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GENETICALLY MODIFIED PLANTS: A NORTH/SOUTH PERSPECTIVE IN THE MEDITERRANEAN REGION

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ABSTRACT

The use of Genetically Modified Plants (GMPs) is considered a controversial issue. On the one hand GMPs seem to promise a way to increase planetary food production, while on the other it seems to open Pandora's box with no hope to erase the impact of un-controlled GMP spread. Those who advocate Research & Demonstration (R&D) of GMPs argue that these plants promise to decrease the use of pesticides and herbicides and therefore imply a hope for an improved and less polluted environment. Those who oppose the spread of GMPs argue that it basically concerns two types of dangers. First, there is a risk of un-controlled spread of GMPs in the global environment. Some recent studies seem to sustain these considerations. Second, there is a possibility that industry financing the research on GMPs develop such species that are resistant to more extensive use of pesticides and herbicides and thus pollutes the environment even more than is the case today. There is also a North/South dimension in this issue. Those who advocate extended R&Defforts on GMPs argue that it would in the long-run solve future food-shortages caused by an ever-increasing population. Dividing the European Union into a northern and a southern part evaluating a recent Eurobarometer provides a superficial North/South perspective on this issue. There is a difference between North and South seems connected to knowledge and how you inform yourself on the issue. Television seems to be the preferred media of information, while those with higher education get their information closer from the source. Concerning the difference between north and south countries of the Mediterranean, the material concerning the Magreb countries has been too scarce to make it conclusive. The international debate relating to GMOs among developed countries concentrate on the trade aspects of the issue. Canada and the US accuse the EU and others that restrict imports of GMOs of using environmental concerns as an excuse to raise non-tariff trade barriers. The main arguments are against applying the precautionary principle and the specific design of the rules restricting imports of GMOs into the EU. EU has stalled its allowing new GMOs and thereby created a virtual ban on imports of GMOs. The international debate among the developing countries concerns the troubling question: Is it reasonable to worry about the state of the environment tomorrow when you are starving today?

Keywords: GMOs, GMPs, EU regulation, GMP-spread, GMP-pollution.

1. INTRODUCTION

All around the world people and experts have been expressing concerns about the extended use of Genetically Modified Organisms (GMOs) and their possible impact on the environment. These concerns are related to the dangers of tampering with nature's often frail eco-systems. It has been claimed that our knowledge of what happens when certain parameters in the environment are changed and new species are introduced is limited. Australia has often been mentioned as a case of what might happen when species previously unknown to a specific eco-system are introduced. The delicate balance between domestic animals and plants was so distorted that some species were put on the brink of extinction. It has been seen that species that are looked upon as relatively harmless in one environment can create a virtual disaster in another. Therefore it is difficult to forecast the 'real' impact of such manipulation on a specific habitat.

Nowadays humans have the opportunity through genetic R&Dto achieve radical changes in various habitats. It has always been possible to breed certain animals and plants into more useful variations by simply selecting preferred variations. But what is new in the current situation is that characteristics from one species can be transferred to another, creating completely different species in order to obtain a desirable capacity. It means that the new we are creating is something we have never experienced before.

Creating a new species of more advanced animals seems to be the most difficult part of genetic manipulation. Therefore R&Don Genetically Modified Plants (GMPs) seems less dangerous. However, it might be the opposite since GMPs indirectly seem to have the capacity to threaten the basis of life. Of course it is impossible to know exactly what happens in a certain habitat if some significant parameter is changed. Some micro-organism or fungi might thrive as a result of this change and start spreading uncontrollably.

Both environmental Non Governmental Organisations (NGOs), and ordinary people all over the world have become concerned about this development. Last year Canadian wheat producers got the following response about one of their newly invented products:

> "The Canadian Wheat Board knows its customers don't want to buy genetically modified wheat. GM wheat is not grown in Canada and none is expected to be registered until 2003 at the earliest. But that hasn't stopped buyers from sending what "very strong messages" that they don't want anything to do with the stuff. Within the last month two more customers Indonesia and Malaysia have told the wheat board they don't want GM wheat in their imports from Canada, joining others like Japan, the United Kingdom, Italy and Algeria. The board responds to such concerns by obtaining a certificate from the Canadian Grain Commission guaranteeing there is no GM wheat in Canadian shipments." (Ewins 2001).

This shows increasing global concerns about these issues. To some extent these concerns has been highlighted and nurtured by environmental NGOs like Greenpeace, which point out that:

> "Many millennia ago, our great […] great grandparents started to develop and maintain the diversity of crop varieties that secure all our food today. It is up to us whether we will be remembered as the terminator generation or whether we pass this global heritage of crop diversity on to our great […] great grandchildren." (van Aken 1999, p. ii)

Greenpeace argue that we are not only threatening the base of existing ways of life, but also destroying the efforts of our forefathers and depriving the base for existence of future generations.

The promoters of GMOs and GMPs on the other hand point out the possibilities of increasing food production and in improving nutritional standards in developing countries. By improving crops and other plants with qualities that contemporary plants lack it will be possible to obtain new qualities unavailable at the present. The promoters simply do not see the problems or downplay the importance of them. An argument in this context that can be traced back to an article by Ronald Coase in *Journal of Law and Economics* (1960) named *The Problem of Social Cost*. In this article Coase argued that if in the 19th Century the British railways had been forced to be fully liable for the damage they caused, they would never been built and this path of technological development would remain unexplored. A similar argument can be used concerning the development and use of GMOs and GMPs: If we do not make use of them and explore what further research in this area might develop we risk losing an entire area of development. This might be an area that might improve the living conditions for future generations. If our ancestors had not developed maize to what it is today we would have a basically useless plant.

So the argument goes on and we have to dig in a little deeper into the arguments and peoples' comprehension on what GMOs in general and GMPs in particular might mean in the future. In the 1987 Brundtland Commission Report *Our Common Future* concluded that:

> "Sustainable use or development is often defined as a use which maintains and enhances the renewable natural resource base in a manner that meets the needs of the present generation without compromising the ability of future generations to meet their own needs from the same resource base."(cited in Kiss & Shelton 1993, p. 36).

The problem with the famous sustainability development principle is that it can be interpreted exactly as different actors prefer to interpret it. Concerning GMOs and GMPs those opposing research and their use would argue that in order to fulfil the needs of present generations they threaten the ability of future generations to meet their needs. To tamper with existing eco-systems is a way to put that future ability at risk. The promoters would argue that if future generations were deprived of the possibility to thrive from the benefits of a genetically modified environment, that would risk depriving them of substantial values connected with their abilities to meet their future needs.

2. PROS AND CONS WITH GMPs

At this point we narrow down the scope of this paper to concern GMPs, and GMOs in food. In 1992, during the Earth Summit in Rio de Janeiro in Brazil, it was stated in *Agenda 21* that:

> "Our planet's essential goods and services depend on the variety of genes, species, populations and ecosystems. The current decline in biodiversity is largely the result of human activity and represents a serious threat to human development."(cited in van Aken 1999, p. 1).

This standpoint is interesting both for those opposing research and use of GMPs and those that are promoting their research and use. The opponents would argue that GMPs would seriously contribute to deprivation of biodiversity by introducing species that might lead to the extinction of existing species in sensitive habitats. The problem is that nobody can forecast exactly what might happen when new species are introduced into an existing functioning ecosystem. This means that the risk we take is basically uncalculated and characterised by mere chance. The promoters would argue that the R&Dof new, genetically altered species actually contribute to an increased biodiversity by adding extra previously non-existing species. Furthermore, this is not a new phenomenon; it has been going on since the beginning of the Neolithic revolution some ten thousand years ago.

However, it might be taking an unrealistic approach to view the GMPs in isolation, without considering that in the real world crops and plants are not grown in isolation from 'natural' ecosystems, i.e. genetically un-manipulated ecosystems. Thus the genetically modified species might risk spreading their altered genes into 'natural' habitats. Thereby risking creating changes that are totally uncontrollable. This would be the argument of the opponents of GMPs.

However, we need a more structured way of addressing GMPs, and problems and benefits connected to the research and use of them, and so now let us turn to how the EU has been dealing with them. It would be an exaggeration to claim that EU came to a comprehensive solution immediately; it has been more a consequence of a long and sometimes indecisive process. The EU Directive 90/220/EEC provides suggestions for the following concerns on environmental risks connected with use of GMPs:

Possibility of GMPs becoming persistent in the agricultural ecosystem and invading natural habitats.
Any selective advantage or disadvantage conferred to the GMP.
Potential for gene transfer to other plants and any selective advantage or disadvantage conferred to those plants.
Potential impact on target and non-target organisms.
Possible effects on human (including allergenicity and indirect impacts on the treatment of diseases with antibiotics) and animal health (including consequences for the feed/food chain).
Possible impacts on cultivation, management and harvesting techniques.
Possible effects on (bio-)geochemical processes (e.g. soil degradation, C/N cycle) (Steinhäuser 2001, pp. 121-122).

In most cases it is not difficult to assess direct effects of GMPs, as these occur without any significant delay. Conversely, forecasting more long-term and indirect effects poses greater problems. Five such problem areas are considered as especially troublesome.

First, there is the risk that manipulated genes spread resistance to antibiotics. At the present the risk of spreading these genes horizontally from plants to bacteria present in the gastrointestinal tract or during composting processes is considered low. However, the argument for having such genes as markers in GMPs seems difficult to support, as they can easily be exchanged for others lacking this trait and thus eliminating the risk. A complete phase out is therefore possible (Steinhäuser 2001, p. 122). The problem is a question of so called 'sunk costs' in industry and therefore to use the existing technique rather than develop a new one is considered as more economical. Therefore the argumentation of the insignificance of the risks becomes valuable and important for industry.

Second, there is the eventual impact on non-targeted organisms. This is of special relevance concerning plants which have been altered with genes resistant to pests. This specific risk can be minimised if the resistance-imparting organisms are not expressed in all part of the plant at all times, but only when their effects are required. These impacts can also occur indirectly, for instance from the recombination of new plant viruses from virus-resistant plants (Steinhäuser 2001, pp. 122). This problem seems to be the most difficult to assess in all its possible consequences.

Third, there is the spread of genes in natural ecosystems; so called naturalisation. This is highly dependent on the problem whether the GMP has any related wild species, where spontaneous cross-pollination can take place. Is the spread of the 'natural' species frequent and do the habitats coincide with areas where the GMP is to be cultivated? A way around this difficulty is to introduce plants that do not flower, but this seems to produce a risk for a 'second silent spring', as entire communities of insects that feed on pollen and nectar as well as birds that live on those insects risk losing their feeding resource (Steinhäuser 2001, pp. 122-123). Those promoting the use of GMPs would argue that this last argument is just a way appealing to people's emotions.

Fourth, there are the effects on various biogeochemical processes. The effects on soil and water might become relevant after an extensive use of GMPs, for instance, when GMPs capable of fixing nitrogen are being assessed. Such a scenario threatens when transgenic rhizobias that have lost their specificity to leguminous plants and are able to invade other plant communities, would also appear problematic (Steinhäuser 2001, p. 123).

Finally, there is a set of secondary consequences, which are produced by the cultivation of GMPs. These consequences may be beneficial or may present considerable risks. Connected to this is extensive use of pesticides in the cultivation of plants with developed resistance to such substances, as other plants lacking these 'improvements' might be wiped out. Economic logic and farmers' tendency to act in a risk averse way may be an incentive for such extensive usage as a mere precaution. There is also a problem when resistance is developed where it is not supposed to occur, thus creating herbicide and pesticide resistant weeds (Steinhäuser 2001, p. 123). A recent proposal to an amendment to the EU Directive 90/220/EEC provides assessment of these secondary consequences. Despite this no experience of handling these types of problems has yet been developed (EU 1999).

What we are able to see from above is that there is a great deal of controversy on how great the gains and risks are with GMPs when introduced into the environment. It is the uncertainty that seems to be the most obvious common trait of these different risks. One of the most obvious difficulties here is that the gains are apparent in the short-term, while the most severe consequences appear in the long-term (Steinhäuser 2001, pp. 121-123). This seems especially troublesome as it is easily combined with the opposing views on GMPs. It is easy to find arguments for introducing GMPs when one is only considering short-term gains. This may attract developing states with problems in the agricultural sector and in need of short-term solutions. It is equally easy for those arguing against introducing GMPs as they are only looking at the long-term risks. This scenario attracts them because they can afford to disregard short-term solutions. The problem is that in this way areas that are least suitable for large-scale experiments are the ones that will most probably become test-areas.

It seems as if the argument is stuck in a state where one side opposes change and the other embraces it. This may be too simplistic. The debate is more nuanced, implying that the opponents point out how to avoid the worst consequences and the promoters downplay the possible consequences and the risk they pose. This debate is troublesome because it is never possible to resist change in the long-term, as we are living in a constantly changing ecosystem. The problem with this argument is that while it might seem dynamic and flexible, it points towards some form of determinism; i.e. there is no point in doing anything because things will change anyhow.

One very obvious advantage with GMPs is that when you are able to introduce a certain crop into a certain area, it substantially increases the yield of that cultivated land area. As this effect becomes obvious other producers will observe this effect and try to get access to that specific GMP. So far this seems to be a success story. The problem is the domination of a certain crop in the cultivation of a larger area. At a certain stage some specie of insects or micro organisms might adapt to the new specie as a nutritious resource. An example of this occurred in the 1840s when millions of people died in the Irish Famine, when a new form of potato pest contaminated a uniform potato crop (van Aken, 1999, p. 3).

In Indonesia and India in the 1970s a grassy stunt virus threatened and destroyed rice plantations to a previously unknown extent. Agricultural scientists screened more than 7,000 varieties of rice in search for a species that was resistant to the virus. Finally they found a wild rice called *oryza nivara* in Uttar Pradesh, India, that had this specific trait, and this capacity was bred into a variety of different rice species and the impacts of the virus was successfully stopped (Mulvany & Bell 1996).

The first example point out that what seems to be salvation at one stage might later become the damnation for an area engaging in cultivating an extreme mono-culture. The introduction of the potato in Ireland expanded the food base, but also made people totally dependent on that specific crop which later

when the famine hit the Irish potato fields caused starvation and the death of nearly two million people. The second is more difficult to interpret one-sidedly. Here it seems that the genetic manipulation actually saved the day in a very tricky situation. If we consider this more carefully we realise that scientists rarely engage in difficult and time-consuming basic research just to benefit some un-specified people in some remote area in the middle of nowhere. Genetic engineering is big business and behind it lies the fact that genetic alteration of plants lead to the possibility to achieve a patent on that specific plant. Such patents represent the possibility of earning a large amount of money, emanating from the fact everybody who wants to use the GMP will have to pay a price to the inventor/producer.

3. EU CITIZENS VIEWS ON GMPS

There seems to be a great difference between the perceptions of risks and benefits with GMPs viewing the issue from a North/South perspective. In late 2001, Eurobarometer published a survey on the subject of *Europeans, Science and Technology*[1]. This survey provides us with some interesting data on European' view on GMPs and the science that generates them. A North/South divide might be perceived also here. However, we cannot take this eventual North/South divide outside the EU, but have to be content at this stage to investigate differences between the northern and southern EU Member States.

Table 1. Which scientific and technical developments do you find most interesting?

ISSUE AREA	NORTH EU	SOUTH EU	EU-15
Medicine	53.0	67.1	60.3
Environment	48.9	53.3	51.6
Internet	31.0	24.5	27.9
Genetics	19.9	22.2	22.2
Economics & social sciences	26.7	21.4	21.7
Astronomy & space	18.8	13.9	17.3
Nanotechnologies	4.4	3.8	3.9
None	8.6	7.7	8.3
DNK*	2.5	1.8	2.3

Source: Eurobarometer (2001), p. 12.*DNK: Do Not Know.

In order to make the analysis interesting in a North/South perspective we have to make a division between the Member States of the EU. This division between North and South EU is done by viewing those with a Mediterranean coast line plus Portugal as South EU. Furthermore, the South EU Member States are more closely connected to the Common Agricultural Policy and thus possibly perceiving some kind of self interest in the agricultural sector, which might affect their views on GMOs and GMPs, in viewing them as possibilities or threats.

First we address the issue of how Europeans perceive different areas of science as more or less interesting. In Table 1, the areas that attracted most interest were medicine and environment. It seems that this interest is higher in the south of EU. This is also valid for genetics, with 33.3 percent of preference in France, , 28.5 percent in Luxembourg, and 27.3 percent in the Netherlands (European Commission 2001, p. 13).

[1] The opinion poll was undertaken between 10 May and 15 June 2001 in the 15 Member States of the EU. For each Member State the used weighting was the proportion of the population aged 15 and over. A total sample of 16,029 people were questioned, approximately 1,000 in each Member State, except in Germany, where 1,000 were questioned in the new and 1,000 old Bundesländer, and in the United Kingdom, where 300 were questioned in Northern Ireland and 1,000 in the rest of UK, and in Luxembourg where 600 were questioned. The figures given for the EU as a whole are weighted averages of the national figures. The Eurobarometer Standard Reports have been undertaken since 1973 for the Press and Communication Directorate-General of the European Commission (European Commission 2001: 4)

Where do people gather this information from? In a North/South division they classified it by preference of its source:

Table 2. Sources of information of scientific and technical developments, classified in order of importance from 1 to 6.

MEDIA	NORTH EU	SOUTH EU	EU-15
TV	60.5	57.4	60.3
Press	41.8	28.3	37.0
Radio	29.0	28.9	28.9
School or university	22.0	24.8	22.3
Scientific journals	18.1	18.4	18.2
Internet	17.7	14.2	16.7

Source: European Commission (2001), p. 13.

The preferences summarised above are very stable from country to country even though we see discrepancies as with less interest in TV in Italy, 48.8 percent, and a higher interest in the printed press in Finland, 50 percent, the Netherlands, 49.2 percent, and Sweden, 46.4 percent (European Commission 2001, p. 13).

How well do Europeans understand the information or similar information that they are confronted with on issues on GMOs and GMPs? In the table below Eurobarometer put a series of questions to the respondents.

Table 3. Indicate whether the following statements are true or false.

STATEMENT	TRUE	FALSE	DNK
Antibiotics kill viruses as well as bacteria	41.3	39.7	19.0
Genes of the father determine whether a baby is a boy or a girl	48.1	30.2	21.6
The first human beings lived at the same time as the dinosaurs	20.3	59.4	20.3
Human beings have evolved from older animal species	68.6	16.6	14.8
The oxygen that we breathe comes from plants	79.7	13.6	6.7

Source: European Commission (2001), p. 20.

The first statement less than one European out of two managed to give the correct answer to, 39.7 percent, while the second was correctly answered by 48.1 percent. The third was correctly answered of 59.4 percent, while the response to man's origins is even better, 68.6 percent. This tendency was increased concerning the origin of oxygen, which was 79.7 percent (European Commission 2001, p. 20). Comparing these data with those collected by the survey in 1992, we find that the issue of man's co-existence with dinosaurs had the correct response by 59.4 percent at the present and 49.9 percent in 1992. The relation between the issue whether antibiotics kill viruses were answered correctly by 27.1 percent in 1992 and in 2001 by 39.7 percent. What is the origin of these changes? Concerning the dinosaurs a lot of documentaries and fictional items have recently been broadcast and this has increased people's knowledge on this topic. The effects of antibiotics is probably more related to increased discussions on the problems of using antibiotics, such as building up resistance and the risk of treating benign illnesses unnecessarily with antibiotics has been pointed out frequently in Europe during the last decade (European Commission 2001, p. 21).

In order to analyse variations within the sample of the survey, Eurobarometer constructed a 'knowledge index', which computes the correct answers given in the survey and ranges from 0 to 13. The average of this knowledge index is 7.8 and its breakdown is exposed in table 4 below:

Table 4. Percentages of marks on the knowledge index.

MARK	PERCENTAGE	MARK	PERCENTAGE
0	0.8	7	12.2
1	0.9	8	12.9
2	1.8	9	12.9
3	3.5	10	11.0
4	5.0	11	10.0
5	8.7	12	5.8
6	11.1	13	2.7
		Total	100.0

Source: European Commission (2001), pp. 21-22.

Calculating this index according to the age when people finished their studies, the correlation between degree of education and familiarity with scientific knowledge can be verified (European Commission 2001, p. 22).

Table 5. Knowledge index related to age when studies were finished.

AGE WHEN STUDIES WERE FINISHED	AVERAGE KNOWLEDGE INDEX
Up to 15	6.4
16-19	7.9
20 and above	9.0
Still studying	9.0
Average	7.8

Source: European Commission (2001), p. 22.

The results in table 5 indicate that the correlation is almost perfect. However, there is a difference according to the North/South divide here and a breakdown into specific countries reveals that countries in northern Europe like Denmark, Finland, the Netherlands and Sweden are on average better informed, while those where the level of scientific information is lower like Greece, Ireland, Portugal and Spain, are more likely to be located in the south of Europe (European Commission 2001, p. 22).

In order to more clearly establish these differences in a closer relation to our investigation of GMOs and GMPs, we looked into the public's understanding of how genetics works.

Table 6. Perception of how genetics works.

Suppose doctors tell a couple that their genetic material is such that they have one chance in four of having a child affected by a hereditary illness. Does this means…?			
ALTERNATIVE	**NORTH EU**	**SOUTH EU**	**EU 15**
If they have only three children, none will have the illness	2.8	2.8	2.8
If their first child has the illness, the next three will not	5.5	7.2	6.3
Each of the children has the same risk of having the illness	73.3	62.9	68.7
If the first three children do not have the illness, the fourth will	4.6	7.3	5.6
DNK	13.7	19.8	17.0

Source: European Commission (2001), p. 23.

The response to these alternative statements reveals that there is a difference between the north and south in knowledge of how genetics works. The correct answer is almost 10 percent more in the North than in the South. This seems to indicate that people in the North have a slightly better grasp of the scientific method and how genetics works. The same seems to be true for people with a higher degree of education. If we move further and put the issue of genetically modified food into a context, how do Europeans then perceive it? There seem to be a confidence among Europeans that they understand the issue of genetically modified food fairly well. However, involving medicine with genetics complicates the issue and consequently this certainty decreases. Of course this is a matter of what they really do understand. In order to grasp this we have to see whether Europeans more generally view genetically modified foods as a promising possibility or as a potential threat.

Table 7. Perception of understanding of different topics (EU 15).

Could you tell whether you have the impression that you understand these topics?	I THINK I UNDERSTAND	I DON'T THINK I UNDERSTAND	DNK
Mad cow disease	76.6	18.8	4.6
Greenhouse effect	72.9	22.4	4.8
Genetically modified food	59.3	34.8	5.8
Genetically engineered medicines	43.5	47.6	8.9
Nanotechnologies	13.8	67.1	19.1

Source: European Commission (2001), p. 25.

With this in mind if we move a bit further forward and try to test the degree of knowledge in the understanding among Europeans concerning the following statements (table 8):

Table 8. Knowledge and perception of topical scientific subjects (EU 15).

In your opinion, are the following statements true or false?	TRUE	FALSE	DNK
The greenhouse effect can make the sea level rise	74.7	8.9	16.4
Genetically modified food is dangerous	56.4	17.1	26.5
Mad cow disease is due to adding hormones in cattle feed	49.2	32.1	18.7
Science & technology improve agriculture & food production	59.0	20.7	20.3
Mad cow disease presents danger to human beings	14.6	78.3	7.1
Sun-rays can both be good and dangerous to health	87.5	7.2	5.3

Source: European Commission (2001), p. 26.

Looking at the notion that 'GMO-based food is dangerous', as high a percentage as 26.5 had no opinion of this. The majority believes that it is true, 56.4 percent, while 17.1 percent believes it to be false. The difference between those who admit their ignorance and those who do not is little; 53.2 percent do not think that GMOs are dangerous compared to 59.9 percent of those who do.

In table 9 we consider the difference in knowledge or level of education. We find that 58 percent of those that left school at the age of 15 or earlier answered negatively, while those who were educated beyond the age of 15 reached a percentage of 53.2.

Table 9. Perception of danger of GMOs related to level of knowledge.

KNOWLEDGE INDEX	TRUE	FALSE	DNK
0 to 4	47.6	8.0	44.4
5 to 6	59.8	12.0	28.3
7 to 8	61.1	17.0	21.9
9 to 10	57.4	19.7	22.9
11 to 13	51.0	25.1	24.0
Total	56.4	17.1	26.5

Source: European Commission (2001), p. 27.

The variance in the sample varies from 47.6 percent for the lowest level of knowledge to 51 percent of those with the highest. Then a series of propositions were put to the sample of respondents concerning genetically modified food, aimed at better characterizing the attitude among Europeans concerning this issue area. The idea was to find out how the respondents were perceiving the propositions; as shown in table 10 whether they were agreeable or not. The attitude most commonly encountered was the demand to be able to make an informed choice. No less than 94.6 percent of the respondents expressed a demand to make a choice when it came to genetically modified foods. There were no indications on any inconsistencies among the subgroups of the sample. Furthermore, 85.9 percent expressed a demand to

be informed of the consequences before eating this type of food. The support for demanding scientific proof before these types of foods are marketed was 85.8 percent. A slightly smaller group, 70.9 percent, agreed with total rejection of the genetically modified foods. This attitude differs among the subgroups; for instance those with a higher education are less likely to take this view, but there is not much difference; 65.4 percent compared with the average of 70.9 percent.

Table 10. Statements of the eventual danger of GMOs.

Would you say that you are more inclined to agree or disagree with each of the following propositions on genetically modified foods?	**INCLINED TO AGREE**	**INCLINED TO DISAGREE**	**DNK**
I want to have the right to choose	94.6	2.5	2.8
I want to know more about this food before eating it	85.9	9.3	4.8
They should only be introduced if it is scientifically proven that they are harmless	85.8	8.0	6.1
I do not want this type of food	70.9	16.9	12.2
They could have negative effects on the environment	59.4	11.9	28.7
The dangers have been exaggerated by the media	33.1	44.3	22.6
This food does not present any particular danger	14.6	54.8	30.6

Source: European Commission (2001), p. 40.

Furthermore, among the youngest strata of the population, 15 to 24 years of age, 64.3 percent reject genetically modified foods, while among the oldest, 65 years and older, 74.8 percent reject it. This slightly less negative attitude among the younger was not related to any higher level of knowledge. Howerver it may be attributed to gender as 60.7 percent of the 15 to 24 year old males rejected GMO foods, compared to 68.1 percent females (European Commission 2001, pp. 40-41).

From the last notion we might draw two possible conclusions: first, this is a specific generation feature, which implies that those who at present are a part of this category have been accustomed to the type of scientific innovation that GMOs symbolise. Therefore their rejection was not so extensive. If this assumption is valid, it could seem to indicate that as this age category ages and are followed by younger generations, the fear of GMOs in society would diminish; or, second, this is a group phenomenon; the youngest category, just because they are young, are less likely to perceive GMOs as harmful, but this attitude will disappear as they grow older. Reasoning in this manner, there is no point in claiming that this difference in attitude between the youngest and the oldest category should change society's overall attitude to GMOs in the long-run (European Commission 2001, p. 41).

On a more general level, various sociological studies imply that younger people tend to underestimate the level of risk and thereby expose themselves to higher degrees of risk[2]. Therefore we cannot exclude the possibility that the less negative attitude among younger men is not a more general tendency to ignore risks with GMOs more often because risks in general appear slighter and less probable (European Commission 2001, p. 41).

Table 11. Answers to the question “GMOs could have a negative effects on the environment”, according to level of knowledge.

KNOWLEDGE INDEX	**INCLINED TO AGREE**	**DISINCLINED TO AGREE**	**DNK**
0 to 4	47.7	9.4	43.0
5 to 6	57.1	11.9	31.0
7 to 8	60.3	11.6	28.1
9 to 10	61.1	13.2	25.6
11 to 13	66.0	11.9	22.1
Total	59.4	11.9	28.7

Source: European Commission (2001), p. 42.

[2] Which is exemplified in the tendency to engage in reckless driving and extensive use of drugs, to a larger extent. One common hypothesis states that younger individuals, especially male, have a perception of being immortal and therefore expose themselves to risks to a greater extent then older people.

As many as 59.4 percent of the respondents perceive that GMOs could have negative effects on the environment, while 28.7 percent have no opinion on this topic. At higher levels of education, the amounts of DNK's decreases and simultaneously more respondents perceive the risk of negative effects on the environment. In a comparison, those low on the knowledge index lists DNK at 43 percent, and 47.7 percent anticipate that there are harmful consequences, while those with high scores on the knowledge index lists DNK at 22.1 percent, and 66 percent subscribe to the statement (European Commission 2001, p. 42).

In order to balance the attitudes to the statements, the last two were formulated in a more positive manner, suggesting that there is no real problem. The first of these statements suggested that 'the dangers have been exaggerated by the media' and 33.1 percent agreed with this statement, while 44.3 percent disagreed. Again the most significant variance in the sample was among the youngest, 15 to 24, who agreed (37.6 percent). Interestingly enough this opinion was agreed upon to a higher extent among Danes, 41.8 percent, the British, 43.9 percent, and the Greeks, 51.8 percent. The second statement formulated in this manner suggested that; 'this type of food does not present any particular danger' was disagreed upon by 54.8 percent, and agreed by 14.6 percent. Among the Dutch, 23.1 percent, and the Portuguese, 24.3 percent, thought this statement agreeable (European Commission 2001, p. 42).

Returning to the more general level, about two-thirds of Europeans consider that they are poorly informed in science and technology, even though 45.3 percent of them declare that they are interested in this topic. Alongside with medicine, environment is what alerts most interest in European and the way to learn more about it is through television. This interest does not encourage the respondents to visit science and technology museums (European Commission 2001, p. 6).

The extent of scientific knowledge among Europeans has increased only briefly since the last survey in 1992. There is only one exception; the action of antibiotics on viruses. In 1992 27.1 percent knew that antibiotics were useless on viruses and in 2001 this had risen to 39.7 percent. Furthermore there is a high awareness among Europeans of such problems as 'mad-cow-disease', 76.7 percent or the greenhouse effect, 72.9 percent, while knowledge of technologies like nanotechnologies seems less widespread (European Commission 2001, p. 6).

Despite certain drawbacks for science during the last decade, such as the 'mad-cow-disease', Europeans still have a positive view on science and technology and its possibilities. In other words this means that the positive balance between positive results and harmful consequences still prevails. Something has happened though, and science and technology are no longer considered the solution to every problem we face, instead other types of solutions are preferred for social and environmental reasons. The statement: 'Science and technology will help to eliminate poverty and famine in the world', did not meet unconditioned support and 52 percent disagreed with the statement. The notion suggesting: '…thanks to scientific and technological progress, the natural resources of the earth will be inexhaustible', was rejected by no less than 61.3 percent. It seems that 83.2 percent of Europeans favour basic research if it is aimed at developing 'new technologies', and 75 percent support the notion if 'it only helps knowledge to progress' (European Commission 2001, p. 6).

The European public seems divided on the issue of the responsibilities of scientists and the statement: 'Scientists are responsible for the misuse of their discoveries by others', with 42.8 percent agree, while 42.3 percent disagree this statement. Thus, contemporary Europeans seem to nurture the idea that some kind of social control on science is needed: '…the authorities should formally oblige scientists to observe ethical rules.' Strikingly enough this urge for constraint is to be found in a variety of areas and it seems that even high levels of education does not provide people with confidence in science and technology. The agri-food sector is blamed for the 'mad-cow-disease' to such a large extent that 74.3 percent think that it is responsible. Politicians were thought to be the guilty party by 68.6 percent, while 59.1 percent blamed farmers and 50.6 percent blamed scientists. However, as many as 44.6 percent felt that they lacked sufficient information in order to pinpoint who the guilty party really was (European Commission 2001, p. 7).

Returning to GMPs and GMOs Europeans were most concerned about their ability to have access to information and thus be able to make a real choice and as many as 94.6 percent want to have the right choice whether they purchase genetically modified foodstuffs or not. Interestingly enough there was no real variance between the different subgroups on this issue. Concerning the second demand, as many as 85.9 percent of the respondents that they wanted an increased access to information, '…to know more about this kind of food before eating it'. These concerns seem widespread and 59.4 percent had serious suspicions that GMOs may have negative effects on the environment, while 28.7 percent had no opinion at all(European Commission 2001, p. 7).

Here we reach the end of our investigation into what Europeans think about GMOs. We succeeded in finding a slight difference between the northern and southern member states. These differences seemed be traceable back to different levels of education. This does not state that people are less worried because they know less, but that they seek their information using different strategies. Access to information in the form of popularised science televised seems to be the main source of information of those lacking higher education.

4. GMPs IN NON-EUROPEAN AND GLOBAL CONTEXTS

If we take these findings and try to consider what the probable difference would be in a North/South perspective including the Magreb countries in North Africa[3], some interesting questions emerge suggesting what may be of importance to investigate in the future. There is no question about the interest in the Magreb countries about GMOs and GMPs. The reasons for this are simple and basically related to the climatic conditions in North Africa. Thus the GMPs seem to offer a short-term solution and substantial long-term risks, as the Magreb environment is extremely vulnerable. Tunisia for instance grow four major crops, wheat, potatoes, tomatoes, and olives. The main problems for the agricultural sector are parasites: such as fungal and viral diseases and insects, together with drought and salt stresses and weeds that can cause large losses in agricultural production. The Tunisians are approaching these problems from different angles:

agricultural practice: optimised use of fertilizers, pesticides and herbicides;

development of adapted cultivars with or without marker assisted selection or in vitro culture techniques;

production of local GMOs: already a local transgenic potato resistant to PVY virus has been developed, and is ready for field tests; ongoing development of herbicide resistant durum wheat(Rebai 2000, pp. 1-2).

It seems that the Tunisian approach has left the planning phase to enter a development phase concerning GMOs. Agricultural biotechnology is not a mere dream any longer, and it is seen as a useful technical device to tackle the agricultural problems of the country. What is wanted is improved food security. The argument used to support this policy choice is that it is better to be involved in biotechnology as active developers rather than as passive spectators (Rebai 2000, pp. 1-2).

Another Magreb country, Algeria, has come to the conclusion not to allow imports of genetically modified wheat. The Algerian Ministry of Agriculture issued a Ministerial Order to prohibit imports and utilisation of GMOs. This was specified as genetically modified plant material, as in living plants, living parts of plants including eye tendrils, crowns, tubers, rhizomes, cuttings, shoots, and seeds intended for multiplication or reproduction. This document is aiming at avoiding risks of possible genetic erosion of the domestic plant heritage in seeds and plants. These concerns are linked to the use of GMP material and to bring together the preliminary technical conditions for organic agricultural production.[4] (Antivivisezione 2001, pp. 6, 15).

In September 2000 the Nigerian Agricultural Minister Hassan Adamu argued African countries need access to GMOs in order to boost food production, and certainly no lectures from different NGOs in the more developed countries about the harmfulness of this new generation of seeds.

> "Millions of Africans - far too many of them children - are suffering from malnutrition and hunger.[…] Agricultural biotechnology offers a way to stop the suffering."(Adamu cited in Planet Ark 2000a).

Adamu argued further that the World Health Organization (WHO), the United Nations Food and Agricultural Organization (UNFAO), and the Organization for Economic Cooperation and Development (OECD) have determined that GMOs are "safe and nutritious". The developing countries are fully capable of taking a decision on how to deal with GMOs on their own, without interference of the developed countries, he continued.

> "To deny desperate, hungry people the means to control their futures by presuming to know what is best for them is not only paternalistic, but morally wrong."(Adamu cited in Planet Ark 2000a).

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[3] The Magreb countries are Libya, Tunisia, Algeria and Morocco.

[4] The final version of this law was issued by the Algerian Ministry of Agriculture and stated that imports, distribution, commercialisation and utilisation of GMPs or plant material was prohibited. Responsible for implementation of the law was the Division of Plant Protection and Technical Controls of the Ministry of Agriculture. The exact text of the law is published in the Official Journal of the Democratic and Popular Republic of Algeria. (Antivivisezione 2001: 19).

Adamu's argument was partially supported by Geoffrey Hawtin, director-general of the Rome-based International Plant Genetic Resources Institute. Hawtin argued that:

> "We [in the richer countries] can afford to say no to genetically modified organisms. For other people it's a matter of life and death.[…] Poor people pay 90 percent of their income for food. If you are in a rich country…you say: 'We don't need to take the risk. We are paying just a few percent…' [of the income for food][…] If you are in Indonesia, China or Africa you may say: 'Look! That…risk is minute compared with the risk of having not enough food to eat"(Hawtin cited in Pardomuan 2000, p. 1).

Thus, Hawtin points out a discursive problem that usually haunts North/South issues in the global debate: Is it possible for those that are worst off, to wait and see if what the North thinks is a possible risk in the long-run, thus ignoring obvious solutions to short-term problems. More specifically in the environmental sector the trade-off is between two approaches. Either we develop now and take care of the environment later when we can afford it, or we develop now and learn from the mistakes of others in order to save money and not risking harming the environment beyond what is possible to adjust to (Pardomuan 2000, pp. 1-2).

As a global issue the GMOs risk becoming an affair for the World Trade Organization (WTO) simply because GMOs provide different countries with the opportunity to take a protectionist approach, arguing that it is done for the sake of the domestic environment. Considering GMOs in this way becomes complicated because countries tailor restrictions in a manner that ban imports that contain a certain percentage of genetically modified material. Following the 'contamination' path some exporting countries, such as the US and Canada, can never claim to produce GMO 'pure' agricultural produce. Therefore exports from these countries risk being structurally discriminated against, a practice that the US has been accusing the EU of undertaking. If this is successful, it will be virtually impossible to restrict or ban imports of GMOs without risking ending up in the WTO Dispute Panels. The concerns over GMO contamination were interpreted by Lord Melchett of Greenpeace UK as he was analysing the position of the Canadians against the EU:

> "These Canadian farmers ask themselves how they can sell GM-free to Europe if they have got GM oilseed rape growing wild in their fields."(Lord Melchett cited in Planet Ark 2000b).

Determined by these external considerations for keeping the GMO issue clean of accusations of being disguised non-tariff trade barriers, politicians cannot make purely environmental and health considerations when determining the adequate policies concerning GMOs.

The arguing between the US/Canada and the EU has been concerned with the usage of the precautionary principle.[5] The EU claims that the precautionary principle has to be considered on issues like trade and imports of GMOs. The acceptance of the precautionary principle has been taken by a unanimous vote, and this allows the Member States to impose trade bans to protect the health and the environment when there is uncertainty or conflicting evidence about the safe use of the targeted GMO. The US, supported by Canada, takes the opposite position and do not recognise the use of the precautionary principle in any issue connected to trade. According to them such bans on trade are nothing but protectionism under a new label (Vorman 2000, pp. 1-2).

These considerations make it obvious that the main concern at stake here is not related with public health, or the state of the environment or even the development of the agricultural sector.

5. EU REGULATION AND DEBATE ON GMOs

In the late 1990s environmental NGOs were waiting for the European Commission's proposal for a directive dealing with genetic contamination of seeds. This directive was intended to establish a kind of threshold of tolerance as low as the analytical detection level, which is around 0.1 percent, for eventual accidental presence of GMOs in conventional seeds. The Commission experienced lobbying from the genetic engineering industry, which was claiming that less restrictive thresholds were needed and that in principle no non-contaminated seeds nowadays are available in the agricultural markets (Balmer 2000, p. 1).

[5] The precautionary principle states that a practice, an innovation or goods should not be allowed until they have been tested under scientifically secured conditions. That means that imports, use or selling of the item has to be stopped until proof of its harmlessness has been established.

Greenpeace International claimed that this was a false statement and the only intention behind it was that industry was searching for a way to create a situation where no non-contaminated seeds *would* be available in the near future. Thus they were trying to create a *fait accompli* (Greenpeace 2002, p. 1).

Until 1998 EU had only approved 18 genetically modified products for sale or production, and since October 1998 no 'new' GMOs have been approved. This was the state of things in late 2000. In July 2000 the EU environment ministers decided that this effectual moratorium on licensing GMOs was to be maintained. The EU Environment Commissioner Margot Wallström was then hopeful that the problem would be solved before the end of that year (Balmer 2000, p. 1). Still early in 2002 the EU Farm Commissioner Franz Fischler explained the state of things:

> "Europe lacks a shared vision and common objective regarding genetically modified organisms (GMOs).[…] Currently, our response is to the challenges of GMOs is 'muddling through'. We have to stop making decisions on such a difficult issue of biotechnology on a purely emotional basis"(Fischler cited in Evans 2002, p. 1).

Policy makers in the EU have made increased calls for a new approach to biotechnology amidst the fear that a hostile public opinion to development of this sector might curb economic growth and leave the EU lagging behind the US. The US and Canada are developing rapidly in this sector. The EU has kept its moratorium on new approvals of GMOs for four years and even though there have been several suggestions on how to solve the impasse, there is no sign of any new approvals. France leads the core of resistance in the EU against allowing new GMOs. The French policy stand on this issue is considered to violate EU law and most certainly the rules of the WTO (Evans 2002, p. 1). Neverthess, the French stated that further rules must be in place before new GMOs can be allowed in the EU market, in order to ensure that GMOs can be identified throughout their whole passage of the production and consumption chain. Other Member States that were reluctant to allow GMO technology were Italy, Austria and Denmark. During the debate the issue surfaced as to whether Member States might maintain their national bans despite the new legislation at the EU level (Evans 2001, pp. 1-2). In this they were supported by some Members of the European Parliament (MEPs). The co-president of the Green group in the European Parliament (EP), Paul Lannoye, said that:

> "The new directive goes along the right lines to protect the environment and human health. But it should not be seen by member states as an encouragement to lift the ban on new GMO releases..."(Lannoye cited in Evans 2001, p. 2).

Environmental lobby groups stated that the new EU laws were insufficient to safeguard human health and the environment. Gill Lacroix, biotech co-ordinator at Friends of the Earth, concluded that:

> "As it stands, farmers face the consequences of GMO pollution, we face the health risks of GMOs and the biotech industry escapes without any strict liability. The directive should have been better…"(Lacroix cited in Evans 2001, p. 2).

The opposing side, the biotech industry did not seem satisfied either and their response was that the EU had to find some sort of workable solution to this problem, otherwise the European biotech industry risks being put out of business. The EU Commission seemed to be well aware of these concerns and Commissioner Fischler concluded:

> "It is high time Europe finds a way to address questions such as: Can we eat food that has been genetically modified? Do GMOs represent a threat to the environment?"(Fischler cited in Evans 2002, p. 1).

The EU Commission plans to improve the traceability and transparency of products containing GMOs, in order to decrease the Member States' fears of increased GMO-contamination and try to re-start the approval process. More specifically this would mean that imports of GMO crops from countries like the US and Canada have to be labelled, thus inflicting extra costs in separating them from conventional strains throughout the whole production chain. The Americans and the Canadians have commented these plans as unworkable and inflicting too high extra costs on importers (Evans 2002, p. 1). According to Commissioner Fischler, such labelling would be virtually worthless if it is unsuccessful in segregating GM from GM-free crops on the European farmlands:

> "Farms will have to segregate production and marketing chains, introduce minimum distances but also different sowing dates between GM and non-GM crop varieties.[…] Agriculture today is demand driven and we will not be able to sell our products if we do not win confidence of the consumers"(Fischler cited in Evans 2002, p. 1).

The EU Enterprise and Information Society Commissioner, Erkki Liikanen, stated that European governments have to play a role in educating the public about the safety of GM crops and foods if the biotech companies within the EU are to exploit this market. Concerning international competition in this sector, European biotech companies outnumber those of the US by 1,570 to 1,273, at the same time as the US companies boast three times the stock market value and generate a three time larger revenue. Of the US companies 28 percent are publicly listed, compared to only six percent of their European competitors. Thus, the Commission President Romano Prodi estimated that the EU industry was lagging four to five years behind the US, which effectively shuts the EU industry out of this rapidly expanding market. In order to come to terms with these problems Commissioner Liikanen concluded that the EU has to improve its regulation, establish intellectual property rights and invest in education in this area (Trotta 2002, p. 1).

> "The only solution is open discussion […] The role of government is to guarantee that a product is safe and if it is it can be made available to the market. But the citizens must have full knowledge. This is where it is important to have proper labels with traceable information. It is not our task to say what the consumer should choose but to make sure it is safe"(Liikanen cited in Trotta 2002, p. 2).

It seems evident that the views of Commissioner Liikanen have some support, considering that a popular label of GM foods is Frankenfoods, implying the ethically suspect that they mess about with nature (Trotta 2002, p. 2).

The conclusion of the situation within the EU is that there seems to be a lot of confusion and conflicting views on how to deal with the GMO-issue. Even different Commissioners seem to express slightly incompatible views. Of course environmentalists want to hear specific statements from the Environment Commissioner, the agricultural sector wants specific statements from the Farm Commissioner, while the biotech industry and the public want to hear specific statements from the Enterprise and Information Society Commissioner supporting their respective cause. These infightings, as well as institutional infightings, might trigger the differences.

6. FUTURE POLICY OPTIONS ON GMOs

What are we, then, to believe about the prospects for the future concerning GMOs? One thing seems to be certain; that nothing is in fact certain. On the one hand, there is the biotech industry, which badly wants to have rules as clear as possible. It is preferred that these rules put as few restrictions on the market as possible, at least inside the Single European Market (SEM). It does not want any radical solution about the issue of to what extent their liability should be in case of failure to control GMOs and their eventual impact on human health and spreading in the environment. Unrestricted liability is not an option that the biotech industry would accept. The main reason behind this is that such liability substantially increases the risk on capital, and thus decreases the probable amount of investment in this sector. On the other hand, there is the opposite side, the environmental NGOs, simply want to maintain the ban at the EU level and if this is not possible they want to keep it on the Member State level, despite the existence of a EU directive forbidding or at least restricting it.

The biotech industry claims that there are no problems with GMOs and that this is something that humans have been engaging in throughout human history. In fact, human history is about genetically modifying the environment in order to meet human needs, and what the biotech industry now is engaging in is just using top modern science as a tool to achieve something completely normal and desirable. The counter argument is of course that this biotech scientific method is actually tampering with the fundamentals of life and is creating species that we know nothing about and that their impacts on human health and the environment cannot be foreseen to their full extent.

The debate can be reduced to the question whether the precautionary principle should be applied or not. If we, on the one hand, want the possibilities of future development in GMOs and rip off the benefits as fast as possible, then we have to abandon the use of restrictions proposed by proponents of the precautionary principle. Instead we have to follow the path suggested by Coase (1960) and rely on the fact that technological R&D will solve the problems as they appear. Our risk perception would then suggest that the risks involved are manageable and therefore worth taking. If, on the other hand, we perceive that the risks are too high and damage cannot be controlled, we have to apply the precautionary principle and not make use of this technology until we feel that it is safe. One of the risks seems to be to let the biotech industry on the loose, because market competition might increase the level of risk taking in order to achieve greater market shares by competing companies.

Concerning the North/South perspective it is, as always, a dividing gulf between what the North can afford and what the South simply has to do. Where the North has the means to sit down and speculate over possible damage and how to control it, the South has to take more or less calculated risks. Usually however, those who take the risks are identical to those that are going to be affected by eventual adverse effects. One problem that the GMOs seem to offer a solution to is that often in the South there is some troubling circumstance that affects growth potential in plants substantially and GMOs tailored for dealing with this problem might seem to be an easy way out. The temptation might be irresistible to invest in obviously short-term solutions, despite risking similarly obvious long-term costs.

The Irish example indicates that such solutions might result in the creation of a vulnerable mono-culture. The introduction expanded the food base, but made the poor people suffer from starvation and death caused by the potato famine. The Indonesian and Indian example seems to indicate that genetic manipulation actually solved a tricky situation. It is rare, however, that scientists engage in basic research just to benefit poor people in developing countries. Genetic engineering is highly profitable and genetic alteration of plants might lead to the possibility to achieve a patent on a specific GMP. Such patents represent a possibility to earn substantial revenues that every user of the GMP have to pay the inventor/producer.

This is a potential problem for many developing countries. If farmers producing what their farmland yield on self-substance basis, they will earn insignificant amounts of cash. This means that farmers in these areas risk being put out of business, or at least stuck in their present economic situation, because they cannot afford to buy the GMP, and therefore cannot compete on equal terms with those who can. Economists usually disagree with this because it is considered an inevitable process, which is irreversible because of the process of continuous urbanisation. This might be valid for developed countries that have experienced rapid urbanisation and a fast growing industry, while it might be something quite different in a developing country where the bulk of the population are occupied in the agricultural sector and urbanisation is caused by poverty or deteriorating farmland areas and not necessarily an increased need for labour in a rapidly growing industry.

However, even though the international division of labour causes the above-described structural problems, the point in this context is that GMPs threaten to increase these problems. One argument against this is that it does not occur in every case where genetic engineering is involved. In fact the large quantity where genetic engineering has been involved has gone un-noticed simply because nothing has happened. Here it is possible to use the argument that Elinor Ostrom (1990) used in her *Governing the Commons*, simply stating that the interesting thing is that some things can happen and therefore that possibility cannot be ruled out. This would be an argument for applying the precautionary principle in this context.

There is also a philosophical concern about the possibility of a controlled spread of a genetically engineered technology. This concern has some moral and ethical aspects. The use of genetic engineering concerns the mastering of a myriad of variables and still there are claims that there is substantial control over the outcome. To claim this seems somewhat irresponsible, and ends up in the argument that “it is worthwhile to take this risk because the gains are substantial, while the risks are insignificant”. Refraining from acknowledging this and instead claiming that the process is under control, indeed, seems immoral and ethically questionable. In fact, genetic engineering is developed typically in the laboratory where the bulk of variables are kept under strict control. However, from the time when genetically altered species leave the laboratory things change, and not much is kept under strict control in 'natural' habitats. This is especially the case in developing states suffering food supporting problems.

7. CONCLUDING REMARKS

What about the present then? It seems that attitudes among people in general and different kinds of policy makers, not surprisingly, differs. It seems that the majority of the public receive their information on GMOs via television, in a popularised version. It also seems that the public's attitude depends on the level of education. The latter influence the way in which the information on the GMOs are collected. The more educated get their information more close from the source where the GMOs are being created. This makes attitudes different according to the levels of education and the availability to television and how diversified the media of a specific country is at that particular stage of development.

Considering the difference between north and south in the Mediterranean region, we have presented a lot of empirical data concerning the EU, while information of attitudes and policy choices made in the Magreb countries have been limited. What we can do at this stage is to speculate. It seems reasonable

that the attitude among the public in Tunisia and Algeria to some extent should be influenced by the French debate caused by their historical and cultural ties to France. The indications from Tunisia and Algeria seems to indicate a positive view on GMOs and their possibilities in Tunisia, while Algeria has taken a negative view and searched for means to avoid being exposed to GMOs. Thus, Tunisia seems to see possibilities, where Algeria only problems.

Furthermore, the international debate relating to the GMO-issue as a trade problem recognises that it might be difficult for countries to avoid imports of unwanted GMOs, as they risk being accused of raising non-tariff trade barriers in violation of the rules of the WTO. Environmental NGOs have pointed out that the GMO-issue contain a trait of being a one-way issue; once your environment is contaminated by GMOs, it will be virtually impossible to return to the non-contaminated stage. Therefore it seems reasonable to argue that the precautionary principle should be applied in this issue-area. Otherwise there is a great risk that GMOs spread in environments without any control at all. This is especially true in developing countries. However, the troubling question remains: Is it reasonable to worry about the state of the environment tomorrow, when you are starving today?

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