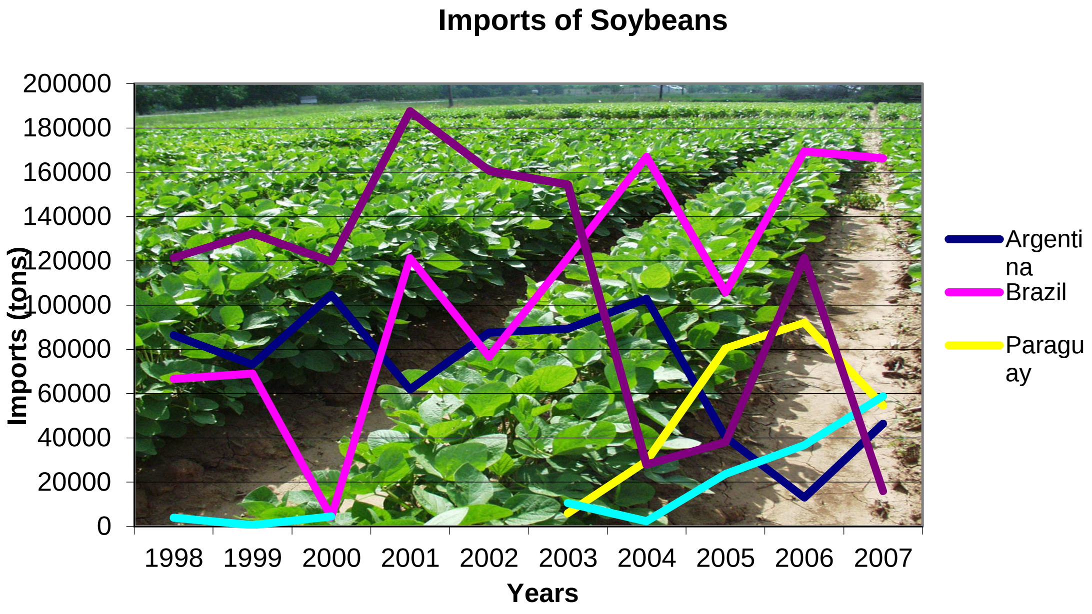

Figure 7.3 *Imports of soybeans in Greece the last decade (FAOSTAT 2010)*

7.3 Biotechnology in Greece

Greece showed interest in biotechnology for a first time in the early 1980's (Marouda-Chatjoulis et al. 1998). Before that time, neither politicians nor the Greek public were concerned about biotechnology. In addition, compared with the other European countries, the Greek state was rather late in promoting research in biotechnology. While in the early 1980's the Greek scientists were instigating debates over biotechnology, always in an informal level, the Greek public remained absent from any technological innovation and largely uninformed about modern biotechnology and its applications until the mid 1990's. After that period, in the advent of GMOs controversy several NGOs like Greenpeace organized their first protests against genetically modified foods while the Greek public was increasingly concerned and anxious about the GM food production and cloning (Botetzagias et al 2004).

Greece is the only inactive country among all the EU members as it is the only one that has not any biotechnology start-up companies, despite the worldwide increase in research programmes and high interest in the applications of biotechnology. What is more, the Greek society is generally opposed to GMOs and in 1998 among seven counties, Greece demanded for a moratorium on GMOs. In 2003, Greece refused to reverse the moratorium while it has signed the Cartagena Protocol on Biosafety in 2000. Although there are some proponents of transgenic products, Greek governments along with the local authorities, scientific cycles and social organizations have strongly supported the traditional cultivations (Tolios 2009).

7.3.1 Biotechnology Policy

Greece has been a parliamentary democracy following the political reform and the collapse of the military dictatorship (1967-1974). In almost all big international conflicts of the century Greece was implicated in, mostly due to its important geographical position. Greece has become a member of all important International Organizations (United Nations, UNESCO etc). Additionally, Greece is a founder country of the Council of Europe, since 1961 member of NATO, and since 1981 member of the European Union (EC 2008).

As for the law making in Greece the legislative role belongs to the Chamber of Deputies. Roughly all laws are based on initiatives of the government. More specifically, project-laws are sent to the chamber by the executive power (ministries) and normally voted by that body. In order to adopt a law a simple majority (50+1) of the votes cast is sufficient. Therefore, the role of the government in regulation and its diffusion in science and technology is very significant and all laws in Greece are constitutional. “Directives concerning their interpretation are issued by the ministries. The administration of justice is exercised through an independent judiciary and a system of civil, criminal, and administrative courts. The Supreme Court hears appeals from the decisions of lower courts. The constitutional court determines whether a law is constitutional in case of conflicting decisions between other courts or administrative organs” (EC 2008).

Since the early 1990’s the policy making of Greece has focused on the reorganization of the research system as well as the knowledge provision, guided mainly by the EC policy directives and the research programmes funded by the EU. More specifically, considerable emphasis has been placed on the creation of scientific infrastructure, the promotion of biotechnology R&D activities and also the enhancement of the collaboration between industry and academia under the adoption of three structural programmes for the period of 1989-1999 (Botetzagias et al. 2004). However, until 1998 these research programmes covered all possible biotechnology areas rather than targeting the development of a specific sector (Bousios & Senker 2005).

A review of the funds distributed only to competitive programmes has shown that 60% of the funds were allocated to medical biotechnology projects, reflecting the higher quality of research in that field (Bousios & Senker 2005). The achievement of close interaction between public sector, research organizations (PROs) and industry is still very limited and the transfer and diffusion of technology unsuccessful (Caloghirou & Zambarloukos 2000). This is possibly attributed to the fact that the majority of the Greek firms are small and medium sized and also lack qualified and experienced scientists and engineers (Gibbons and Johnston 1974; Cohen and Levinthal, 1989 cited in Bousios & Senker 2005). Also, due to the lack of national grants for biotechnology research, researchers prefer to work for international research networks rather than for projects of national importance. The limited market, due to the small population of Greece and the neighbouring with relatively poor countries with traditionally low investment in modern technologies, also explains the "limited dimensions" of this sector (EC 2008).

The advent of the new applications of biotechnology soon was covered by the media and instigated the first concerns of the public about the potential risks and moral issues. For instance, when the issue of the cloning of Dolly came to the forefront along with the permission for experimental cultivations (see section 7.3.5) soon mobilized the protesting from several NGO's and consumer groups, leading to the suspension of these cultivations. In parallel, a number of EU directives were incorporated into the Greek law instead of making an effort to promote public familiarity with biotechnologies. These were, the EU directive 90/220 about the deliberative release of GMOs into the environment and the EU directive 90/219 for the restricted use of transgenic micro-organisms, both in 1995 (Botetzagias et al. 2004; Authors 2004).

In 1996, a committee competent for the supervision of the implementation of these directives was established, which is composed of representatives from the Ministry for the Environment, Planning and Public Works; the Ministry for Health; the Ministry for Agriculture; the General Chemistry Laboratory of the State; the Ministry for Development; and two scientific experts (Caloghirou & Zambarloukos 2000 cited in Botetzagias et al. 2004).

During the period of 1993-1997 the new transgenic products, especially in agriculture, caused the debate to change as apart form scientists new stakeholders started taking part in it. Specifically, in 1993 the Ministry of Agriculture made an attempt to promote the biological agriculture and certify biological products by establishing the Organization for the Control and Certification of Biological Products (OCCBP) (Marouda-Chatjoulis et al. 1998). In addition, the National Hellenic Research Foundation organised a conference about biotechnology and its impacts on the environment and human health and also the ethical and social aspects of GMOs (Marouda-Chatjoulis et al. 1998).

In 1997, OCCBP gave permission to Syngenta (then Zeneca) to develop transgenic tomatoes however, the protest mobilization of Greenpeace in Greece compelled the state to withdraw its initial approval. This GM tomato also known as “tomato-saga” soon became publicly known and became the first issue in the media. However, the Greek government moved on the approval of four more cultivations, three of cotton and one of corn, in 1998 (Caloghirou & Zamparloukos 2000). Gradually, consumer and environmental groups started to become more and more negative towards biotechnology and asked for stricter application of the law and even more for the labelling of all GM-deprived products (Caloghirou & Zambarloukos 2000; Marouda-Chatjoulis et al. 1998).

In 1998, the first institutional advisory body was created, the National Commission on Bioethics, composed of nine members, distinguished scientists and appointed by the Prime minister for five years. Half of its members are experts on medical or agricultural applications of biotechnology and genetics, one is a professor of sociology, one of philosophy, one of theology, one of criminal and one of civil law (Botetzagias et al. 2004; National Commission on Bioethics 2010). Commission’s main goal is to look for the ethical, social and legal impact of the evolving biological, biotechnological, medical and genetic sciences. Furthermore, in cooperation with related ministries it is responsible for composing proposals of general policy and providing scientific recommendations, it represents Greece in the international level collaborating with international organizations and also informs the public –as it runs an awareness website- about biotechnology and the impacts of its applications. For instance, the Commission on Bioethics has made in the past recommendations on GM plants, genetic fingerprints and stem cells and lately has made recommendations on the prenatal and preimplantation diagnosis, the artificial prolongation of life etc.

However, the views of the Commission are not always based on scientific evidence, but also on philosophical approaches to biotechnology developments, significantly influenced by the views of several NGOs who usually argue that the research in risk assessment has been disappointing (Sekliziotis 2005).

Afterwards the related Ministries such as the Ministry for the Environment Physical Planning & Public Works, the Ministry of Health and Welfare and the General Secretariat of Research and Technology created another three committees related to biotechnology issues (Caloghirou & Zambarloukos 2000 cited in Botetzagias et al. 2004). In April 1999, the Ministry of the Environment in an attempt to compose public's concerns about new biotechnological applications announced that the General Secretariat for the Consumer would start up inquiries to ensure that all GM derived products are labelled (Botetzagias et al. 2004).

Since 1990, several ministries have taken part in the policy making on biotechnology with the most important being the General Secretariat for Technology and Research (GSRT), supervised by the Ministry of Development. GSRT's main goals are to support the distribution of advanced technologies to the productive organizations of the country, mainly through competitive programmes, to contribute to the fortification of R&D of Greece, to represent the country at the European level and collaborate with other international organizations in technological issues, to finance universities, research institutes, private sector research. In total, it funds and supports 19 of the most well known and important research and technological organizations (GSRT 2010).

During 1997 and 1998, the National Agricultural Research Foundation (N.AG.RE.F.), under the supervision of the Ministry of Agricultural Development and Food, was offering courses to farmers with a view to making them familiar with biotechnology, its aims and its applications on agriculture. In 1999 and 2000 however, they were suspended and in 2001 they restarted under a new programme called 'Dimitra' (Botetzagias et al. 2004). Dimitra, continues its work and its main vision is "To contribute through the fields of its activities, vocational training, research, technological innovations and the development of transnational co-operations to the shaping of the necessary preconditions, which lead to the utilization of the total of human resources as a driving force for the integrated development of Greece." (Dimitra 2010).

7.3.2 Coexistence regulation in Greece

Coexistence policy in Greece is of less importance to Greek farmers since the government has banned all GM crops and both farmers and food retailers reject GM products. However, the Greek government has already implemented EU regulations on coexistence and traceability, while detailed rules for their application in the state of Greek agriculture are being proceeded by a competent committee. And after the committee publishes its results, legislation will follow shortly (GMO Compass 2010).

Coexistence legislation, however, is less likely that will change the practical situation in Greece. Both the strong consensus of all the stakeholders against GMOs and the rising interest in the organic sector by the Greek public, will make a potential change almost impossible (GMO Compass 2010[2]).

7.3.3 Greek decision making on imported GM food products and seeds

As a member of the European Union (EU), Greece follows EU directives and regulations. Labelling and ingredient legislation for all food and agricultural products are based on EU rules and regulations. Nevertheless, Greece maintains specific labelling and ingredient rules for some products, described in detail in the Greek Food Code and published by the General State Chemical Laboratory (GSCL).

Figure 7.4 provides an overview of the structure of the main authorities involved in the decision making on GM products. The role of the Ministry of Rural Development and Food is to supervise the implementation of food law, to ensure that the control system works properly and assess its efficiency. It is also responsible for the policy making and for organizing its related local authorities. At local level, the official food control is implemented by the competent Prefectural Departments of the Ministry Agricultural Development and Food and at the regional level the Quality Control Centres have also a coordinative role (Varzakas et al. 2006).

Ministry of Rural Development and Food has several production branches, with the General Directorate of Plant Produce and the Directorate of Processing, Standardization and Control for Agricultural Products being responsible for the implementation of the legislation on food safe and distribution of food products in the Greek market. The Directorate of Plant Produce supervises four Departments, with the Department of Plant Production Input being responsible for seed and plant controls. Under this Department, several regional and decentralized institutes perform, like the Variety Research Institute of Cultivated Plants, the Seed Control Station, the Vegetative Propagating Material Control Station, the Centres for Control and Certification of Propagating Material and Fertilizer and the Quality Control Centres.

The need for both modernization and establishment of a uniform control system led to the foundation of the Hellenic Food Safety Authority (EFET), a governmental organization supervised by the Ministry of Agricultural Development and Food on the 28th of September 1999. EFET aims mostly to control that the food produced, marketed or distributed in Greece is in accordance with the national and European legislation about the food safety and hygiene (EFET 2010).

EFET is also responsible for the creation of mechanisms that can identify the origin of the food ingredients, as well the creation of mechanisms that will withdraw any food from the market that may cause problems. These mechanisms are included in the planning of systems for the guarantee of hygiene and are obligatory for each enterprise of foods today. Therefore, EFET with the creation of register of food enterprises will be able to ensure the control in all stages of food chain.

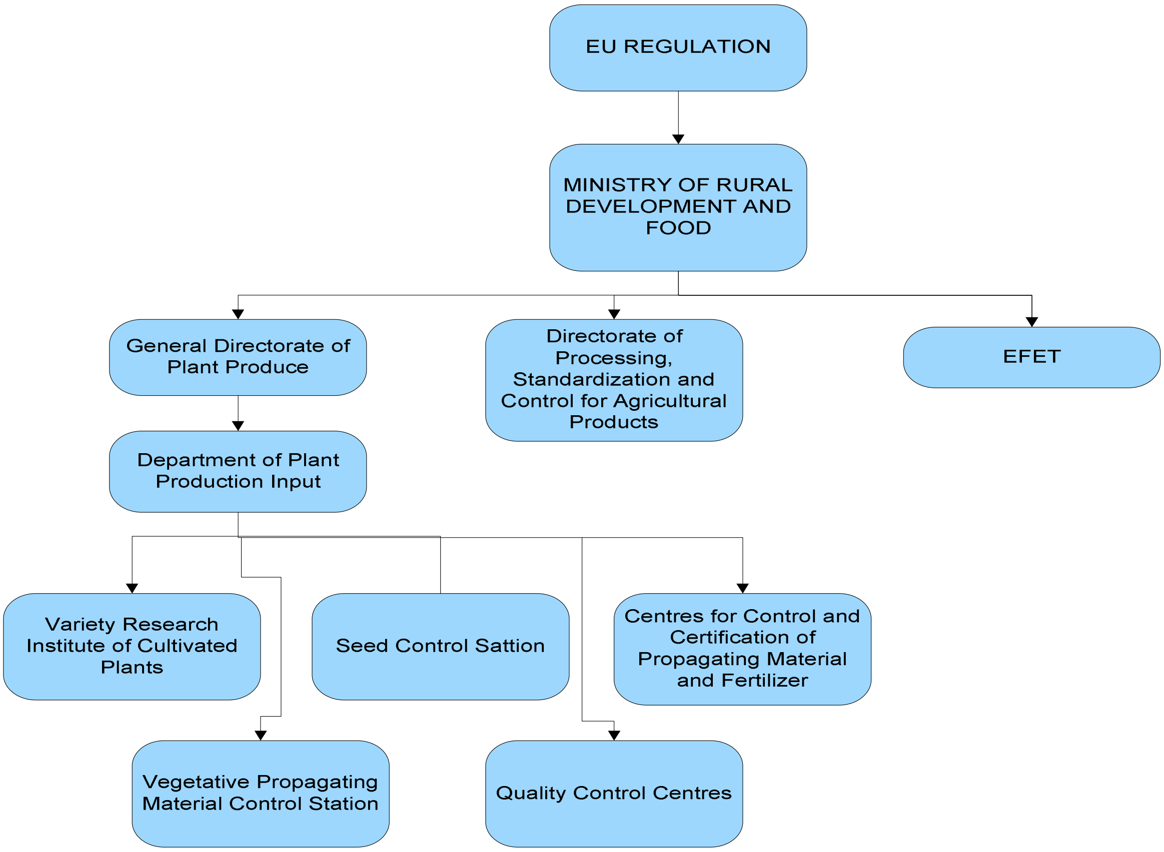

Figure 7.4 Structure of the competent authorities for the imported GM products. *The Ministry of Rural Development and Food and in collaboration with the EFET and the GSCL are the main authorities who decide for the import or not of GM products.*

All GM products for food or used as ingredients for food, entering Greece have to be accompanied with the necessary documents implied by the Directive 1830/2003. Figure 7.5 presents the authorities responsible for the GM products from the moment they enter Greece until their distribution in the Greek market. The Quality Control Centres in collaboration with the Prefectural Department of Agricultural Development are competent for the document inspection and the laboratory tests of imported GM products. Laboratory tests are conducted on samples by officially authorised laboratories. In cases of primary GM products destined for processing (e.g. soybean used for the production of soya oil), whether they are properly labelled or not, they have to be tested by EFET. In cases that some of the requisite documents are missing or do not comply with the (EC)178/2002, these products must be bound

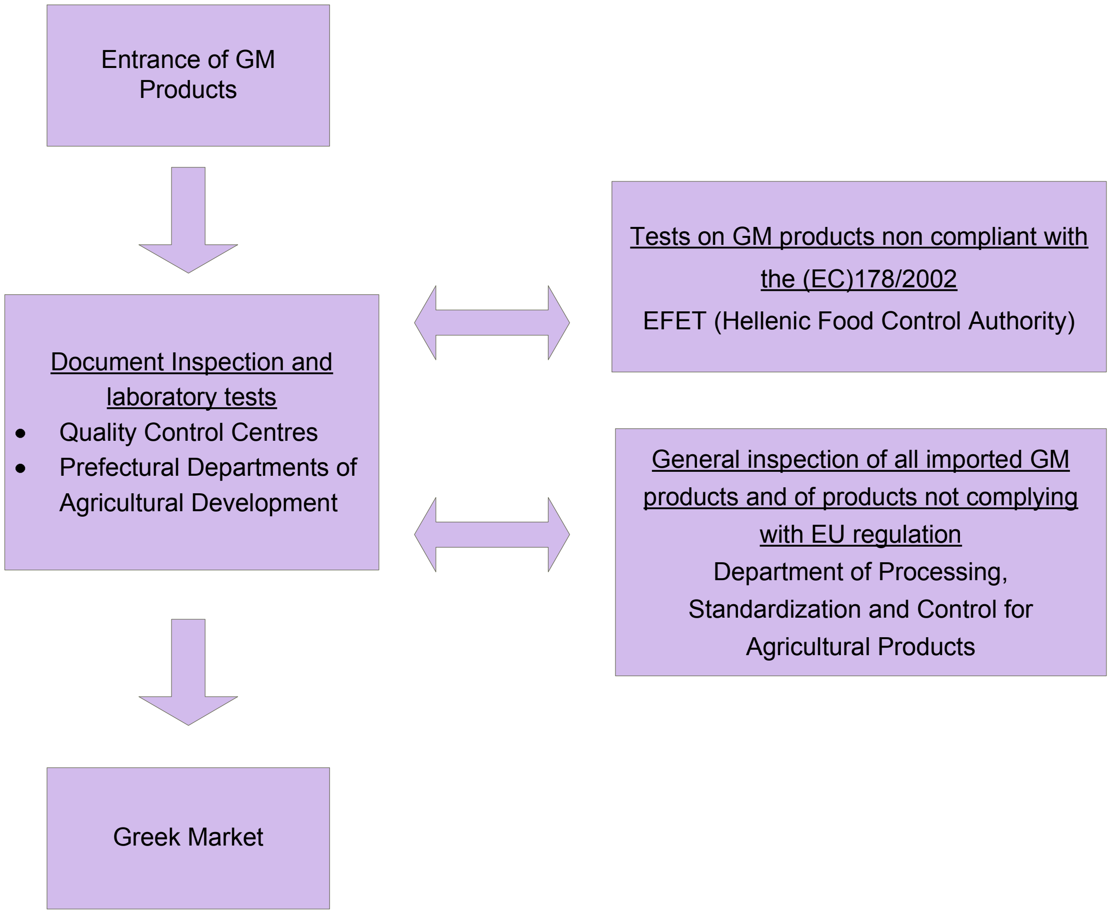

Figure 7.5 Competent authorities for controls of imported GM products in Greece. *Regional Centres for Plant Protection and Control in cooperation with the Prefectural Departments of Agricultural Development under the supervision of the Department of Processing Standardization and Control for Agricultural Products and with the contribution of EFET are responsible for the permission of imported GM products entering the Greek market.*

in place of importation and the Quality Control Centres inform EFET and the Department of Processing, Standardization and Control for Agricultural Products. Every 6 months the Quality Control Centres have to send to the Department of Processing, Standardization and Control for Agricultural Products a document with the aggregated results of all imported products ((Directorate of Processing Standardization and Control for Agricultural Products 2010).

Regarding the import of conventional seeds or seeds produced in Greece, are checked for being intermingled with GM seeds (Decision 332657/16-2-2001, FEK 176B/21-2-2001). Plant species protected by this Decision are cotton, maize, sugar beets, soybean, canola and tomato for processing. The legalized percentage of authorized GM seeds intermingled with conventional seeds is 0.5%, while the mixing with not authorized GM seeds is forbidden. Seeds of the above plants that do not comply with Greek regulation either are exported or are destroyed (Dimitra 2000). Services responsible for control and certification of produced and imported seeds are shown in Figure 7.4. under the supervision of the Department of Plant Production Input.

7.3.4 Greek decision making on the cultivation of plant varieties registered at the Common EU Catalogue

Responsible for the approval of the cultivation of plant varieties in Greece and their registration at the National Catalogue of varieties are several authorities performing under the supervision of the Ministry of Rural Development and Food. The authorities involved in the decision making are shown in Figure 7.6.

In case that the owner of a plant variety that is already registered at the Common EU catalogue but not at the Greek variety catalogue, wants to cultivate it in Greece has to apply in the Variety Research Institute of Cultivation Plants (VRICP).

The Variety Research Institute of Cultivated Plants is responsible for the registration of varieties (conventional, GM, plant genetic material resources) to the National catalogue, as well for the continuation of varieties on the National Catalogue. In order to ensure that the characteristics of the varieties registered to the National Catalogue remain unchanged, trials are conducted in the filed using seed samples from several lots, which are compared to a certain reference sample for each variety (Department of Plant production Input 2003).

In case that the VRICP approves of the specific variety then the applicant has to apply to the Department of Plant Production Input providing also the certification of the VRICP. Then if the Department of Plant Production Input decides that the particular variety meets the prerequisites acquaints the VRICP with the approval of the specific variety. The results are forwarded to Services responsible for control and certification, as well as to the interested companies (Department of Plant Production, Input 2003).

7.3.5 Field trials in Greece

In Greece, although there have been some attempts in the past to cultivate GM plants for experimental reasons, they were all brought to an end by vandalism. Before the establishment of the EU moratorium, in 1998, 19 GM plant events had

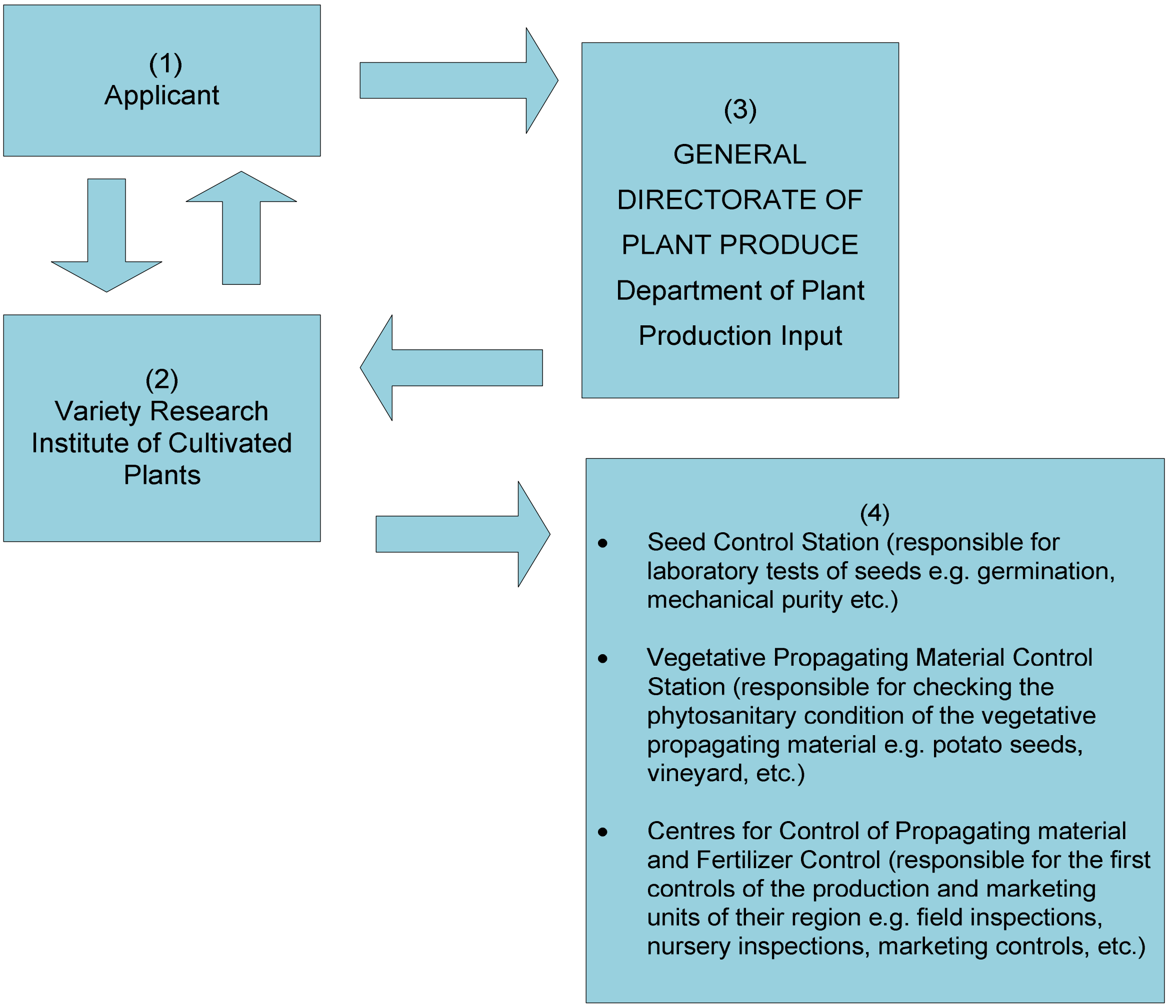

Figure 7.6 Decision making on the cultivation plant varieties in Greece. *The owner of the plant variety sends an application to the Department of Plant Production Input, along with the confirmation of the Variety Research Institute that it has approved the variety. If the Department of PPI approves the variety then results are forwarded to all control services through the Variety research Institute.*

Table 7.2 *Field trials conducted in Greece the period 1992-2008*

Crops	number	period
Cotton	10	1997-1999
Maize	6	1997-1999
Beet	2	1999
Tomato	1	1997

Source: GMO Compass 2010[1]

been approved for environmental release. All the deliberate releases of GMOs into the environment for field trials since 1992 were 19 and were all transgenic plants and no other GMOs (GMO Compass 20101). Table 7.2, shows the kinds and the number of GM crops used for field trials in Greece the period of 1992 till 2008.

7.3 6 Research on biotechnology conducted in Greece

Until 1987 Greece had involved slightly in the European biotechnological research. Biomolecular Engineering Programme (BEP) and Biotechnology Action Programme (BAP) were the only proposals incorporated into the EU research programmes. During the period 1982-1989 the Greek government placed emphasis on infrastructure, so that biotechnology research would be carried out mainly in state universities and public research institutes (Caloghirou & Zambarloukos 2000). As a result of this policy, the Institute of Molecular Biology and Biotechnology (IMBB) in Crete was established in 1983 and some of its research (insect molecular biology and molecular biology of unicellular organisms) has received a high degree of international reputation (Caloghirou & Zambarloukos 2000).

In 1984, the public company BIoHellas S.A. was established, mainly funded by the General Secretariat for Research and Technology, (GSRT), the Agricultural Bank of Greece and the Greek Bank for Industrial Development (EYBA). BioHellas aimed to produce a virus free potato seed, veterinary vaccines and proteins from the exploitation of milk whey (Economou 1991). This company was an effort by the state to create an intermediary between the private industry sector and the state funded universities and research centres, but it failed to succeed and closed down in the early 1990s. In 1987, the Greek Association of Biotechnology (GAB) was founded and despite the primary enthusiasm, its impact was not larger than previous attempts and soon waded off (Gaskell & Bauer 2001). In fact, GAB was never considered from the state authorities as a consultative body and now is almost inactive.

7.3.7 Companies and state enterprises investing in agricultural biotechnology in Greece

Many European countries have shown a great interest in biotechnology, in Greece, however, only in the mid 1980s has been founded a biotechnological company, Biohellas SA, but unsuccessfully (see section 7.3.7). Despite an increase in the state's investment in biotechnology in the 1990s, the state funds have never been more than 9% of the total state funds spent on R&D, also considered one of the lowest among the EU member countries. In fact, according to Eurostat the amount of expenditure as percentage of the GDP in Greece in 2007 was 0.57%, relatively small compared to Sweden (3.6%), Finland (3.47%), or Austria (2.56%) etc. In addition, the reduced demand for ‘know-how’ and applied scientific skills led the indigenous scientists to seek for cooperation with multinational or foreign firms, usually at the European level (Moses et al. 2002 cited in Botetzagias et al. 2004).

National Agricultural Research Foundation (NAGREF), was established in 1998 and is an official body in Greece responsible for agricultural research and technology (Investment In Greece Agency 2003). NAGREF has developed a Biotechnology Research Section, operating under very limited stuff and funds (Sekliziotis 2005). In addition, the School of Agriculture at the Aristotelian University of Thessaloniki, Laboratory of Genetic Engineering and the University of Crete, Laboratory of Molecular Biology are regarded as the most progressive organizations in Greece on biotechnology.

Another institute investing in agrobiotechnology is the Institute of Agrobiotechnology (INA) which was established in 2000 as part of the Centre for Research and Technology (CERTH 2010). INA has been involved in more than 10 EC R&D projects and more than 40 National projects. Some of the research areas that INA focuses on, is the breeding of seed improvement and germline for the production of disease resistant plant varieties, the genetic detection of GMOs, nutrigenomis, functional foods and plants etc. (CERTH 2010).

In 2002, it was founded Bionova, a Greek company which considered itself as a consultancy company that focuses on biosciences, mainly in biotechnology and with systematic, continuously growing activities, covers the essential needs of all stakeholders involved in biotechnology field.

Among Bionova’s activities are:

The representation of Europabio (European Association of Bio-Industries) in Greece since 2004, as EuropaBio Hellas, the edition of BIO magazine which informs about issues in biotechnology and especially in medical, environmental and agricultural field, the edition of books like “Genetically Modified Foods”, the arrangement of annual international conferences of Biotechnology and seminars in Greece inviting prominent scientists and representatives of state agencies, such as research institutions, government ministries and officials (Anonymous 2006).

Founders of Bionova are, among others, academic professor from Universities of Crete and Athens, while the company has created a network of people involving representatives of companies and business consultants with academics and researchers in order to promote the cooperation and partnership between academia and the business world (Anonymous 2006).

7.3.8 Potential benefits and costs of introducing GM maize in Greece

According to several studies, on average the gross margin per area from transgenic crops is at least as high as, and in some cases even higher than, that of non-transgenic crops. However, benefits are not equally distributed in each region, as they are correlated with regional factors like pest infestation levels and climatic conditions. Also a possible decrease in the amounts of pesticides in specific regions and specific years has been indicated (Carpenter and Gianessi 1999; Fulton and Keyowski 1999; Fernandez-Cornejo et al. 2000, Scatasta et al. 2006).

Potential economic benefits and costs for pest resistant Bt maize and HT maize if these would have been cultivated in Greece for grain production, were studied (Wesseler e al. 2007). According to this study the benefits from adopting GM maize in Greece, due to higher yields and changes in pesticide and fuel use were calculated. Based on the results Greece forgoes about 12 million euros per year for postponing the introduction of Bt maize and about 5.5 million euros for postponing the introduction of HT maize. Considering costs of planting GM crops in Greece, results showed that these costs could not be as high as the calculated threshold values below which the GM crop is economically profitable (Wesseler et al. 2007).

Based on that research, the only conducted for Greece so far related to potential cost and benefits of GM crops, there are not any economic profits for Greece from banning the cultivation of GM maize. On the contrary Greece would be benefited from casting the ban on the cultivation of Bt and HT maize.

7.4 A Political-Economic Interpretation of the Greek Ban on Agricultural biotechnology

Since 1981 Greece is officially part of the European Community (affiliation in the European Economic Community) and so far has streamlined all policies with those that the EU orders (Girgiannouli et al. 2008). In 1999, in the Council of Environmental Ministries, five European countries including Greece, declared a moratorium that lasted until 2003. In June 2003 the United States resorted to the WTO, considering the moratorium as illegal depriving the consumers of their rights to choose (BBC News 2006; Peter and Sawicka 2007 cited in Moutsaki 2009). Recently, Greece has been under the pressure of the EC to raise the ban on the marketing and cultivation of MON810 as well as to “loosen” its GMO policies (Moutsaki 2009).

The Ministry of Rural Development and Food has rejected all applications even for experimental purposes and there have never approved GM-plants for commercial cultivation or GM-filed trials.

This section is related to the position of different stakeholders towards GMOs, how they affect the policy making in GMOs and the real reasons that lie beneath this attitude. It is also defined who are the stakeholders that take part in this controversy, who benefits from the sale of GM products and who is responsible for their regulation and their production. Therefore, the main interest groups in Greece that weigh in on agricultural and food policy are in the private sector consumer groups and public opinion, environmental groups, food manufacturers and retailers, farmers, the media and in the public sector the political parties, scientists and scientific committees.

7.4.1 Consumer groups and public opinion

Since the early nineties several organizations, media and individuals provided the Greek public with information about genetic engineering. Greek consumers have always been negative towards the introduction of GMOs into the food chain, as 93.3% of Greek consumers have refused to buy GMO foods (eutobarometer 2001).

According to Eurobarometer 58.0 (EC 2003) the opposition of Greek consumers towards GM cultivations was more than obvious and in 2006 (Eurobarometer 64.3) out of 1000 Greek respondents only 12% of them where in favour of GMOs (Moutsaki 2009). In addition, comparing the Eurobarometer survey 64.3 (EC 2006) with the surveys of previous years regarding GM foods, results showed that the percentage of those that are in favour of GM foods and those that do not resist to GMOs, is gradually declining (Moutsaki 2009).

Table 7.3 shows the percentage of the proponents of GM foods in 15 European countries that is obviously decreasing in most of them with Greece having the lowest percentage. Additionally according to VPRC’s (a Greek statistical company) survey about GMOs, 70% of the Greek consumers declared that are aware of the potential dangers of GM foods, while considering teratogens (63%) as the major potential risk (Siouti 2004). Even labelling does not make consumers feel safe, and especially those that are 45-65 years old, as 60% does not trust the Greek food control system and only a 34% does (Siouti 2004).

Another study found that Greek consumers are very concerned about a number of factors they consider them as harmful for health (Table 7.4). Greek consumers prefer to know more about their food content and claim not to be misled. In Table 7.4 it is shown that 89% of the Greek consumers regard foods containing GMO ingredients as the factor of highest awareness and 82% are concerned about agricultural chemicals and pesticides as posing serious health risks.

In the near past many demonstrations have taken place in major cities regarding the future of agriculture and food production and the concerns of the introduction of GMOs into the food chain. Because of the spontaneous and enthusiastic attitude of Greek people, any information about unknown potential applications of biotechnology can emotionally affect the public (EC 2008). Usually, the concerns of the public about the dangers and advantages of GMOs are reflected on the way that media cover the issue. Therefore, the way of presenting an issue as well as the correlation between "conception of the public" – "newspaper's position" has been the subject of analysis for a lot of research. As expected, all this negative attitude of the Greek population is attributed in large part to the one-sided "influenced" reporting in the press and the politicians, the majority of whom, are vocal opponents (Sekliziotis 2005).

Table 7.3 *Percentage of supporters of GM food in Europe 15*

	1996	1999	2002	2005
Spain	80	70	74	74
Portugal	72	55	68	65
Ireland	73	56	70	55
Italy	61	49	40	54
Holland	78	75	65	48
United Kingdom	67	47	63	48
Finland	77	69	70	46
Belgium	72	47	56	45
Denmark	43	35	45	42
Sweden	42	41	58	32
Germany	56	49	48	30
France	54	35	30	29
Austria	31	30	47	25
Luxemburg	56	30	35	20
Greece	49	19	24	12

Source: Eurobarometer 64.3, European Community 2006, cited in Moutsaki 2009

Consumer associations in Greece are getting more and more in favour of and promoting organic farming, taking part in every possible debate and discussion around the country. Organic products are available in all Greek supermarkets, while the number of specialised organic shops is rising. However, legal aspects or gene technology, especially traceability and labelling, are some of the issues that consumers really insist on (EC 2008).

Table 7.4 *Awareness of Greek population in factors posing serious health risks*

Subject (Health risk from)	Awareness (% of Greek Population)
Foods containing GMO ingredients	89
BSE	86
Agricultural chemicals & pesticides	82
Dioxins, mycotoxins, heavy metals in the food chain	81
Snack food consumption	73
Hormone content in food	72
Food additives (E-number etc.), preservatives (nitrares, colorants, sweeteners, other) and flavorings	65
Food irradiation	60
Fast food (all chains)	58
Food contamination (listeria, salmonellas, etc)	57

Source: INKA Surveys (Consumers institute) found in GAIN report 2009)

In 2009, the minister of the Centre for the Protection of Consumers, N. Tsemperlidis, indicated that there are not any reliable studies to prove that GMOs are harmless. In order to support his argumentation, he revealed that recently came to the surface a study of an English scientist proving the dangerousness of GMOs and as a result he was removed from his position. Hence, according to Tsemperlidis, if the life science companies and especially Monstanto had irrefutable evidence that GMOs have no adverse impact on human life or the environment, they would have published his work. He expressed his fears that the impact of GMOs on biodiversity will lead to annonary problems, as the seed producers will be controlled by the few

GM companies and seed prices as well as the prices of the final products will be controlled by the oligopoly of food companies worldwide (apogeumatini 2009).

Moreover, according to the statement of the undersecretary of Agricultural Development and Foods in 2005, the structure of the Greek agricultural production, the relief of the land and the special climate conditions in Greece favour the production of high quality products, with high technological and organoleptic characteristics. Therefore, the introduction of transgenic organisms into the cultivations will cause insurmountable obstacles in the introduction and conquest of high quality agriculture and as extended will lead to the shrinkage of farmers' income (agrotypos.gr 2005).

7.4.2. Environmental groups

In Greece genetically modified organisms are widely known in the public as "mutants", a term that was first introduced by Greenpeace and then established. The Greek office of Greenpeace in 1996, after the release of GMOs into the environment had as a first concern to render people aware of the concealed dangers of GM products. The term "mutants" seemed to express with one word the scientific uncertainty, the unknown dangers to which people are exposed to, because of the large agrochemical companies who promote them and the arrogance of several scientists.

In 1996, considering the risks of GMOs for the environment, agriculture and public health, launched a campaign against the cultivation and trade of GMOs. The Greek office of Greenpeace undertakes active action under the slogan "We should not become test animals" (Pispini 2009). In 1997, Greenpeace's research showed that 124,000 tons of transgenic soybean were introduced in Greece, while an illegal shipment of transgenic maize was attempted to be unloaded in the port of Thessaloniki. At the same time, a report with the title "Genetic Hiroshima – Experiments with our food, playing with our lives" was published (Pispini 2009). Greenpeace's request to the Greek state was clear: The immediate ban on the imports and cultivation of GM products. The same year the Federation of Supermarket Firms in Greece, in a press conference with Greenpeace asked for the full labelling of transgenic products and their separation from the conventional ones.

Greenpeace persisted in its reactions especially when the ministry of Planning and Public Works gave permission to the experimental cultivation of Syngenta's transgenic tomato in Greece. Greenpeace in order to show its protest demonstrated outside the Ministry of Planning and Public Works. Furthermore, farmers and local authorities also condemned the permission of this cultivation, while three of the biggest tomato processing industries threatened not to buy any tomatoes produced from the experimental cultivations and also from the areas near them (Pispini 2009).

Generally, NGOs in Greece with Greenpeace being the leader are the main opponents to both agricultural and industrial applications of biotechnology. To some extent the strong opposition of Greenpeace against GMOs, can be considered as a chance for enhancing its reputation and gain members, after the Brent Spar incident that damaged the credibility of Greenpeace in 1995. Usually, via the mass media, they manage to show their activities and present themselves as "activists", exerting considerable influence on Parties and individuals (EC 2008).

Lately, apart from Greenpeace, several other activist NGOs have developed, but due to their inefficient scientific backgrounds and also limited communication skills they cannot considered as significant contributors to the Greek anti-GM movement (EC 2008).

7.4.3 Agricultural companies

Agricultural companies in Greece have not any profit from the distribution of GMOs in the Greek market. These companies supply agrochemicals and pharmaceuticals to the primary sector of production. Maize, for instance, is susceptible to many pests and diseases therefore maize producers rely on the introduction of insecticides, fungicides and fertilizers.

A potential permission to the cultivation of GM crops would incur severe economic losses for most agricultural companies, as GM plants would decrease the need for several agrochemicals. As a result agricultural companies in Greece support the strict legislation on GMOs and the ban on the cultivation of GM crops.

7.4.4 Food manufacturers and retailers

Like in Austria, Germany and the UK, food retailers and manufacturers in Greece have also removed any GM ingredients from their products due to the less consumer demand for these products (McKelvey 2004; GMO Compass 2010). In 2003, Greenpeace conducted a survey asking 30 retailers about their policy in GM foods. Out of the 17 companies 14 answered (including the subsidiary companies or the companies that merged with others as their policy was the same with their respective parent companies); 14 of them alleged that their policy is against GMOs and the rest declared that the manufacturers and/or the state should guarantee for the prevention of the usage of GMOs in food (Greenpeace 2005).

Furthermore, the Greek Association of Supermarkets (SESME) has declared that: "The Management Committee of SESME is against the use of GMOs in the production of food and animal feed. However, food producers and the State are liable both for labelling issues and for the certification of food composition, while retail companies do not have the qualifications or any institutionalized operation for the control or the certification of products composition. Certainly, being based on their attested position against the use of GMOs in food production, retailers will not agree to merchandise private labelling products for which there is no certification of non-use of GMOs provided by producers." (EC 2008).

In Greece until 2009, there have not been traced GM labelled goods, showing that most of the food manufacturers and retailers avoided the use of transgenic foods. According to Greenpeace's recent studies, food manufacturers and retailers are against the use of GM ingredients in standardized foods, mostly for two reasons: first, because of the vast reaction from the consumers' side and second, because of the obligatory labelling (Pispini 2009).

However, in 2006, EFFET ceased the flow of thousands tones of transgenic soybean oil without the GMO labelling and relegated four well known food chains of super markets to the procurator for selling illegally transgenic rice, which was not approved of consumption from the EU (Eleftherotipia 2006). Very recently, in January of 2010, Greenpeace revealed the existence of a product including transgenic corn syrup, on the shelves of many Greek supermarkets. Although the specific product bore the GMO labelling, Greenpeace in its report, named its brand and introduced ways of how consumers could complain to the administers of these food shops (Greenpeace 2010).

7.4.5 Farmers

Farmers and farmer associations and especially those specializing in biological agriculture are against and sceptical about the introduction of GMOs in Greece. For example, in 2003 the Greek Union of Organic Farmers Associations voted a statement for: "GMO-free Greece, strict regulations on the EU level for reliability in case of contamination on polluter pays principle and zero level for seed contamination" (Anonymous 2005).

One reason that farmer associations are so firmly opposed to GMOs is the influence from political parties, and the adoption of their policies. Greek farmers although they have never experienced the reality of GM farming they are strongly opposed to GMOs (EC 2008). According to Monsanto, small farmers would prefer a trade barrier to GM products so that they can profit from the selling of high quality agricultural products, as there is a premium for food that is GM free. What Lappas (head of Greece's largest farmers' union) has said in 2007, "This is a cutthroat global market and if all we do is cultivate mass-produced GM corn, we're finished, since other nations will be able to provide that cheaper," gives an insight of the farmers' real incentives (Leonard 2007).

In 2006, Nikos Lappas had also stated that “For farmers, forcing GMOs would be economic suicide, since our market doesn't want them” (Rosenthal 2006). In addition, owing to the fact that Europe's agricultural insurers are reluctant to cover farmers for any possible environmental damage from their crops, or contamination of nearby fields, it is difficult to grow them especially when the market does not buy them (Rosenthal 2006).

Greek farmers have always used to rely on EU subsidies and state. Therefore, as long as their crops, especially cotton, are subsidised they have no reasons to change their cultivations. Maize, an also subsidized crop, is highly demanded in Greece for feed and lately for biofuels encouraged by the new CAP. Also politics and farmer groups, exert a great influence on Greek farmers that although they have not experienced the cultivation of GM crops they reject them.

7.4.6 Media

The last decade, Greek media have largely increased their interest in food hazards especially after the emergence of the issue of genetically modified foods. A research conducted during a period of three years (2001-2003), showed that genetically modified foods were the most referenced food hazard (Kehagia and Chrysochou 2007). According to the main results drawn from the analysis of 311 articles from two daily and one Sunday newspaper, the most extensively food hazard covered by all three newspapers, with a total percentage of 37.4% were genetically modified food products. Regarding the analysis of the relationship between food hazards and content of articles, in the case of GMOs, articles' content could be considered as more conflicting related to the other food hazards (Kehagia and Chrysochou 2007).

According to a study related to the position of the Greek newspapers towards GMOs during 2003-2009, the majority of them have been against GMOs regardless of the political faction that each newspaper adjoined. The negative position of the

Greek newspapers may be attributed to the position of the political parties against GMOs (Moutsaki 2009)

Mass media have occasionally been accused of hiding the truth or telling half the truth. In cases that reporters do not provide the public with all the information related to important issues, it is difficult for lay people to formulate a complete and substantiated opinion (National Research Institute 1999). In Greece, television and the radio are exclusively dependent on the advertising and possibly on several donors in order to survive. There is a prevailing perception in mass media that the more people are scared the more are interested in that specific news item. As a result, televisions and radios tend to exaggerate their news whether they are political, social or scientific. However, media avoid mentioning potential dangers form products that come from companies being their main sponsors (e.g. dieting products) (National Research Institute 1999).

7.4.7 Political parties

Since 1974, the party that has constituted the Greek government was the one that had the majority in the chamber of deputies. Among the several parties in Greece, two of them (the conservative party Nea Demokratia and the social-democratic party the Panhellenic Socialist Movement PASOK) represent around more than 85% of the total voters. Also, the Greek parliament has representatives from the Communist Party of Greece (KKE), the coalition of the radical left SYRIZA and the far-right party the Popular Orthodox Rally (LAOS)(EC 2008).

Both the Greek government and the Greek Parliament parties (at least according to their allegations), have been really critical against GMOs, along with local authorities, scientific communities and social organizations (Tolios 2009). The current government composed of PASOK, and each Greek government so far, have always banned GMOs invoking the safeguard clause. Recently, under the approval of the new transgenic potato Amflora by the EU, Y. Koutsoukos, a representative of PASOK, declared that the Greek government will proceed to a ban after the new variety's inclusion in the Common Catalogue of varieties in Europe. Apart from expressing his fears for the potential risks of Amfllora to the environment, Greece has not any commercial interest in this GM potato as there is not any paper industry in Greece using starch to produce paper.

Despite, the government's concerns about GMOs and their impact on the environment, the reasons for banning GMOs are more political. Due to the general and strong negative climate among consumers and the pressure from activist organizations, political parties do not risk to displeasure their 'voters' by adopting policies counter to the public opinion. Hence, the adoption of stricter measures regarding GMOs is not the outcome of a trend towards consensus, but it rather reflects the main characteristics of the Greek political system such as trapping votes and minimizing political costs (Botetzagias et al. 2004). Hence, in many cases political parties take decisions based on the potential reaction of the Greek public. Avoiding protests and securing votes for next elections, are sometimes considerable reasons to take into account during decision making.

Therefore, the strategy adopted on this issue has always been very conservative (EC 2008). It is also noteworthy that all political parties agree on and forward this strategy and as Theodore Koliopanos, a legislator and former deputy environment minister, said in 2006 "all political parties are opposed to GMOs, which is odd because we disagree on everything else" (Rosenthal 2006).

7.4.8 Scientists and scientific committees

Greek scientists have played a significant role in the debates and decision making processes during the 1990s. They have been responsible for providing both the public and the national political field with information about GMOs. In contrast with the 1980s that they were alone in defining the issues, since 1990 new actors have started taking part in the GMO debate like environmental NGOs and specifically Greenpeace (Botetzagias 2004).

Despite the large number of the various advisory committees, their impact on Greek decision making centres is not as significant as their number. There is a general impression that these committees' major role is mainly to satisfy legislative needs rather than to play any real advisory role. These committees which consist of experts that rarely have a broad view of the topic they examine, are formed when a need occurs (EC 2008). In Greece, two kinds of committees exist:

- The permanent scientific committee of the parliament; this committee consists of lawyers and is main duty is to reconcile new legislation with the existing, the Greek constitution and to avoid contradictory rulings.
- The ad hoc committees; these are formed only for a limited period of time and their main duty is to give scientific advice on several issues (e.g. prioritisation of state research biotechnology programmes, the assessment of submitted proposals, the research for potential social or health risks of various applications, etc.) (EC 2008).

8. Discussion and conclusions

8.1 Discussion

Greece has always been negative towards GMOs but never managed to provide the EU with sufficient scientific proof of the impact of GMOs on the environment. Additionally, the fact that Greece allows the imports of GM products (only if they are labelled according to Dir. 1830/2003) and covers most of its needs for soybeans by imports from USA and Latin America (the major producers of GM soybean), is contradictory to its GM free position. Additionally, although it has been studied that Greece would gain from the cultivation of transgenic maize (section 7.3.8), the persistence in its ban may lead to the conclusion that the reasons of this ban are more political rather than economic. Based on the theory of political economy, this thesis analysed the main reasons that the majority of the Greek stakeholders insist on opposing the cultivation and the distribution of GMOs in the Greek market.

The large majority of the Greek stakeholders along with the related authorities are reluctant to loose the GMO policy and insist on a GMO-free Greece. In fact, there is a common perception that the global campaign for GMOs is to serve the financial profits of large multinational life science companies like, Monsanto, Dupont, Bayer, Sygenta, Glaxo, etc. regardless the potential impacts on human, animal health and the environment. Besides, the inexistence of Greek biotechnology companies and the insignificant public and private investment in biotechnology also contribute to the denial of GMOs since there are no economic profits.

Media in Greece have played a catalytic role in the formation of public opinion. Similar to Europe, the majority of Greek journalists are clearly affected by politico-economic factors; especially, television and press are the less objective sources of information, as they are mainly driven by political or commercial objectives. Furthermore, it has been concluded from several studies that the more people are scared the more are interested in the specific news items. Hence, the negative position of Greek media towards GMOs serves both their political and economic profits.

Several demonstrations and the results of surveys have shown that at least until 2005, Greece was the country with by far the fewest supporters of GMOs comparing to the other European countries. Greek people can be emotionally affected from information about unknown potential applications of biotechnology especially when Greenpeace expresses its opposition to GMOs using pompous words, like “mutants” instead of GMOs. Furthermore, issues in the past like HIV virus or the mad cow’s disease have shaken people’s trust in scientists and the scientific advances. Therefore, 88% of the Greek consumers, according to the last Eurobarometer, voted against GM foods and would never buy them even if they were cheaper.

As extended, consumer protests and boycotts have forced major retailers to eliminate transgenic ingredients from their own brand-products and to remove any transgenic food from their shelves. Hence, consumers’ perception about GMOs has a great impact on GMOs’ demand from retailers and farmers. That explains why Greek and most of the European supermarkets and retailers try to exclude GM foods from their products, especially in countries that the large majority of consumers are against GMOs.

Environmental groups and especially Greenpeace, in whole Europe and in Greece have fought GMOs with great ardour. They have launched countless campaigns and have protested against GMOs, warning people about the devastating impacts of GMOs on the environment and human health. Friends of Earth and Greenpeace, being the largest environmental networks have the power to boycott specific products, firms or industries, influencing producers’ attitude in the market place or even resulting in changes in policy making. Environmental groups through their extreme acts of protesting against GMOs and caring about the environment, manage to capture public attention and enhance their reputation as defenders of the public good. As a result, more new members are attracted to environmental groups, their funds increase; existing members are more activated so that pressures on governments and policy makers become more intense. In fact the more critical or fearful a public is the more popular environmental groups are. In the case of Greece, they have been successful in mobilizing their members to protest for more stringent regulation on GMOs.

Despite Monsanto’s campaigns about the safety of GMOs and the economic prosperity of farmers by planting GM crops, most of the European farmers are hesitant to use them. The inexistence of GM subsidies, the little correspondence of consumers to transgenic products are some of the reasons why most of the European farmers would not risk their adoption. In Greece, the large majority of farmers along with the Ministry of Agricultural Development and Foods and the farmer associations are firmly opposed to the plantation of GM crops although they have never experienced the reality of GM farming. The influence of political parties to farmer associations and the great opposition of Greek consumers to buy transgenic products are the main reasons for farmer’s denial to adopt them. Furthermore, farmers are not willing to risk the subsidies for the cultivation of cotton or maize to start growing GM plants. Besides maize in Greece is already highly demanded especially for feed and farmers have no reason to change their cultivations. However, the unwillingness of Europe's agricultural insurers to cover any possible environmental damage or the contamination of nearby fields is another deterrent for Greek farmers to adopt GMOs.

Agricultural companies in Greece would also undergo economic losses, if the cultivation of GM crops was permitted. A potential planting of GM crops would induce a decline in the sells of agrochemicals and pharmaceuticals due to less need of transgenic crops for them. Therefore, Greek agricultural companies have economic reasons to support the strict legislation on GMOs and the ban on the cultivation of GM crops.

Greek political parties are unanimously against GMOs. This thesis indicated that the reasons for banning GMOs are not economic but mostly political. The Greek political system was always based on trapping votes and trying to minimize political costs. Therefore, because of the strong dissatisfaction of consumers and activist organizations against GMOs, political parties would not risk to displeasure them by adopting policies counter to the public opinion.

Some of European countries that have banned the cultivation of transgenic crops may allow them in the future. For example Germany, lately, although it has banned the cultivation of Bt maize in 2009, approved the cultivation of the new transgenic potato Amflora in 2010. Greece however does not seem to change its position, at least for the near future, as the political profits of keeping GMOs away from the Greek market outweigh the profits of adopting them.

8.2. Conclusions

Biotechnology is applied in many different scientific fields, such as microbiology, agriculture, animal sciences, DNA finger printing, bioremediation, aquaculture and medicine. Although all types of biotechnology have been accepted and applauded, agricultural biotechnology has been a controversial issue for many years. Multinational life science companies have launched countless campaigns about the benefits of transgenic crops for the environment (less use of pesticides/herbicides), the economic profits for the producers (larger production, higher prices) and the consumers for providing them with better quality products. However, although the global cultivation of GM crops in 2008 reached 125 million hectares and continues to rise, the majority of the European countries continue to counter the adoption of most of the GM crops, as the EU has approved only the cultivation of transgenic maize and the potato Amflora.

Since the early 1990's, the EU has been legislating on the authorization and the use of GMOs. And until today EU has addressed concerns of citizens by introducing a labelling and tracking and tracing system for GMOs, as well as coexistence rules governing the planting and commercialization of GMOs.

Based on the political economy model about the interaction amongst competing interest groups in the formation of expectations, this thesis captured the key elements that form the political economy of agricultural biotechnology. Member states within the EU have played an important role in policy making. Responding to the pressures or incentives arising from various groups in society, like elections, campaign involvements, lobbies from pressure groups etc., the majority of the Member States have asked for stricter rules in order to protect the environment and consumers' health. Greece, one of the strongest opposed countries in the EU, has received many times the pressures of the EU to loose its policy against GMOs.

Even though Greece has incorporated all the EU regulations regarding agricultural biotechnology, into the Greek law, still insists on its ban. Analysing the gains of stakeholders from the ban of GMOs and the potential losses from lifting the ban, it is concluded that there are strong political reasons for Greece's insistence on the ban. Besides, the recent negative vote of Greece on the approval of transgenic Amflora potato shows that Greece is reluctant to change its policy at least in the near future.

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