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Insights form the Brazilian and British Biotechnology Controversy

Working Paper Series 2004/02

Nijmegen, February 2004

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ISSN 1570-551X

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Abstract

This paper highlights the elements from environmental sociology that try to explain the fuss around complex and risky technological developments. Genetically modified crops for agricultural purposes present some of the latest challenges in this respect, giving rise to scientific disagreement about the interaction of GM crops with the environment and the human body and involving societal value conflicts. Decision-making, eventually, becomes complicated in the light of persistent controversy while at the same time a rational and legitimate line of policy with regard to biotechnology is urgently wanted. The changing nature of 'risk' as identified by Beck and others is interpreted as the main cause for this controversy, coupled with the current trends to reconsider a) the 'traditional' practice of science and b) the configuration of policy-making. As the British and Brazilian debate show, arguments of protagonists and antagonists to encourage respectively halt the GM development involve fundamentally different views on science and the way policy-makers should cope with the biotech controversy. Some findings from a case study in Pará (Brazil) show how essentially two different discourses on agricultural development prevail in the public debate. In addition, it is found how new social movements stand up to claim a 'discursive space' to influence public debate and policy-making, willing to change the current inadequate framework of risk assessment and policy-making. It remains to be seen to what extent these efforts contribute to an erosion or alteration of the belief in science and technological progress as the main rationale for policy-making.

1. Introduction

The 1987 World Commission on Environment and Development report 'Our Common Future' (WCED 1987) identified how the human capacity to intervene radically in our natural surroundings gave origin to the Earth's distress and crisis in present times. The analysis was clear: poverty and developmental problems on the one hand and pollution and disruption of ecosystems on the other stand aside in a global problem definition. At the same time we face an 'institutional gap', defined by the inability to organize states, actors of industry and social forces to integrate different interests in the wake of the global crisis. In this era the concept of 'sustainable development' was born to formulate collective answers to the pressing environmental questions. The sustainability discourse has found recognition among a wide range of social actors, initiatives have been set up, policy-plans have been formulated and projects carried out. However, the burden for future generations becomes bigger as the planetary ecosystem seems to be more damaged than ever. Some argue that the concept has been abused in the name of political and economical interests because inherent dynamics of our modern 'growth' paradigm has prevented governments around the world to make true sacrifices to enlighten the future's environmental burden.

We may be disillusioned by the lack of executive power and gloomy foresights, but we should also acknowledge that the identification and resolution of environmental problems is a highly complicated matter. It demands, first, a clear analysis, secondly, new ideas and initiatives and finally, joint efforts and investments to curb negative trends. In this way, the sustainable development movement has made some first steps forward and the sideway involvement of environmental sociology has played its part. In accordance with the WCED contemporary environmental problems are commonly understood as a) anthropogenic in origin, b) global in reach, c) socially and spatially uneven with regards to their impacts, d)

seriously affecting the natural systems to the extent that questions of survival are legitimised, e) dependent upon scientific expertise to identify, clarify and possibly resolve their existence, f) representing conflicts of interests and g) involving serious conflicts over ethical and moral values expressed in the course of the debate on our nature-society relationship (Blowers & Leroy 1996; Held et al. 1999). This quick characterization shows that no simple answer to the environmental problem can be given or it would entail the world and its populations and cultures as a whole. It should not be expected that this paper can provide any short-term relief for any of the environmental stress situations. It probably makes the picture more complex as it sheds light on one important aspect of current environmental problems, namely the upsurge and changing character of 'risk'.

Therefore the controversy about genetically modified organisms (GMOs) will be discussed, a crosscutting theme that entails value conflicts, scientific contestation and political disagreement in various fields of policy-making, whether engaged with food policy, biodiversity, trade policies or the organisation of democracy itself (Marchi & Ravetz 1999). In a way, it represents the quintessence of today's environmental controversies, similar to nuclear energy in the eighties or climate change in the nineties. Setting limits (or not) to the biotechnological development means that political actors, NGOs, farmers and consumers have to cope with uncertainties about a possible large-scale introduction of GMOs into their living experience that may affect them in social, environmental and economic respect. But everyone trying to find out the truth about biotechnology[1] and its workings gets stuck on conflicting data and opposing views. The situation has become confusing for policy-makers and citizens and in many countries protagonists and antagonists of GM are entangled in a complex discursive arena where facts and values overlap, in spite of scientific expert committees and efforts to reach public and political consensus. Here is a role for the environmental sociology that has studied the nature-society relationship and the 'hybrids' that occur in the wake of technological advancements (Latour 1993). The following themes will be illuminated to some extent. First, some of the popular considerations among the current authors in the field of sociology and policy-analysis will be explored (section 2). The nature of risk, it is argued, has been responsible for a reconsideration of the practice of science and policy-making. In section 3 reference is made to the British biotech debate. It highlights the concerns that are commonly raised with regard to agricultural biotechnology and its possible effects. In section 4 the central focus lies with a clarification of the Brazilian public debate on sustainability and the introduction of biotechnology into society. This will be done by presenting some findings of a case study in the state of Pará. The findings from Brazilian and British debate demonstrate how discourses on GM differ across society and how the notion of Beck's 'risk society' (Beck 1992) holds explanatory force, discussed in section 5. It is generally hoped that some insight is provided into today's GM controversy: what is it about, what causes it and how could we mitigate the inadequate current legislation efforts and the emergence of controversy in the past years?

2.1 Environmental sociology and the upsurge of risk

The globally cultivated area with GM crops has increased 35 fold from 1996 to 2002 mounting to more than 58 million hectares in 2002 (James 2002). With America on the lead, already more than half of the 72 million hectares of soybean grown worldwide were

[1] In this paper, reference to modern biotechnology is restricted to its use in agriculture and must be understood as *the controlled intervention in DNA-structures of plants (e.g. crops) as to insert or modify genes in order to modify the behavioural traits of the plant* (cf. Dommelen & Steensel 2001).

transgenic in 2002, and 20% of all cotton yields were GM. Yet, the introduction of biotechnology does not occur silently in the course of modernity. Over the past decade, public reaction ranged from fierce rejection to moderate objections as to the safety of biotechnological applications. Disagreement manifests itself in many forms and in many parts of the world. What is most prominently at stake is the perception of risk and the emergence of novel dangers for the environment and our health. The nature of risk and its proliferation in current society is to be understood as one of the main causes for structural changes from a modern to a post-modern to a reflexive society (Leroy 1995). These 'structural changes' have been occurring in the field of technology, welfare politics, science, the individual sphere and the social and eventually relate to processes of globalisation, individualization and political modernisation (Tatenhove & Leroy 2001; Giddens 1994; 2000). With regard to environmental risks and politics, the sociologist Beck provided an influential account for a general comprehension of the changes in the political domain of society. Central is the concept of reflexive modernization, which is not something revolutionary in the form of a drastic change or breaking with the past, but seen as the radicalization of modernity which in effect put in motion a creative self-destruction, immanent and silent, of existing social life, policy-practices and democratic order. If we want to define it we could say it is 'a developmental phase of modern society in which the social, political, economic and individual risk increasingly tend to escape the institutions for monitoring and protection in industrial society' (Beck 1994: 5). We can conceive of three phases of reflexive modernization. A reflexive society is, first of all and above all, a society that is confronted with the latent side-effects of the autonomous process of modernization or industrialization. Secondly, when dangers of industrial society begin to dominate public, political and private debates and conflicts, when uncertainties are observed as central to political action, then it is presumable that ample consideration is given to the way society should cope with these threats (Beck 1996). When the latter gets embodied in durable social practices, alternative ways of policy-making and different coalitions between science and society, it can be seen as the third inherent stage of reflexive modernization, labelled as 'subpolitics'. Optimistic about the force and momentum of the social developments 'opportunities to consult and participate are growing for groups which have so far not participated in the substantive process of technification and industrialization: citizens, the public sphere, social movements, expert groups, employees on the scene, even the opportunities for individuals with civil courage to 'move mountains' in the nerve centres of change' (Beck 1997: 107). In this sense, reflexive modernization entails the emergence of extra-institutional politics beyond the boundaries of formal procedures, new forms of direct political interference and a decline of the governmental steering capacity (Hajer 2003).

When Beck nailed his statements on the walls of modernity as early as in 1986 his explanation of risk and society gained credibility and empirical significance through the unfortunate disasters and crisis, such as the Chernobyl-incident, the food scandals in the nineties in Europe, and recently with the controversy about biotechnology. However, the question may be asked what is so new and relevant about risks? Technically speaking a risk is the product of the probability a certain event to happen and the damage incurred. Uncertainties in social or economic life have long been associated with and reduced to this definition assuming that there is knowledge available about a certain event to happen (for example, a car accident) and its consequences. However, the economical and technological expansion of activities in modern times gave rise to problems with regard to the predictability and quality assessment of risks. It has turned out, for example, that the possible negative consequences of the burning of fossil fuels are extremely hard to assess. Technological developments such as genetic engineering, nuclear energy and the use of chemicals withdraw themselves by their very nature from the domain of conventional mathematical evaluation, because there are little or no *causal laws* embodied in theory that provide ground for logical

inferences for long-term, real-life effects. With the novel GM organisms ecologists have warned for the slow, subtle and long chain of events that could have dramatic impacts on the ecology, while GM protagonists argue that these concerns are imprecise or unreasonable. Scientists only seem to be able to produce controversial knowledge claims, or 'plausibility claims', constituting an 'epistemic discussion' within scientific reasoning (Schomberg 1997). In contrast, an 'empirical-theoretical' discussion copes with the interpretation of accepted theories and uncontested assumptions. This latter type of discussion could provide a consensual basis for policy-making. There are, however, little empirical-theoretical data about the consequences of GM grown crops interacting with native biological systems or the human body (Visser et al. 2000). Laboratory or short-term, small-scale field trials cannot provide reliable information to what extent biodiversity will be damaged or what the future consequences will be for our soils or our immune system, nor can we carry out the badly needed long-term experiments (see also the discussion about the British field trials in section 3).

Where hypothetical dangers and knowledge gaps prevail as in many contemporary technology related developments, the status of knowledge becomes questioned and we need to revise the technical definition of risk assessment: no longer is information on negative consequences available as an input-variable to be incorporated in 'predictive calculations' within a risk assessment, we now question the '(…) *basis of the content, reliability and validity of current knowledge'* (Strand 2001: 194, italics in original). This is where the risk society begins: the *latent side-effects* produced by industrial society exceed the bases of predictability and scientific determination and therefore constitute a kind of 'virtual reality': 'The essence of risk is not that it *is* happening, but that it *might be* happening' (Adam et al. 2000: 2). In this case it would probably be more appropriate to speak about *uncertainties* instead of risks; speaking of risks entails the notion that the probability of a certain event to happen is known or at least knowable, while with uncertainties it is not (WRR 2003). Actually, a further distinction between dimensions and aspects of uncertainty and risks could be part of an extended analytical refinement (e.g. Funtowicz & Ravetz 1990; Asselt 2000), but is omitted in the approach adopted here. A further explanatory lay-out of the terms is not deemed necessary for this paper, being more sociological in nature.

2.2 Risk construction, 'lay' awareness and science

As a consequence of the above stated, the question has emerged to what extent risk assessment can still be an exercise based on expert estimations and science-based judgment. It goes without saying that many day-to-day practices benefit from informed judgment, cost-benefit analyses and formal risk assessments. In the insurance business, risk assessment traditionally forms the overall basis of the company's management and profitability. But as risks become more pervasive and less tangible and 'low risk' could imply 'high stakes', insurers choose to abstain from insurance cover. I cite Beck who uses the lack of insurance cover as an operational criterion for the emergence of a risk society: 'The entry into risk society occurs at the moment when the hazards which are now decided and consequently produced by society *undermine and/or cancel the established safety systems of the provident state's existing risk calculations*. In contrast to early industrial risks, nuclear, chemical, ecological and genetic engineering risks a) can be limited in terms of neither time nor place, (b) are not accountable according to the established rules of causality, blame and liability, and (c) cannot be

compensated or insured against'(Beck 1996: 31, italics in original). Interestingly, GM farmers are faced with insurance bans in the UK[2].

Instead of an unproblematic employment of a scientific rationality to assess risks, science has become a source of trouble. What this means for policy-making is explained in the next section. First, it is indicated how the 'normal science approach' should be complemented by an acknowledgement of the social dimension of risks, i.e. the individual or public perception of risks induced by modern technological developments. At least with regard to health, safety and environmental risks currently at stake people tend to signal and bring up relevant issues that would not be part of an ordinary scientific frame of risk assessment. In the public domain, risks are subject of evaluation determined by human-dependent preferences. Characteristic of this non-technical approach is that it takes into account all possible impacts of a new technology in all spheres of life. Lay persons tend to incorporate a sensitivity towards the immaterial dimension of risks; they are more sensitive to social and psychological traits of the technology-driven modernization and grant more importance to the possible unintended side-effects, perceived as involuntary, unobservable and uncontrollable. This is what makes risks *constructions*: they are not given *realities* out there, but perceived as more or less frightening, more or less threatening a feeling of safety, more or less 'real', all dependent to the extent that risks penetrates people's living experience and conflicts with their socially important values (Slovic 2001). Moreover, according to cultural theory, risk perception varies not only among individuals who express divergent opinions on what is tolerable and which risks are to be tolerated, but corresponds with a culturally determined set of values, beliefs and views on nature with respect to the organization of society, the role of science and the acceptance of risks. Hence, risks are *collective constructs* (Douglas & Wildavsky 1983; Steg & Sievers 2000).

All this means that interpretations of risks obey a socio-psychological logic, revealed through a discourse or reasoning based on a broad and non-technical view. This non-technical or 'irrational' rationality shapes public opinion and demands to be incorporated within new forms of risk assessment, since a pure mathematical calculation of risk is invalidated by societal perception of dangers and uncertainties. In this sense the risk society challenges the modern scientific approach. Not only are there provisional and conflicting scientific statements, or 'structural uncertainties' (Irwin 1995) that cannot be bridged with the simple generation of more expertise, we also have to deal with issues of public accountability, trust in scientific practices, participation and lay knowledge versus expert knowledge. This has had some consequences for the way knowledge is produced and communicated.

First, an important observation stems from Gibbons (1994). Science as a subsystem with relative independent procedures and distinct authority crumbled and adapted steadily under the influence of both internally and externally induced pressures. The general notion is that the hold of the conventional mode of knowledge production is weakened and replaced by what is called a 'Mode 2' type of knowledge production (Gibbons 1994), defined by different conditions of application, the move beyond disciplinary boundaries, a differentiation of sites of knowledge production and altered and additional criteria of quality control. The latter is essential: the articulation of social demands and changed expectations of the role of science ultimately contribute to an *integration* and alignment of the scientific community with the social environment external to the previous *segregated* belief system during simple modernity when scientists upheld their epistemological code of conduct and only connections were established between scientists internally for peer reviewing. In this era science communication was the only thing to worry about for academics, implying that better education and less ignorance among the general public resolves issues of fear or resistance in

[2] 'Insurers refuse to cover GM farmers', *The Guardian*, October 8th 2003.

relation to scientific developments. But besides the fact that communication of the scientific method has always been complicated, the non-science community now poses profound questions to the nature of science as a result of the spread of uncertainty and unpredictability (Boulter 1999). The imposition of norms and objectives from outside the scientific establishment now give rise to a reconsideration of its core epistemological values of reliability and validity (Nowotny et al. 2001). The goal of this reconsideration would be to produce socially robust knowledge, similar to strategies endorsed with the idea of an 'extended peer review' from the 'Post-Normal Science' concept, induced by Ravetz and Functowicz (e.g. Ravetz 1999).

The Post-Normal Science approach takes up the challenge to improve the quality of science and environmental policy decisions under conditions of complexity. It therefore proposes an increased involvement of all stakeholders that might be affected by any kind of policy or technology issue, labelled as an extended peer community. This plea echoes widely in the literature. On the one hand, it has been recognized how public opinion is shaped by ethical and social considerations that extend the formal risk evaluation into the less accessible domains of subjective personal and cultural sense-making. On the other hand, science needs to be made socially robust as it has lost its authoritative and self-referential power in the wake of the various technological developments. This understanding has permeated policy-making objectives and scientific practices. It is at the same time congruent with the literature on lay-knowledge and a more radical epistemological turn towards an appreciation of local and indigenous knowledge. With regard to biotechnology it is argued that the position of laymen in societal and scientific debate needs be reformulated and more attention should be given to the needs, interests and concerns of the primary stakeholders the 'commoners' in the biotechnology arena (Sagar et al. 2000). They focus not just on the narrow aspects of individual technologies, but also on the broader institutional and political context in which they are introduced. A less one sighted technological-scientific approach would imply a reinforcement of local, peasant or indigenous knowledge (Sevilla & Woodgate 1997; Irwin 1995). Wynne (1996) further notes that non-institutional forms of knowledge and lay experiences have *always* been systematically ignored in modern epistemological paradigm. Ruled out from the frames of experts, the public has been 'alienated' all along the modernization process resulting in a feeling of distrust towards institutions and scientific authorities. This has been responsible for a kind of lack of legitimacy that has had its effects on policy-making customs and structures.

2.3 Policy-making and uncertainty

The risk society has implications for knowledge production and consequently for policy-making. Policy-analysts have been concerned with the types of policy-making logic that is employed under various conditions of complexity. Logically, the most 'solvable' problems are characterised by low complexity and political consensus. For this purpose, we have several scientific advisory bodies and bureaucratic coping structures in place. This could be called an expert-oriented model. But that model of decision-making and the authoritative status granted to science on technocratic grounds has been diversified and revised with regard to the considerations mentioned above. Comparable with Hisschemöller & Hoppe (1996) Pellizoni (2001) offers a four-type summary of policy solving strategies. In figure 1 we distinguish four types of problem structures and corresponding policy-making logic defined by the score of the issue at stake on the continuum of the dimensions *knowledge* (contested-uncontested) and *discourse framing* (unity-plurality).

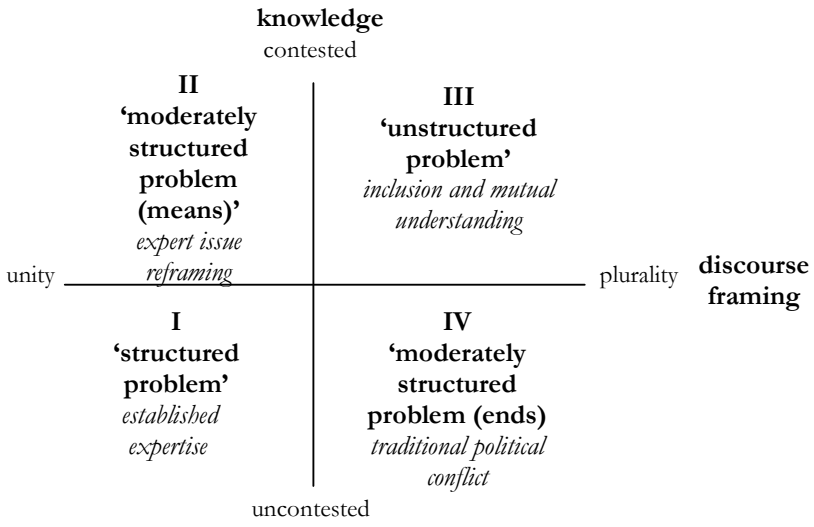

Figure 1, Uncertainty, policy discourse and policy-making (based on Pellizoni 2001 and Hisschemöller & Hoppe 1996)

For policy design, structured problems present the least difficulties as mentioned above. In type I a 'structured problem', bureaucratic logic and the input of expertise are most common strategies to solve public policy issues. Type IV 'moderately structured problems' represents the traditional framing of politics, when political priorities and interests differ across society ('ends'), but, similar to type I, there is certainty about relevant knowledge. A different situation occurs when issues on the policy-agenda give rise to scientific dissent. When such an issue is not salient and debate does not include wider public involvement, contesting norms or values, the most appropriate strategy would be to reframe the issue in a cognitive sense (Type II). This sort of a 'moderately structured problem' lack certainty about relevant knowledge and implies that 'means' and policy-measures must be sought for. However, with 'intractable' or 'unstructured problems' the situation differs to the extent that neither clear guiding norms are agreed upon, nor do policy-making institutions possess sufficient knowledge (either qualitatively or quantitatively) base policies on. The proposed solving strategy would be something like creating the right conditions for an extension of the existing knowledge/ value community, which needs to focus on the inclusion of insights, local and contextual knowledge(s), and the inclusion of different discourses and values throughout the policy process. Participation then means a public review of science and its risk assessments, public access to information and an open debate where different values are respected and the conditions for all parties are equal. Many alternatives are recently tested and developed under the headings of 'Participatory Technology Assessments', 'deliberative democracy' and 'Post-Normal Science' (e.g. Pellizoni 2003; Sluijs 2002; Joss & Bellucci 2002).

Many of the contemporary policy problems are of such a complex character that they are to be categorized under the label of 'intractable' or 'unstructured', including agricultural gene technologies or adjacent issues that spring from the dichotomies that bear responsibility for the clashes that frustrate society at large. These clashes include: economic activity vs. environmental damage, scientific innovation vs. the creation and proliferation of risk, public risk perception vs. conventional risk assessment, institutional belief in regulation vs. organized irresponsibility, lay knowledge vs. scientific knowledge and more. This does not mean that governmental institutions and policy actors, faced with intractable problems, still

heavily rely on conventional scientific consultation or limited forms of representative democracy. This is understandable. It has been our current and past custom to rely on the expert definitions of risks. The provisions of technical norms, 'acceptable risk levels' or exposure rates is in an ideal-typical view in the hands of experts that base their judgment on profound scientific investigation and experimentation. Experts and their expert-knowledge are granted the status of 'guardians of truth' (Giddens 1994) and something like a blind trust has prevailed within our institutional, democratic and scientific practices. But in many instances – and to an increasing extent with the proliferation of novel technologies – the expert reliance and the 'science-centred' approaches (Irwin 1995) tensely contrast with public and 'lay' assessments of risk and technology (Wynne 1992; 1996; Irwin 2001). This leads to the paradoxical insight on the relationship between expert authorities and citizens: the public does not trust and feels belittled by expert authorities, but yet appeals to scientific authorities enforced by their dependency on science for information to frame their complex surroundings and to invent possible solutions for environmental and other problems (Healy 2001). In Weberian terms, society and politics still helplessly cling on to a conventional functional relationship with science (Schomberg 1997), while unable to cope with many of the tensions that are brought about, flattered by the spread of uncertainty and high-decision stakes. Beck would call this 'organized irresponsibility' understood as the fragmented and limited political capacity to cope with crisis, claiming to control and act in accordance to threat, but still dependent upon a kind of regulation and organization that leaves little room for a thorough consideration of the demands of pressing policy problems.

On the other hand, it is hard to digest and to understand that many policy problems are still categorized as moderately structured or even structured problems whereas a characterization in line with Type III of figure 1 would be more appropriate instead. Earlier experiences with environmental crisis and food scandals have fed the public's doubt that science and institutions are able to control or impede unintended side-effects to happen. GM scepticism is in a way logical given the risk management absurdities in the case of BSE (Miller 1999; Jasanoff 2001), demonstrated by the lack of confidence, present in western countries and in development countries as to the extent regulatory agencies can ensure a proper implementation of biosafety guidelines (Aerni 2000). In other words, we should expect that a mere technocratic approach to frame complex questions that include socially divergent values and uncertainty in knowledge would be abandoned at the gain of solving strategies from an innovative order. This has not been so obvious with respect to the decision-making process for agricultural gene technologies[3] in Europe or Brazil, to which we will give attention in one of the next section. Predominantly, it is expected that quantitative data, scientific reports and eventually more knowledge will serve as a sound basis of legitimacy for policy-making, while lacking proper social consultation. As Slovic (2001: 23) says: 'trying to solve risk controversies primarily with more 'sound science' is, in fact, likely to exacerbate conflict'. This has led to a situation in which knowledge is used strategically and every viewpoint is disqualified with the use of a counter-expert. The British GM debate is an illustrative example. In the subsequent section the Brazilian GM debate is analysed to extend our view on the sustainability debate and GM in a non-western setting. In both situations the risk society thesis explains much of the fuss: risks are negatively evaluated, NGOs and consumer groups rise, policy-making is far from unproblematic and views on science diverge drastically.

[3] Note that 'intractable problems' should not be identified solely with GM regulation and other infamous debacles such as climate change or BSE. A study of four massive projects in the field of Dutch environmental planning in the nineties showed how contested knowledge claims coincided with a lack of agreed guiding principles (Veld 2000).

3. Biotech controversies in effect and out of control

In Great-Britain about 90% of the population is reluctant to approve biotechnology for food and agricultural purposes and question the safety-issues[4]. Their skepticism concerns either biotechnology as a whole, or expecting at least some kind of a positive trade-off between benefits and risks before a commercialization of GM foods should take place (Gaskell et al. 2003). The controversy recently reached new heights with the publication of the so-called Farms Scale Evaluations (FSE) published by the Royal Society in October 2003 (Royal Society 2003). The long-awaited report dealt with the effects of genetically modified herbicide-tolerant (GMHT) varieties of sugar beet, oilseed rape and maize on the country's biodiversity. The FSE showed that GM rapeseed and beet in a combined usage package with herbicides bear a disastrous potential for the existence of bees, butterflies and beetles, and eventually farmland birds, as weeds and small insects disappeared. Scientists have been surprised by the consistent character of the extended field test results, showing for the whole of Britain a 'dramatic' decline in farmland biodiversity[5].

In the backwash of the publication, the debate gained new momentum as opponents and proponents articulated their position once again, thereby interpreting the scientific findings of the biological traits of GM plants and its accompanied use of pesticides for their own good. The biotechnology industry stated that the tests 'were not GM on trial'[6], a correct phrase if we realize that it is not the technology on the whole that should be judged, but only the varied applications of weed killers[7]. Of course, environmental groups reacted more strongly, because reliable data present some of the negative interactions between GM crops, herbicide use and nature impact. It has been remarkable that despite the efforts to produce authoritative answers for pending GM issues, scientists are divided, sometimes even 'displeased' with the design of the field trials and commonly warning for the difficulty to generalize, suggesting that more research needs to be done (Andow 2003). This is certainly true if it is realized that ecosystem disruption of GMHT crops is only but one of the many dimensions that deserve further investigation. For example, in environmental respect we have to consider the possibility of chemical pollution with the *increase* of pesticide use in GM agriculture, in spite of industry claims that assume less pesticides are necessary (Benbrook 2003). One consequence of a less discriminatory application of pesticides associated with GM tillage could be the development of weed and insect resistance and higher contamination levels of ground and surface water. Possibly more worrying is the case of genetic pollution which is pretty much in dispute in scientific circles (Perry 2003; Snow 2002). Both GM maize and rapeseed show signs of unwanted cross-pollinization with wild relatives (Quist & Chapela 2001; Wilkinson et al. 2003; DEFRA 1999)[8] and all other GM crops are to some extent capable to reproduce autonomously and to endanger genetic diversity. The human induced spread and use of GM seeds further contributes to genetic pollution, since a separation of GM

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4 See http://www.gmnation.org.uk/

5 See the coverage in the media, for example: 'Number 10's wildlife experts warn against GM damage', *The Observer,* October 19th 2003 and 'Birds and the bees: how wildlife suffered', *The Guardian*, October 17th 2003.

6 'Outright ban, caution or green light?', *The Guardian*, October 17th 2003.

7 'UK field-scale evaluations answer wrong questions', *Nature Biotechnology*, vol. 21, no. 12, December 2003.

8 The Quist & Chapela publication in Nature (2001) stirred much debate; in subsequent letters to Nature, critics accused both authors of 'bad science' and the editorial board of Nature revoked the article. Others reacted that Nature and the biotech-funded critics of Quist & Chapela were acting in defense of GM industry-interests, rather than opening up the debate on GM maize contamination. Chapela eventually has been denied tenure at Berkeley University as a result of a highly controversial 'illegimate' and 'corrupted' process of tenure evaluation (see 'Berkeley accused of biotech bias as ecologist is denied tenure' *Nature*, vol. 426, p. 591). Recent publications with regard to the decline of maize diversity due to alleged GM contamination to be found on http://www.etcgroup.org/article.asp?newsid=410 and http://www.etcgroup.org/article.asp?newsid=409.

varieties in non-GM seeds and crops is hard to manage (IPTS 2002) or at least costly, both for regulatory institutions as for the industry – such has been the case for Aventis with the StarLink-maize food crisis in the US in 1999[9].

In addition, still little is known about the safety of transgenic food for human or animal consumption. It could cause allergenic or even pathogenic reactions, of course differentiated for each GM product. The fact that consumers in the US are at first sight not suffering from any alleged health problems due to the consumption of GM ingredients still little says about long-term effects, neither is there any research done on this subject since the traceability of GM is virtually absent, so disabling the linking of pathogenic patterns with GM food consumption (Smith 2003). There are also socio-economic issues that demand attention in the international debate on biotechnology. Firstly, it is still to be seen if GM crops turn out to be more profitable in comparison with conventional varieties that are not accrued with the costs of patent rights or increased costs due to a combined herbicide package. Monsanto's GM soy Roundup Ready has not led to substantial productivity increases since its introduction (Benbrook 2003)[10], nor do we oversee the economic dynamics of soybean in the marketplace, which rather invalidates the potential profitable results of GM use than strengthening the industry promises (Sonka 2003). Secondly, there is the liability-issue: who is to bear responsibility, financially or legally, for the co-existence of both GM crops aside conventional varieties in case 'something goes wrong'? The court ruling against the Canadian farmer Schmeiser vs. Monsanto is the more illustrative in this respect, showing that '[Genetic] pollution as a practical problem, and as an object of intense scientific controversies, was ultimately deemed irrelevant to the Court's reasoning, and to patent infringement cases more generally' (Lezaun 2003). Interestingly and noted before, UK insurance companies decided to ban GM technologies in agriculture from insurance cover, thereby deeming the risks of GM too high in relation to their benefit analyses[11]. Thirdly, the gene revolution has raised awareness with regard to corporate power, intellectual property rights, food security and the dominance of just a few companies in the agricultural seed, pesticide and food processing business (Bijman 2001). Lastly, special consideration should be given to the position of developing countries and their specific challenges with regard to GM in agriculture. We shall go into some of them in the next section.

This brief characterization of the GM debate and its dimensions is far from conclusive, leaving aside many details, its ethical dimension and the implications for policy-making. It is actually unfeasible to establish which aspect is the more important or to say who is right and who is not; industry inspired one-liners and blatant anti-GM rhetoric dominate at least in the UK coupled with either a severe distrust in experts, science as a whole and regulatory institutions to cope with risks, or either accusing the 'antitechnology zealots' for frustrating scientific development. What we have instead is first, lack of certain knowledge on consequences and effects of GM or in the words of figure 1, contested knowledge claims. Philosophically spoken, we have to deal with the 'unavoidable problems of epistemology (in coming to know about the world)' (Irwin 2001:168) which leads us in a second instance to reflect on the GM case in a rather sociological manner, presuming that worldviews and personal and collective convictions shape in fact our belief in technology, science and the manageability of risks. This reverts to diverging values, priorities and a plurality of discourses. Although the science discourse demanding ever *more* knowledge to enlighten our path is still vivid (e.g. Miller 2000; 2003), many in the GM debate have already endorsed a different view.

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[9] 'Liabilities and Economics of Transgenic Crops', *Nature Biotechnology*, Vol. 20, pp. 537-541.

[10] See also research from the University of Wisconsin-Madison on: http://soybean.agronomy.wisc.edu/education.htm. For Brazil, please check: 'Com transgênico, cai produtividade dos EUA', *Folha de São Paulo*, October 5th 2003.

[11] 'Insurers refuse to cover GM farmers', *The Guardian*, October 8th 2003.

The 'sound science' slogan for risk regulation is rather an ideology, since '(…) a purely science-based regulation can never be achieved' (Levidow & Carr 2000: 269). In this view, another technical account on specific physiological interactions of GM crops in the environment seems superfluous and of less interest since, as Lord May of the British Royal Society stated: 'much larger questions need to be answered about the kind of world we want to live in. Social and environmental choices about agricultural practices and their impact need to be made before we look to science and technology to help provide the solution'[12].

As we shall see, the features of the Brazilian debate are somewhat similar to those explored in this section. In both countries some profound controversies lie at the heart of social discussion.

4.1 The GM debate in Brazil

Developing countries and their agricultural potential soon became focal point in discussions as the biotechnological revolution took off. The 2001 United Nations Human Development report, for example, chose to be optimistic about the opportunities of applied biotechnology, provided that national strategies and global initiatives are undertaken to encourage Research & Development and risk-management (UNDP 2001). The promise of biotechnology as a 'new science for development' is actually quite broadly underlined (Acharya et al. 2003) but this hasn't prevented the spread of dissent and conflict within the many political, social and scientific arenas of discussion in the different countries in the South. On the contrary, the possible introduction of GM probably stirred more debate than in a European context.

Let's broaden our scope with some information about the Brazilian public debate. First of all, whilst a court ruling from 1998 elicited by Greenpeace and consumer organisation IDEC has prevented a large-scale liberation of transgenics so far, contamination of soybean fields with the GM Roundup Ready variety has taken enormous proportions. It is estimated that between 10 and 20% of the domestic soy harvest is GM. For 2004 this percentage will be around 25%[13]. Above all there are economic interests. Brazilian soybean market is extremely important for Monsanto's business prospects. Brazil's capacity and expansion potential to cultivate soy is impressive. FAO statistics point to 16,4 million hectares of harvest area of soybean agriculture with a production volume of 42 million metric tons in 2002 representing a 24% share of worldwide soy production. It is thereby the second largest exporter of the world of soy grains and oilseeds, after the USA. One can imagine Monsanto's high expectations if the soybean farmer population in the South and in Central Brazil would adopt GM seeds. The core argumentation of Monsanto and agro-industrialists is that the newly developed varieties would decrease the need to apply herbicides, bringing more welfare to Brazilian farmers. Less use of pesticides and a better growing cycle would enhance yields. Lobby activities of Monsanto to legalize GM soy exceed the traditional efforts to persuade government officials and members of political parties in the capital. In November 2002 and re-initiated in the autumn of 2003, Monsanto launched a massive campaign to influence public opinion, which included prime-time television commercials on national networks and the supply of reading material for schools. In a journalistic setting, viewers are explained the benefits of GM in order to positively influence public opinion and to facilitate a possible liberation of GM crops that could bring million dollar profits for the company (Kesan 2000).

Will the country lose markets if it lags behind in biotechnological improvements in soybean production? The anti-GM position – besides battling with anti GM-arguments out of

[12] 'Debate on GM crops 'beset by confusion', *The Guardian*, November 25th 2003.
[13] 'MP 131 intensifica comércio de sementes transgênicas', *Folha de São Paul,* October 20th 2003.

concern over the environment and human health – also uses an economic rhetoric as they claim to listen to the European call for GM-free products. In comparison with conventional methods of growing or even with organic cultivation of soybeans, costs per hectare have not shown to become substantially lower with the use of GM seeds (Weid 2001). Especially when a monopoly on seeds becomes in the hands of one multinational, it is feared that farmers are made dependent upon the supply of GM seed and accompanying herbicide. Their socio-economic position could worsen in this respect. On this topic it is even stated that of all farm systems and options for soybean cultivation, small ecological-organic family farming should be preferred above chemical and machinery intensive tillage, as well as above modern transgenic cultivation. In their assessment of organic agriculture by Ortega et al. (2002), the overall socio-economic performance in terms of employment rates and profitability is better and production takes place within the parameters of sustainability.

Factual developments and prospects look gloomy for those organisations united in the campaign 'For a GMO Free Brazil'. They complain about the lack of control by the Federal Police and the omission of the Ministry of Agriculture to restrict the large scale smuggling of transgenic seeds from Argentina. Instead of a reinforcement of the government's responsibility to counter any illegal form of cultivation or commercialisation of GM crops in anticipation of future policies or court decisions, the Federal Government granted a temporal legal status to GM harvests of the year 2002/2003 by means of Provisional Measure 113/03 (now converted into Law 10.688/03), allegedly pressed by the powerful Southern Federation of Agriculture and Monsanto. For environmental and consumer organizations, this measure was a frantic act of a desperate government, unable to constrain the illegal dispersal of GM crops any longer. In September 2003, the regulatory powers went a step further with Provisional Act 131/03 (Law 10.814/03) that issued, with some binding conditions, the free planting and use of GM soy seeds for the current growing season (USDA 2003). In the capital state of soy production Rio Grande do Sul about 33 thousand soy farmers have already indicated to adopt GM soybeans by signing an agreement with terms and references for this year's harvest. The total number of GM practitioners is probably much higher, but many farmers fear elevated costs of production as Monsanto has already announced to claim their patent royalties for every hectare of GM soy grown[14].

Whatever the moves of Southern farmers to adopt transgenics and the government steps towards a complete legalization of GM products, it has extreme relevance for Europe. The countries in Europe take almost 80% of their total soy imports from Brazil as the European moratorium on GM is still in effect. If Brazilian's position as a predominant non-GM country is affected or completely lifted, Europe has no alternative left to satisfy their demand for GM free products. The fate of Europe is connected with the fate of Brazil in this respect.

4.2 The case of Pará

With its natural resources, high biodiversity and rich cultural background descending from Indian and colonial tradition, many say the state of Pará in the Northern region of Brazil is a privileged state with great potential for the future. However, it is confronted with some persistent problems related to poverty. The federal government has attempted to bring development to the Amazon region since the seventies by constructing roads crosscutting the vast area of forest. Instead of a transformation of the unexplored Amazon into prosperous rural and urban communities, the development of the Amazon has not been so positive so

[14] 'Maioria dos produtores de soja do RS não assina TAC', *Folha de São Paulo*, December 10th 2003.

far. The vulnerable Amazon soil did not produce the high agricultural yields that were hoped for in the seventies and large-scale soil degradation and erosion took place. In the forested areas, illegal or at least unrestrained logging is considered a problem. Governmental control is complicated and nature preservation has only become an issue in the early nineties and since then environmental policies have only been weakly institutionalised. Poverty in the Amazon and Pará is comparable to poverty elsewhere in Brazil, but rates of illiteracy are higher, health care is worse and education is many times out of reach for the smaller communities near the many rivers. In the cities, things are not much better either. To manage issues of poverty, unemployment and the destruction of nature, Pará and other states in the North need to make enormous social and economic investments that surpass the available means.

This has been the background for a case study about the GM debate, a study limited to the confines of Pará in the first place, but not without relevance with regard to the Brazilian or western debate. Interestingly, Pará is not noteworthy as a soybean producing state, nor is there any relevant institutional engagement with GM research. Those farmers who are actually planting soy in some of the Southern parts of the state in the past few years have recently signed an agreement not to meddle with GM seeds, even when national decrees do allow the use of GM. In fact, it has been the first Brazilian state to ban transgenics by law for a period of two years (Law no. 6.328). The expression of this early concern could have its origins within other forms of social and political engagement over biosafety, environmental degradation and international concern over biodiversity in the Amazon region. Internationally funded NGOs and local environmental groups actively monitor western biotech companies that are accused to plunder the Amazon germoplasm, taking samples of medicinal plants in order to patent them in a later stage. The benefits of these pharmaceutical or agronomical 'inventions' rarely return to the region of origin (Macer 2001). Although current GM applications do not entail any Amazonian ingredients, the whole GM story does evoke some resentment in line with concerns over biopiracy. NGOs and social movements have thus been engaged from an early stage with the biotechnological development.

Interested in the content and configuration of the debate in Pará, I followed the 'political stakeholder' approach adopted by Aerni (2001a/b) to reconstruct the meso-level stakeholder engagement with biotechnology, assuming that '(…) it is the perception of the political stakeholders rather than the perception of the public at large that counts in public policy. In turn, these political stakeholders also depend on a certain degree of public support. In other words, they are in need of public trust to enhance their freedom of political action' (Aerni 2001a: 8). With a limited timeframe for this case study (from January 2002 to May 2002), it would have been too ambitious a task to include micro-level experiences from farmers and consumers. Besides, public awareness on the issue is generally low. Political stakeholders better perceive what development lies ahead of them and have better access to information (Ibid.).

I have identified several stakeholder groups for the research, namely the 'Government', 'NGOs', 'Farmer Organizations', 'Research Institutions' and 'Industry' with in total 22 participating organisational or institutional representatives. They are shortly mentioned in the scheme below; those participating with the questionnaire are marked with an asterisk. Through conversations, in-depth interviews and a semi-quantitative survey, filled in by 16 representatives, I gained a quite clear picture about the (a) general attitude towards Brazilian agriculture and biotechnology, (b) views on citizen participation, (c) trustworthiness of stakeholders in the public debate, and (d) relations of power and influence. Each subject will be explored below. In the conclusive section these issues will be related to the theoretical part of this paper and the British debate.

Stakeholder group	Name	Stakeholder group	Name
Government	SECTAM – State Secretary of Science, Technology and the Environment of Pará*	Non-Governmental Organizations (NGOs)	SOPREN – Society for the Preservation of the Natural and Cultural Resources of the Amazon*
	Federal Delegacy of the Ministry of Agriculture in Pará*		FASE Amazônia – Federation for Social and Educational Assistance*
	SAGRI – State Secretary of Agriculture of Pará		Environmental Association of the Amazon 'Os Argonautas', Pará*
			FASE Brazil
	Public Ministry of Pará*		Greenpeace Brazil
	Agricultural expert, Department of Agriculture, Brazil*		IDA – Brazilian Institute for Environmental Development*
Farmer Organizations	FAEPA – Federation of Agriculture of Pará*	Research institutes	EMBRAPA Amazônia Oriental – Brazilian Research Institute for Agriculture, Pará*
	Syndicate of FAEPA Bragança (Pará)		EMBRAPA Trigo (wheat), Brazil*
	FETAGRI – Federation of Rural Workers of Pará and Amapá*		INESC – Brazilian Institute of Socio-economic Studies*
	Syndicate FETAGRI Jacundá (Pará)		FUNDACEP – Centre of Experimentation and Research of Fecotrigo (wheat)*
	FAEMG – Federation of Agriculture of Minas Gerais*	Industry	Pioneer Sementes Ltda.*
			FMC Agrochemicals

Table 1, Stakeholder groups and stakeholders

4.2.1 Discourses on biotechnology in Pará

The creation of modified plant varieties and its pace of development could give the impression that we face some urgent problems that need to be resolved by means of more recombinant DNA-technology and research. After all, GM crops are meant to bless production numbers and enhance the farmer's welfare. Will it succeed? Does it lie within the scope of GM-techniques to play a decisive role with regard to food security, the farmer's income and environmental benign tillage? For what does biotechnology actually serve and what can we expect? The core question becomes whether biotechnology is expected to solve Brazilian agro-economic problems. Figure 2 is the result of the answers of the participants on two related questions in the questionnaire, first: indicate to what extent the issue mentioned is to be considered problematic for the development of Brazilian agriculture on a scale from 1 to 4. At the same time, it was asked whether GM could potentially contribute to overcome or lessen the problematic situation, ranging from 1 ('has no potential') to 4 ('has great potential').

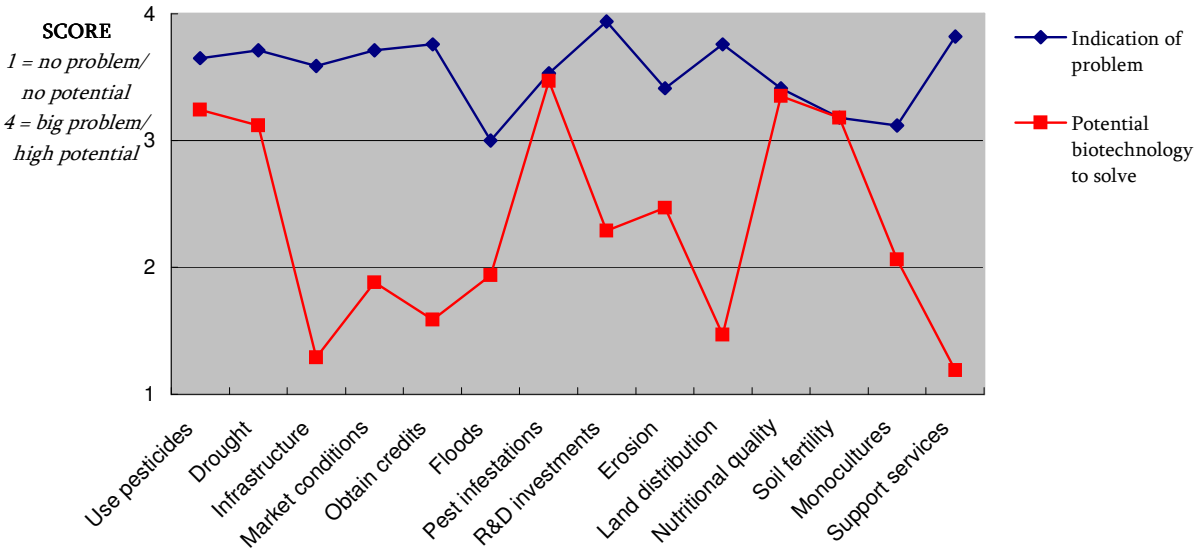

Figure 2, Perceived problems in Brazilian agriculture and potential for GM to solve them

We can see that biotechnological solutions are somewhat expected to overcome problems related to 'pesticide use', 'drought', 'pest infestations', 'nutritional quality' and 'soil fertility'. Biotechnology has little or very little potential when we consider the more fundamental social problems that frustrate successful agricultural growth and development (cf. Aerni 2001a). To improve the basic conditions for a balanced socio-economic development of Brazilian agriculture, some basic problems related to infrastructure, market conditions, credits, land distribution and support services need to be tackled, something which is, according to the respondents, not expected to be achieved through the input of more applied biotechnology. It is surely true that we can expect new GM crops with modified features to withstand natural climatic constraints or enable farming techniques to become more efficient. But many structural problems will continue to exist, even when groups of farmers decide to switch to GM varieties. Whether the overall position of the Brazilian agriculture is benefited by biotechnology remains to be seen. Or, as the director of the rural workers federation of Pará states: 'Even when GM applications would become accessible for our farmers, they still need a market for their products. We have to think on a micro-level'. Here we could draw a parallel with the Green Revolution in the seventies and eighties: subsistence farmers see themselves confronted with the hurdles that characterize small-scale farming: the success of the introduction of GM crops depends upon the possibilities for small-scale farmers to modernize, to obtain medium-term credits or receive better education and access to markets (Arends-Kuenning & Makundi 2000; Scoones 2003).

This first impression does not discriminate between different parties involved in the public debate. Figure 3 therefore is based on the combined answers given on 14 statements either formulated positively or negatively toward biotechnology. A zero score would imply a 'very negative' attitude, while a 3 score would imply a 'very positive' attitude, whereas a 1.5 score or higher must be conceived as moderately positive. A predominant positive stance is taken by the biotech venture Pioneer together with three research institutes (EMBRAPA Pará, EMBRAPA Trigo and FUNDACEP), two agricultural federations (FAEPA Pará and FAEMG) and the state secretary of Science, Technology and the Environment in Pará. Some NGOs linked to the anti GM-campaign together with the rural workers association FETAGRI, the state

secretary of Agriculture and the Public Ministry of Pará represent an attitude in which caution towards biotechnology is more common.

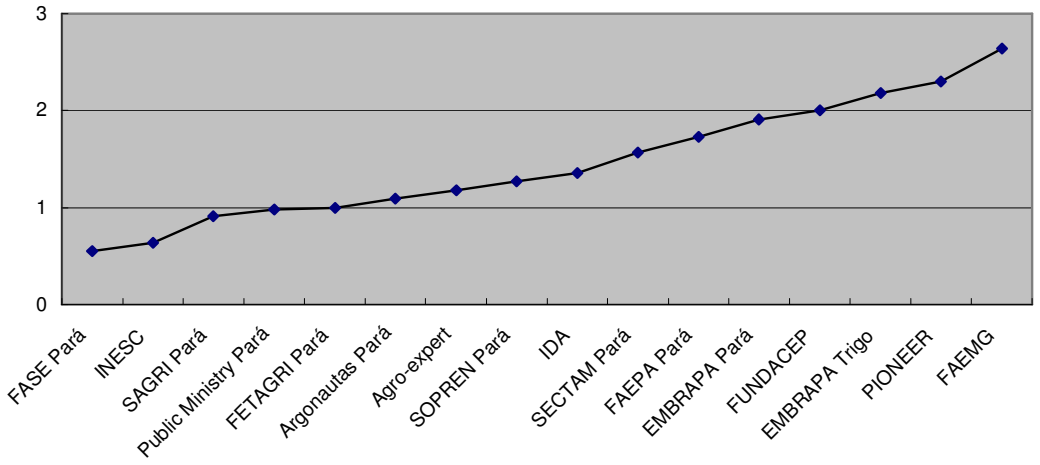

Figure 3, General attitude towards biotechnology based on questionnaires.

Naturally, the above figure only indicatively displays the stakeholders' association with a negative or positive attitude towards genetic engineering. Those parties involved in the public debate in Pará have been scrutinized more thoroughly. I have found it useful to order the statements, ideas and convictions held by the stakeholders according to four areas, being a 'general view on biotechnology', 'socio-economic considerations', 'environmental and health considerations' and 'opinions on policy-making'. This has led to table 2 that summarizes the positions adopted in Pará.

Outspoken entities in favour of the development and introduction of biotechnology in Brazil, such as EMBRAPA and FAEPA see biotechnology as a 'big promise', 'a second Green Revolution that will benefit all', or a 'tool for progress'. They stress that the debate about genetic engineering should start from the premise that virtually all vegetal material can be modified genetically, which could provoke enormous changes in agricultural productions systems, 'generating creative alternatives to enhance production and productivity of foods with environmental safety and reduced costs' (EMBRAPA 1999).

Government agencies are more neutral about the GM development, for example, the Public Ministry has no institutional position pro or contra GM, but it lies within the scope of its competency to protect the citizen and the environment with all means possible[15]. In a similar way SECTAM sees it as one of its responsibilities to implement biosafety policies, while at the same time stimulating GM research. A more radical stance is taken by the NGOs in Pará. Besides their struggle in defence of the Amazon forest, their mission is to 'criticize, reject and accuse the basic arguments that are used by those who accept transgenics. There is nothing scientifically proven, if it does harm or not, and this argument should be more than sufficient not to accept GM'. This elicits the bold statement that science is part of the problem: 'Forget the idea that scientists can solve anything. They don't. They create dreadful problems'[16].

[15] Personal communication with a representative of the Public Ministry.
[16] Personal communication with Mr. Viana, SOPREN.

	General view on biotechnology	Socio-economic considerations	Environmental and health considerations	Opinion on policy-making
Positive towards GM	• FAEPA, EMBRAPA, SECTAM in favour of biotechnology • GM is 'promising technology with unlimited possibilities' • Scientific progress for welfare and well-being	• GM presents economic benefits (productivity increase) • Higher yields ensure food security • 'Corporate responsibility' prevents the abuse of power of multinationals	• Scientific evidence of environmental damage is lacking • Advantage of decrease use agrochemicals • Enhanced nutritional quality	• No bans or rules to halt technological innovation • CTNBio is competent authority • Certification to satisfy consumer
Negative towards GM	• NGOs, FETAGRI, Public Ministry oppose • GM can be important but so far presents unnecessary risks • 'Science is part of the problem' (SOPREN) • All agree: fundamental agricultural problems not solved by biotechnology (figure 1) • Struggle over agricultural models	• Power multinationals vs. position farmer • Monsanto deploys aggressive strategy • Sovereignty over national food security endangered • Amazon 'colonized' by the West (through patents and corporate power) • Agro-ecology better alternative for small farmer	• Too little research about effects of GM in nature/ human body • Genetic pollution • Food safety and human health are possibly in danger • Amazon ecology demands great caution • Modern agriculture and soy cultivation is devastating for nature • Agro-ecology better alternative	• Adherence to precautionary principle implies a moratorium • Policies must reflect society's concerns • CTNBio is not representative for society • Environmental Impact Assessment must be obligatory prior to release of GMOs • Governmental control is lacking both in Pará and Brazil • Certification very important

Table 2, Summary of arguments in favour or against agricultural biotechnology, Pará.

With regard to possible environmental and health damage, there is the general concern that GM creates new health and environmental risks. One observation by the chair of Os Argonautas illustrates this: 'GMOs can cause reactions in the human body which are difficult to trace. It can cause allergies or give immunology problems, which are maybe only visible after many years. It could diminish the natural resistance of newly born babies'[17]. More fundamentally, there is the conviction that GM fits all too neatly in the process of the modernization of agriculture that only benefits some big landowners (Shantharam & Montgomery 1999). Soy is among those plants that promote the clearing of land, mechanization and the large scale use of pesticides: 'This current model of development privileges extensive agriculture and biotech industries. It increasingly shows to be unsustainable because it more and more dissociates man from nature. This typical aggressiveness of man against nature is now responsible for the creation of aggressive GM plants who reproduce their characteristics without any control. It is like a snowball that grows and only explodes in the hands of our grandchildren'[18]. A member of FASE puts it more bluntly: 'It's a fight, a struggle over agricultural models. The conventional model of mechanization, risks and with an enormous environmental impact versus a model that is more adapted to the Amazon and the soils here. (…) The interests of big farmers are antagonistic to those of subsistence farmers. They are only interested in quick profits. It is

[17] Ibid. A similar expression of concern comes from the director of FETAGRI: 'Fifty years ago, nobody probably could think of so many diseases and types of cancer that have emerged through the use of chemicals on foods. With transgenics there could appear another couple or more diseases'.

[18] Personal communication with Mr. Paixão, Os Argonautas.

very common in Brazil to treat the environment, the ecosystem as a place to make money, where you can abuse natural resources. Some species of wood already show signs of extinction; mining products are sold for low prices on the world market and it only causes huge holes. Finally, the cultivation of soybean is starting to become popular in the southern states of the Amazon region. They use techniques that are based on the Southern climate of Brazil, but the Amazon reality and ecosystem is completely different. Soy plantations are very extensive, which means that forests must be destroyed and large areas of land have to be cleared. If we know one thing from the Amazon, it is that soils will degrade rapidly when there is little vegetation. Further, soy is aggressively treated with agrochemicals, which can easily spread in the groundwater through heavy rains and the many rivers. Besides, soy introduces new pests that formerly would have taken twenty years to reach the Amazon. Soy plantations will further aggravate the concentration of capital and labour extensive agriculture. Unluckily, the governments in various states in the region stimulate projects for soy production.'[19]. This kind of reasoning is underlined by all other GM skeptics.

On the other side, we find those optimistic about the possibilities of biotechnology. The economic advantages seem out of dispute and environmental problems are not expected: 'There exists a risk, but for the moment we don't believe that there are any technical-scientific indications around the world that show beyond doubt that product X or Y derived from genetic engineering, has caused certain harm to environment X or person Y (..)'[20]. Besides, we should 'show trust in the self-regulating capacity of companies' and their will to act 'sufficiently ethical and socially responsible', as is stated: 'A company will only make profit if it has a good product. A product needs to be good in every way, it has to be efficient, effective and it has to comply with norms of safety that are formulated by society'[21]. Actually, most stakeholders seem to acknowledge that governmental control is far but effective, but most pro-GM entities at the same time believe in the regulatory power of the main Brazilian ruling agency, the Technical Committee on Biotechnology (CTNBio). For example, FAEPA puts emphasis on the potential positive effects of GM for Brazilian agriculture and rejects too strict policy measures that impede society to reap the benefits of GM technologies. In general, prohibitions, bans and rules will complicate technological development and halt economic progress. Hence, the installation of a moratorium on whatever policy level would be ridiculous. Similarly, EMBRAPA has full faith in the political will and power to control adequately the GM development (Fontes 2003). The moratorium in Pará that lasted from 2000 until 2002 is labelled 'a farce', an unnecessary restriction for the development of science: 'here they are still planting maize in the way of the Indians. How can you just forbid any development? You can't reach the moon on a bicycle, can you?'[22]

This great faith in policy regulations or even the self-restriction by commercial companies is not shared by most NGOs: by putting up rules for private enterprises the government should ensure that the fruits of GM technologies are accessible for all rural classes and no unnecessary risks are taken. But, laws are not being complied with, control is lacking: 'The government knows what to do! But it does not undertake any action because there are big economic interests behind the GM development. These industries finance the campaigns of the president and federal deputies. As long as the government is involved with this neo-liberal ideology, they won't do anything. They know for example that if they would invest in organic agriculture, markets in Europe and Asia would open up, but right now they are more allied to the North-American politics that privileges the biotechnology industries[23]'.

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[19] Personal communication with Mr. Gasparin, FASE.
[20] Personal communication with Mr. De Andrade, EMBRAPA.
[21] Ibid.
[22] Ibid.
[23] Personal communication with Mr. Paixão, Os Argonautas

The government is accused to be incompetent and little motivated to do anything about questions of safety. The CTNBio is not regarded as a representative organ of society, nor do their regulations suffice to guarantee a safe introduction of GM in Brazil. Environmental law and judicial decisions urge the authorities that an Environmental Impact Assessment (EIA) should take place before any kind of GM is liberated. This has not yet been acknowledged by the CTNBio. Other entities in Pará also support the moratorium and stricter legislation, especially since certain constitutional articles cope with environmental protection. The Public Ministry states: 'One of the social values that are laid down in constitutional terms is to preserve the environment and national biodiversity for the sake of the citizen's well-being. (…) We must relate the question of biotechnology to those norms that are established to prevent any damage to the environment which means that the precautionary principle should be honoured'. More than any national legislation, the international convention on biodiversity could provide a normative framework for a clear implementation of the precautionary principle.

Concluding, it should be clear that the debate transcends the interpretation of technical risk assessments, addressing some crucial points about man's domination over nature and its subsequent pursuit of economic gain. Different arguments seem to originate from fundamentally divergent views on science, nature and society, similar to the pattern observed in the British debate earlier. The public debate eventually is about discordance in an ethical sense, here to be understood as the acknowledgement of different cultural, religious and political values that shape diverging worldviews. Consequently, public values form the bottleneck and the basis of social controversy about biotechnology (Paula 2001). These visions seem to culminate into two distinct models on sustainability, one where humanity should try to establish a relationship with nature based on the natural constraints and possibilities of the natural system, its biodiversity and the place of the human community within, and one where the conventional modern paradigm about economic prosperity and universal scientific progress dominates. Both claim to offer sustainable solutions for environmental and social problems, one using the rhetoric of market efficiency and the other through small-scale agro-ecology (Levidow 2000). Resistance to GM in this case amounts to a particular engagement with the concept of 'sustainability' that includes a rejection of the Northern model of development, one that is associated with tremendous inequalities between rich and poor countries, exploitation of natural resources and global environmental collapse (FASE 1998). In this view, risks are not just side-effects of an alleged beneficial innovative technology, but unacceptable products of the combined forces of economic rationality, corporate power and scientific modernization in agriculture that have been responsible for so much social and environmental damage in the first place, especially in developing countries. In the Amazon region, where this struggle against the imposed interests of industrialized countries has particular salience, the biotechnology controversy represents the latest clash of discourses. In the eyes of opposition groups from civil society, accepting risks is conceived as an uncritical continuation of the limited sustainability discourse which has been all too eagerly applied in the discussion about biotechnology and the Amazon. Antagonistic towards GM, the voices of organized civil society propose the agro-ecological alternative instead and try to contribute in their particular way to a substantial improvement of the social and environmental reality of the future[24].

4.2.2 Grass-root participation or education?

[24] However appealing, Tripp (2000) rightly remarks that 'NGO projects that support low-input and traditional agriculture require careful evaluation in order to test widely-made claims about their potential for replacing conventional agricultural technology'.

Just as in other political debates, the biotechnology issue is not restrained to scientific investigation only; it has become subject of social and political deliberation as well. Dealing with such an apparent controversy, it is commonly agreed upon among the stakeholders in Pará that public discussion and public commitment should be enhanced. Most of them agreed to the statement in the questionnaire that the dissemination of more information about such a complex issue as biotechnology would not have to confuse the lay public and therefore complicate the debate further. Moreover, almost all respondents agreed to the suggestion that the citizen's concerns are not taken into account sufficiently. In this view, future biosafety policies should integrate and investigate the doubts existent with the lay public. But although there is a general recognition among the circle of debate members that public debate must be enforced and efforts should be made to eradicate the ignorance with lay people about GM applications, interpretations differ *how* and *to what extent* improved participation is attainable and desirable.

One of the prominent government stakeholders in Pará and in Brazil as a whole, the Public Ministry closely monitors the development of biotechnology in society and supports public events to strengthen public debate. However, today's debate is still premature, as one representative says: 'In Pará, there hasn't been an ample discussion or heightened awareness among the population. Some NGOs issued a law, together with the Legislative Assembly, but there has been little media-attention and only very few public hearings'. In this opinion, it is essential for the course of the debate to include citizens and farmers, for example by means of a permanent forum of agriculture. Earlier experiences with the introduction of agrochemicals showed how end-users became many times victims of the power of agro-industries, which eventually lead to pollution and the abuse of chemicals. This should be avoided by capacitating society to define strategies and to cope with GM, not in a centralized way, but based on the needs and wishes of the population. This would do justice to the principles of an informed citizenry in Brazil.

Similarly and even promoted more vehemently, the grass-root approach is propagated by the small-peasants organization FETAGRI and the socio-environmental NGOs in Pará. This strategy involves community-based cooperation with farmers, to discuss the problems of the Amazon with local stakeholders and to set up local gene banks. The Citizen Jury stands out as an event in line with the many participatory practices in Europe and elsewhere surrounding the GM debate. The format was similar to a formal court trial, except for the fact that the final verdict did not have any political or judicial power. Further, it was the explicit intention of the organization to compose a jury consisting of only rural and urban poor and to create a setting in which their opinion could be placed equal to those of scientists, politicians and NGO representatives. To convince the jury members of the blessings or disadvantages of GM for Brazilian agriculture, some features of the pleadings stand out (see FASE 2002; Toni & Braun 2001). The promotional arguments always reverted to the promise of biotechnology enabling farmers to cope with natural constraints, such as drought, pests or salinity. They further engaged with the classical argument that biotechnology will contribute to higher yields to meet the growing food needs in the world. The concerns over environmental and health consequences and the dominance of multinationals in the agro-business are downplayed since there are several respectful governmental institutions and agencies such as the CTNBio that will ensure safety, accessibility and transparency when transgenics are introduced on the Brazilian market.

The accusation strongly opposed these arguments and put more emphasis on the risks for environment, consumers and the position of small-scale farmers. Above all, they associated GM with a model of agriculture that is destructive for the environment and social irresponsible. In this view, the dominant tendency since the Green Revolution has been to

modernize agriculture based on extensive large-scale farming, monocultures, input of agrochemicals and with little consideration for biodiversity, environment and land reform, of which the cultivation of soy is exemplary. Further, in a GM dominated agriculture few agro-industries will reign the market of seeds through patenting which will automatically make possible GM applications too expensive for resource poor farmers.

This event demonstrated how one can successfully involve civil society and in particular the poor to reflect upon the introduction of GM something formally restricted to governmental policy arenas. But it demands that the scientific and regulatory authorities grant a fairly big amount of trust to lay people and their capacity to assess risks. Therefore, proponents of GM criticize the result of the trial being an 'ideological rejection' and 'scientifically irresponsible'. Or, as one scientist as an assistant in defence of GM stated: 'A highly complicated matter was decided upon by very simple people, with little knowledge. We are talking about the molecular basis of life; you add a bit of biochemistry, physics and microbiology in a very subtle formula. It is very difficult to understand all the changes that occur on a molecular level. It is something that is very hard to discuss with low educated people'[25]. The vice-director of FAEPA agrees strongly and says he 'cannot suppress the impression that the environmental organizations are acting antagonistic towards any kind of technological development. This is first of all a cultural reaction of distrust to the new technology because people are accustomed to do things in a particular way. This could turn out to be contra-productive. We cannot return to the Middle Ages when there was no electricity or agrochemicals'. Further, he points out that the debate is insufficiently based upon scientific facts about the workings of GM and that many times 'sensational media attention, emotional or political interests generate disinformation and distort the debate'. Here, there is clearly a lack of trust in what lay assessments can contribute to decide upon GM regulations.

4.2.3 Stakeholder trust

Continuing the pursuit to clarify the public debate in Pará, the questionnaire included a list of stakeholders that have been important within the configuration of the public debate in Pará. Then, all participants assessed to what extent the organizations/ institutions could be considered as trustworthy in relation to their performance in the public debate in the eyes of the public. The scores ranged from 1 ('not trustworthy at all) to 4 ('very trustworthy'). Figure 4 below displays the average score per organization, understood as their assessed reputation conceived by those stakeholders that participated with the questionnaires. For the sake of clarity, the letters behind some of the stakeholders indicates the stakeholder group, N is 'NGOs', G is 'government', R is 'research Institute', F means 'farmer organization'.

[25] Personal communication with Mr. De Andrade, EMBRAPA.

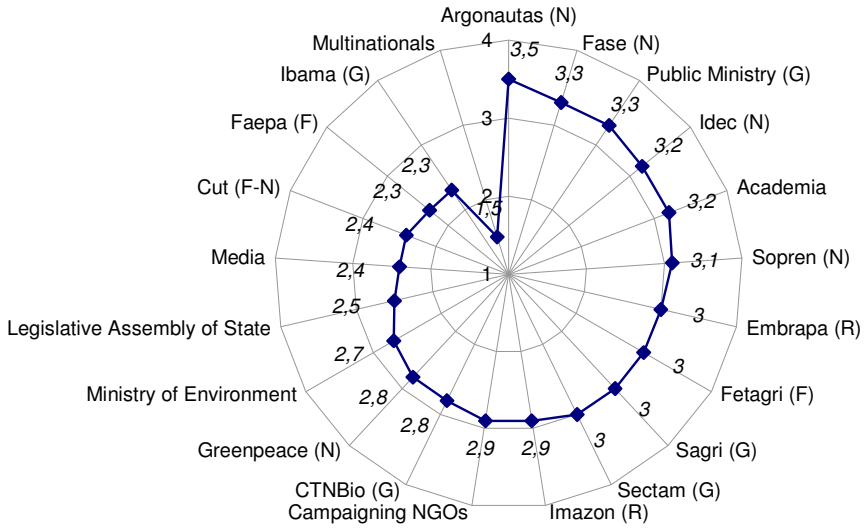

Figure 4, Stakeholders and trustworthiness

From the government agencies, the Public Ministry of Pará received the highest average score (3.3). Both SAGRI and SECTAM were considered 'trustworthy', but the Legislative Assembly of Pará , traditionally the most important political decision-making authority, has an overall low score. The Ministry of Environment, IBAMA and the CTNBio representing national legislative and controlling institutions also received a score below 3. IBAMA probably suffers from stories about corruption and its poor capacity to halt environmental crimes that are committed in the Amazon. According to figure of all non-governmental organizations, the socio-environmental association Os Argonautas has been widely evaluated as a more than trustworthy entity in the debate. Its fame may originate from its widespread involvement in public actions, publicity stunts, conferences and political and judicial actions alike. Other NGOs such as IDEC, FASE and SOPREN are also considered 'trustworthy'. Greenpeace, also famous for its visible actions against GM, is a bit more negatively assessed, which could be due to their image as a non-compromising group of activists.

The public performance of the small farmer federation FETAGRI is better than that of FAEPA, its counterpart that represents the rural producers. The multinationals, in turn, receive the lowest score. Especially Monsanto is negatively associated with mere self-interest (Tokar 1998), despite their efforts to make the Brazilian population believe that the GM revolution is beneficial for all. It is commonly considered that Monsanto has been foolish to enter the market with a contested technique. Instead of an introduction with GM medicines that would, for example, combat diabetes or thrombosis, which would have been much more ethical, they have lost their sympathy on the Brazilian market. It will be a hard job for Monsanto to recover from this general distrust in Brazilian society. EMBRAPA, although allied to Monsanto in doing research, does not suffer. Its reputation as a reliable and independent agricultural research institute that employs activities for the benefit of the land and its farmers has not been affected. The scientific community headed under 'academia' seems to be a steady entity as well. IMAZON (a research institute for the Amazon) has a slight negative score. The place occupied by the media as an autonomous force in the debate indicates that the respondents do not conceive the media as an independent, reliable and truth seeking ensemble of actors. It is rather just as well an entity that puts certain viewpoints to the fore while neglecting others, thereby influencing the direction of the debate.

4.2.4 Power and/ or influence?

Any debate can be conceived as a powerplay between different actors and interests. Especially in the case of GM, the capacity to influence the course of the debate or to mobilise one's resources in order to influence public policy is extremely important. The ability of organizations to exert power over public opinion and policy-issues depends on many factors. Many would instinctively say that access to the domains of political decision-making is crucial, but it would be wrong to think that only the traditional democratic or bureaucratic institutions determine which policy-line is followed. In the trajectory towards a final decision, both pro- and anti-GM groups have financial, organizational and personnel resources at their disposal to publicly unfold their argumentation in order to promote particular interests. Many factors ultimately define the successfulness of these efforts: the available financial resources are important, but grass root support, silent lobbies or noisy public actions, press attention, timing or one charismatic key person can be decisive.

One part of the questionnaire was dedicated to explore each organization's power position within the public debate about biotechnology. The emphasis in this analysis lies with one's capacity to influence public opinion (see figure 5) and one's capacity to influence policy-making (see figure 5). The respondents could choose a number from a scale from 1 to 4, where 1 = no power, 2 = little power, 3 = moderate power, 4 = much power. Figure 4 below presents the assessed values with regard to the stakeholders' power to influence public debate. In a general way, it is noteworthy that 80% of the respondents is given a 2.6 score or higher, indicating that almost all stakeholders in the list have influenced the public debate to a more or lesser extent. Even those with a 2.5 score or lower should, in my opinion and based on other observations be regarded as influential parties. For example, EMBRAPA and FASE both certainly contributed to the form and content of public argumentations, probably more than one can read from the scores in the figure below.

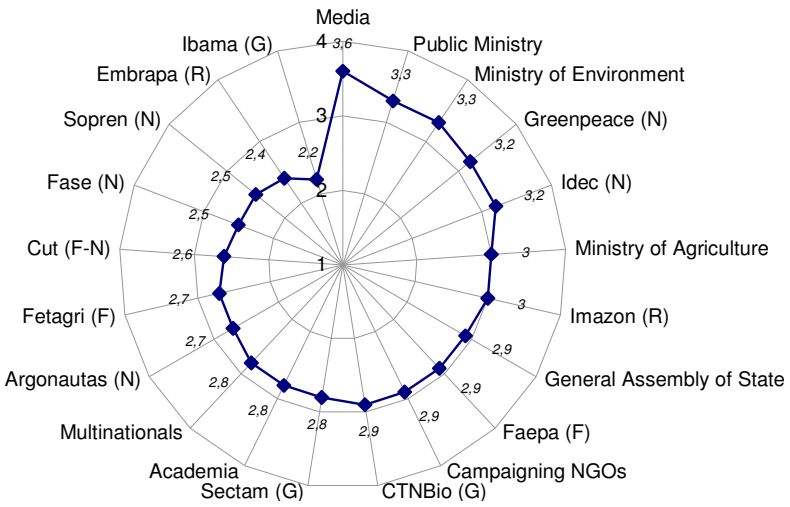

Figure 5, Power to influence public debate

Figure 6 is based upon the answers on the question whether one considered the power of each entity to influence public policy-making in the field of biosafety and biotechnology regulations to be high or low. Political power is crucial for every stakeholder to translate one's wishes and opinions into policy-statements and eventual norms. I am inclined to state that this is what finally counts for many NGOs, farmer organizations and multinationals, but as

we can see, most political power is considered to be in the hands of the traditional state agencies. Noteworthy is the dominant position that is granted to the media and FAEPA, while the multinationals are also assessed to hold more than moderate power. The CTNBio and EMBRAPA are both considered to have slightly less than moderate power.

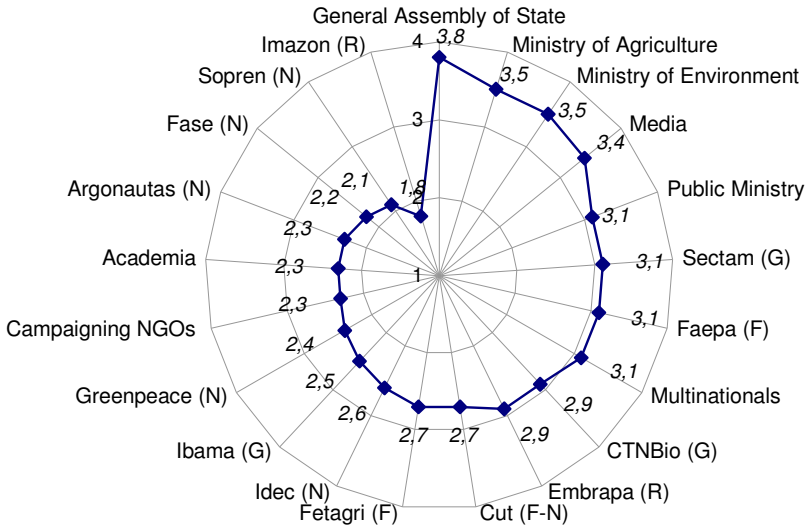

Figure 6, Political power

Note that besides the political institutions pro-GM entities could be considered to be influential. Most NGOs, even when they were formerly assessed to have much power to influence public opinion or great organizational capacity, are in this figure not seen as very influential, which means that their arguments against GM are less likely to become translated into policy-measures. This is in line with current developments in both Pará and Brazil, where the pro-GM lobby is making considerable steps towards a release of GM crops.

5. The roots of controversy and the emergence of 'subpolitics'

This concluding part is divided in three main themes. First, the changing nature of risk is interpreted as the cause of some deeply rooted contrasts. Secondly, in accordance to the theory of reflexive modernization, new social movements stand up to claim a 'discursive space'. Thirdly, policy-making efforts fall flat in the face of risk regulations.

- At first sight, knowledge gaps about the consequences of GM are slowly decreasing as field trials and research progress. However, disagreement and uncertainty has pretty much increased as the debate intensified in the last years (see section 3 on the British debate). A plurality of values along with scientific dissent therefore dominates pro- and anti-GM stakeholders. The experiences with the debate in Pará for example show some deeply rooted contrasts between agro-ecologists who address the structural flaws of the mechanized agrosytems and proponents of GM that are driven by the promise of more technology. Several times, the pro-GM representatives expressed their disappointment in the general fear among the public and 'sensational media attention' that distorts a sound scientific presentation of *facts*. In the eyes of FAEPA and EMBRAPA ideological arguments prevail above scientific reasoning. Under these conditions public debate is harmful for

the advancement of a promising technology and therefore counterproductive for the good of society. But as a consequence of the multi-dimensional nature of technology in society anti-GM entities think the GM debate should not be limited to an exchange of ideas about scientific innovation, which in itself is already highly questionable with regard to its performance in the open field, but should explicitly question the *desirability* of GM in the first place by addressing the *context* in which GM is introduced. Their scepticism is fed by earlier negative experiences associated with the Green Revolution, exploitation of the Amazon and policy-failures by the Brazilian government. Among the European stakeholders we could discern similar positions; a fully-fledged belief in biotechnology contrasts with a context-driven ex ante evaluation of the possible merits and disadvantages of biotechnology in an institutional context. This latter approach endorsed by the 'the public' should not be conceived as an *a priori* rejection of GM, or as an unfeasible call for 'zero risk' technologies as is often lamented by the pro GM camp (Marris 2001). It is more like an overall assessment that takes into account '(…) *the past behaviour of institutions responsible for the development and regulation of technological innovations and risks*' (Marris et al. 2002: 6, italics in original). A mere plea for 'common sense' or 'scientific reasoning' thus does no justice to the wider evaluation framework of the broad array of social stakeholders. Besides the noted diverging opinions on forms of agriculture and sustainability (Levidow 2000), it also prominently includes the role of science and its role in society (cf. Rogers-Hayden & Campbell 2003).

- Whilst the interpretation of risks has become a source of controversy as outlined above, it also became at the center stage of political deliberation. I made reference to the idea of subpolitics to illustrate that the political domain has been prone to change. In the case study on Pará, this has been analyzed by means of figures 4, 5 and 6 on respectively trustworthiness, influence and power. The issue of trust, reputation or trustworthiness is seen as important according to current business and government strategies to respectively 'greenwash' their image (Zadek 2001) or 'rebuild social trust' between citizens and institutions (TRUSTNET 1999; EC 2001). The public trustworthiness of those in power as the keepers of the public good, caring for citizens, the economy and environment altogether is indeed subject to a form of erosion. Comparing the figures 4 and 6 it is shown that those who are considered to hold most political power are also among those assessed to be least trustworthy with regard to their performance in the eyes of the public. Only the Public Ministry can be considered a trustworthy government institution, probably due to their openness and function to inform and support the citizenry in all its aspects. Thus, opponents of transgenics certainly do not have most regulatory tools in hands, but received pretty much credibility for their role in the public debate, which has been started in the first place by concerned NGOs. Interestingly, Os Argonautas received the highest score on this topic underscoring their pivotal role in Pará. Both pro biotech stakeholders FAEPA and 'multinationals' scored very low, which is not surprising given that their interests have been mainly associated with the 'logic of free trade' and self-interest. Considering the situation in Pará, most political power is found with the actors of government, while EMBRAPA, FAEPA and multinationals are perceived to be close to the locus of power as well. NGOs only play a marginal role in this respect. Although it would be too bold to state that either one suffers from mistrust or powerlessness, the discerned pattern could be seen as corresponding with the notion that traditional political stakeholders in a risk society see their trustworthiness affected and hence their legitimacy of acting threatened. Those stakeholders realize all too well that trust is something conditional.

The stakeholders from civil society further seem to have a relative good position to influence public debate which is comparable with the overall Brazilian situation:

> 'In spite of the federal government's attempts to control and limit the GM debate, state governments, social movements, and non-governmental organizations have removed the GM policy question from CTNBio's control. They are challenging not only the regulatory institution, but using global environmental discourses and economic resources to construct, through networks and associations, or 'spaces of engagement' a means to force Brazilian governing bodies and civil society to reconsider the scales at which GM crops are to be regulated' (Jepson 2002: 915).

Jepson then outlines the resistance in Brazilian society to GM as an example of newly globalized political action putting in motion a 'rescaling' of biotechnology governance and power. First, rescaling happens when the authoritative, all influencing policies of national legislation are replaced or anticipated upon by state policies, such as happened in Pará where exclusive and independent jurisdiction has been formulated against the GM development. Other states formulated similar legislation, for example, Paraná is keen to stay out of any involvement with GM agriculture. In Europe, Austria applied for the status of a GM free country, just as several regions in Italy want to affiliate them with the non-GM movement. Secondly, the biosafety issue is downscaled in a distinct way by NGOs from civil society all around Brazil and Europe. Consumer and environmental activism manifests themselves pushing for stricter state-level regulatory control and try to expand the debate beyond the scientific elite. Being part of an (inter-) national network of campaigning organizations they shape the overall body of criticism towards the narrow task definition of the scientific and regulatory institutions. Whether the concerns of the society at large can or will be integrated in final legislation depends upon each country and each situation. In a sense, it has been already quite remarkable how social debate stirred up Brazilian society and awareness in the first place. In the words of Mr. Gasparin of FASE, stressing the merits of social debate: 'It is for the first time in history that civil society succeeds to participate, to rethink and to discuss such a revolutionary technology. The atomic bomb was already dropped on Nagasaki when civil community began to act against atomic energy. The same goes for agrochemicals. With transgenics, society makes part of the discussion'. Similarly, Aerni (2001a) found how NGOs are central in the process of information dissemination and public opinion-forming in Mexico and the Philippines. They have been assessed to influence the public debate relatively more than governmental agencies. Moreover, the mutual assessed positions of all political stakeholders involved in Mexico regarding public confidence showed that political institutions, business and the mass media (among others) received the lowest rates of public confidence, while NGOs and consumer organizations scored relatively well. Although not sustained by facts and figures, these findings could well be part of a trend in developing countries, where societies are challenged by the biotechnological revolution to redefine their agricultural problems and interests.

Optimistic about the force of NGOs, activities and their range of influence, one could assign the label of 'subpolitics'. But this would leave out the fact that that policy-making power remains largely in the hands of those who are traditionally associated with decision-making. The 'discursive space' has certainly broadened, but improved levels of influence can difficultly be equated with power. It therefore remains very much to be seen whether (future) policy debates are determined by the agenda of social stakeholders in the discussion over the ambiguities and contrasts that continue to characterize transgenic crops. The question becomes how much 'discursive space' is incorporated in the deliberation process. Until this moment, Brazilian government has not undertaken any initiatives to frame public controversy, nor has it shown to put interest in a broad

consultation of society prior to a release of agricultural biotechnology. In Europe several initiatives for improved levels of participation have been carried out (e.g. Joly & Marris 2003; Joly et al. 2003; Hagendijk & Egmond 2003), but little has been done to overcome the substantial neglect of discursive disagreement on the conception of science and sustainability.

- Versatile in nature, the GM question crosscuts the lines of formerly demarcated fields of competence and knowledge production. Scientific and ethical controversy abounds and regulation patterns demand adaptation. Adequate policies in such a case are hard to formulate. This is partly due to the in worn patterns of customized policy-making, in other words, the established structures of politics and bureaucracies act within the constraints of simple modernity and its prescribed models of policy-making is. This is, somehow, understandable: the belief in the functionality of the instrumental relationship between state and science has not totally collapsed. But to deal with agricultural biotechnology as if it were a matter of bureaucratic or technical reasoning that prevailed during earlier times of modernity could cause more conflicts within an increased politicized and polarized society (Taylor 2001). However, not all conflict and discussion must be avoided; it is in fact a sign of a healthy balance of powers within a democracy and therefore desirable to some extent (Stöckelová 2003). However, the sort of conflict that is meant here relates to fundamental different views on the course of modernity. Within the current political participation programs, the range of solutions that could alternatively shape society are downplayed or restricted, since the paradigm of a 'sound science' and 'technology for progress' predominantly occupies the mind of decision-makers. Future policy on participation should therefore address the GM development with a profound awareness of the sort of doubts ruling the people's minds. As one of the conclusions of the PABE project on the public perception of biotechnology in Europe was: 'Policy makers should be prepared to consider that the source of the problem is not only to be found in the behavior of the public but also in the behavior of institutions responsible for creating and managing innovations and risk. This seems to us the most urgent imperative for the development of a more constructive and satisfactory debate on agricultural biotechnologies in Europe' (Marris et al. 2002). If this sort of reflexive adaptation of strategies is not endorsed chances are big that stakeholder positions polarize more or that the trustworthiness of the government could run further damage. Especially when GMOs turn out to be harmful in practice or creating social inequality, it will be very hard to explain the lousy governmental commitment to social, environmental and health concerns.

  Concluding, the dominance of many risk controversies led to the fact that '(r)isk society is *not an option* which could be chosen or rejected in the course of political debate' (Beck, 1996: 28, italics in original). It is an inescapable structural condition of advanced industrialization, where risk calculations fail to grasp all aspects of reality; this has provided a ground for an erosion of science and its instrumental relationship with policy-making. The paradox reads that institutions and politics bear the responsibility to decide under circumstances of uncertainty, as questions of food safety, nuclear energy and the regulation biotechnology demands clear and 'rational' decisions (Rip & Smit 2002), but it remains much to be seen whether this rationality in a traditional sense can be obtained as we confronted with unstructured or intractable problems. A tension between the need for acting upon the GM development and the debacle of scientific risk assessments and existing policy-frameworks maintains the hard-to-handle GM imbroglio for the time being.

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