Review: Rethinking Communication Strategy in the Debate on GM Crops

Regulation of GM crops and Science Communication,
Possible Interaction Networks

Web Version

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Summary

Introduction:
After giving a general survey on the strategy of the debate on GM crops worldwide (1.1), illusions and realities on the education on educational effects on the debate are discussed, (1.2). The role of the internet is often underestimated (1.3), and the same counts for the influence of the economy on the debate and public perception (1.4.).

Regulation:
The dialogue on regulation of GM crops is a complex set of issues (2.1.). The role of peer reviewed literature needs careful consideration and more appreciation (2.2). A crucial element in this debate is the often over-estimated difference between GM and non-GM crops (2.3.). The exorbitant and unjustified costs and lost benefits of over-regulation and the reasons behind are discussed. Biofortification is one of the most efficient and sustainable ways of foreign aid today (2.4.) The example of the Golden Rice regulation demonstrates an unfortunate follow-up of regulatory misconceptions (2.5.).

Communication and Debate:
The dispute between scientists and opponents is unfortunately often dominated by cheap propaganda of the protest corporations for commercial reasons (3.1.). The use of strong language in this debate is discussed in detail with recent and historical examples (3.2.). As a rule negative statements on GM crops do (or should) not pass peer review, with some notable examples discussed (3.3.).

Debate improvements:
Some proposals are given on how to solve these complex problems stemming from low acceptability – the example of the ASK-FORCE organization as one of the solutions (4.1.). There is also a need for a long term discourse organized along the strategy and thinking of the Systems Approach (4.2.) by using internetworking in a creative way.

(The next contribution: Improvement of research, development and production)
Introduction to the way forward in regulation, development and production of GM crops (5.1.). New look at regulation of GM crops: Revision of the Biosafety Protocol (5.2.). Proposal of new collaborative development schemes under the focus of feeding the world (5.3.). Proposal on how to reorganize agricultural and food production related agencies of the United Nations (5.4.).

1. Introduction

1.1. The general strategic situation of the debate about green biotechnology today

The aim of this text is to set the framework for a better communication about science and regulation and production of GM crops. GM stands for Genetic Modification, basically an unfortunate denomination, because actually *all* crops are genetically modified, but it is a worldwide accepted term for genetically engineered crops, including transgenes, auto- and allotransgenics, cis- and infra-genes and synthetic genes, for details see Beardmore (Beardmore, 1997). By including gene stacking of various kinds the situation is getting even more complex (Taverniers et al., 2008)

The strategic situation in the debate on GM crops is difficult, but not desperate, particularly in Europe – this is an evaluation shared by lots of experts of the debate about agricultural biotechnology, in Europe it is negatively affecting research and researchers (Rauschen, 2009). We have reached in Europe the peak of anxiety related to GM-crops since the introduction of the new technologies, and some opponents to transgenic crops have taken advantage of this situation. They have organized themselves in a veritable protest industry, see chapter 3. Nevertheless, the next years should lead to reassurance on biotechnology views. We encounter the same repeating dynamics as described for previous technology introductions (Showalter, 1997). The Gartner Hype Cycle (Linden & Fenn, 2003) adds another dimension to technology life cycle models: it characterizes the typical progression of an emerging technology from user and media over-enthusiasm through a period of disillusionment to an eventual understanding of the technology's relevance and role in a market or domain. It is interesting to note, that the Showalter 'hystories' on the introduction of most new technologies (Showalter, 1997) report no real damage in their subsequent introductory phase – or – the benefits were so overwhelming that the debate was soon fading away. This alone demonstrates clearly that it is the socio-cultural environment strongly influencing the risk debate (Adams, 1995). The most recent events seem to hint that Europe finally finds to a more de-contracted way of looking at GM crops: The new report of the Royal Society (Royal-Society, 2009) tries to unite conventional and biotechnology approaches for the sake of making progress on agricultural management in developing countries:

"Past debates about agricultural technology have tended to involve different parties arguing for either advanced biotechnology including GM, improved conventional agricultural practice or low-input methods. We do not consider that these approaches are mutually exclusive: improvements to all systems require high-quality science. Global food insecurity is the product of a set of interrelated local problems of food production and consumption. The diversity of these problems needs to be reflected in the diversity of scientific approaches used to tackle them. Rather than focusing on particular scientific tools and techniques, the approaches should be evaluated in terms of their outcomes."

It might well be that we arrive sooner than expected from a period of disillusionment to an eventual understanding of the technology's relevance and role in a market or domain.

1.2. Illusions and realities on educational effects in the debate, the dialogue between science and the public

There is no doubt that there is hope and need to simply start and/or maintain an open dialogue between major stakeholders among young scientists, politicians, industry and society (Keller, 2009), although there are many obstacles such as asymmetric relationships among the partners, which can render the discourse complex and unpredictable. And it is uncontested here that education on all school levels has its justified place, this has again been shown with empirical results from Spain (Harms, 2002; Ramon et al., 2008). Gensuisse should also be mentioned here with educational activities in schools and a popular open day of Genetics in major Swiss cities organized by researchers and institutes every year[1]. And education on biotechnology in the developing world is especially important, if done in a participative way, and with proper ramifications in all institutions of communication, science and regulation: In April 2007, biosafety and biotechnology scientists, regulators, educators, and communicators from Kenya, Tanzania, and Uganda, met to examine the status and needs of biosafety training and educational programs in East Africa (Sengooba et al., 2009).

Thus, educational efforts on all levels are not in vain, and deplorably there are too few academic institutions active in biotechnology education (McHughen, 2007). The structure of the debate has

[1] Gensuisse webportal http://www.myscience.ch/research_daily/other_links/gensuisse

shifted: Today the GM crop debate is steered by scientific *and* pseudo-scientific arguments. And this also includes an element of hope for the pro-scene: Slowly but surely the pseudo-scientific arguments are fading away for the opponents, since there is no serious incident known despite the fact that millions of hectares are grown with GM crops worldwide (James, 2009).

There is a widespread mistrust against new technologies where everybody feels it will change their own life, and this often happens in a phase where the benefits are not yet clearly visible, especially for the consumers/users. But it is not correct to reduce those difficulties to an exclusive criticism of the so called *'deficit model'* (Sturgis & Allum, 2004; Sturgis et al., 2005a; Sturgis et al., 2005b) where the people just have to be educated and then they would refrain from negative emotions. A question mark on the exclusive use of the 'deficit model' is justified, but surprising conclusions emerge from the above mentioned critics themselves: They do not discard altogether the traditional deficit model, rather they propose to combine it with the *contextual approach*, thus emphasizing the complex and interacting nature of the knowledge-attitude interface. This highlights the sophistication and value of lay understandings of science that can exist in the absence of formal scientific knowledge (Gaskell et al., 2000; Schuman & Presser, 1980).

There is growing consensus that scientific knowledge extends beyond the simple learning of 'facts' that can be straightforwardly defined and measured (Irwin, 2006). From this perspective, privileging formal scientific knowledge as the sole basis of rational preference formation leads us to overlook other knowledge domains that may be equally, or even more important determinants of attitudes towards science.

These insights have been condensed into a feasible discursive method of the *Systems Approach* initiated by Churchman (Churchman, 1979) and refined by Rittel et al. (Rittel & Webber, 2005). Details on the methodology are given under chapter 4.2., where the *solutions* are discussed.

It is an illusion to solve ill-fated GM-disputes by just adding social and cultural aspects, or, that the dispute should so to say start from the other end of the controversy ignoring the biosafety science (Magnan, 2003) or even worse to primarily appeal to feelings and emotions of the public and indulge into entertaining but ultimately meaningless discussions in order to catch the interest of the public – we should not mimic the strategy of the protest corporations. That said, this does not mean, that socio-cultural aspects including emotions should be neglected and the boulevard press. Vaughan's (Vaughan, 1995) plea is that regulatory officials should engage in an interactive process of information and opinion exchange that is reasonable and effective within vastly different socioeconomic and cultural contexts, This is often a challenge to government employees concentrating on office work routine. Patricia Osseweijer (Osseweijer, 2006a, b) is offering an interesting compromise: a mix of science, ethics and emotions with her 'Three E-Model" Entertainment (getting attention), Emotion (identification) and Education (information and skills for (future) decision-making)). It has been developed on the basis of long-term experience and observation of public communication by individuals in the Department of Biotechnology of the Delft University of Technology (Osseweijer, 2006c).

It should also be possible to think and act about the reconciliation of science and spirituality, since it will be an important element besides the ratio of science, the ethics of our societal activities and the emotional elements in human life. But it will be difficult to separate the cheap esoteric chaff from the precious seeds of true spirituality, as Helmut Reich's writings demonstrate (Reich, 2008).

A final remark to 1.2.: this paragraph is not about training and education of biotechnologists for biosafety assessments and field trial strategies, as well organized by ICGEB[2], biosafety classes of UNIDO in Gent[3], Belgium, Cornell University USA, Biotechnology and Biosafety information center[4] and many other organizations and universities.

Despite of all possible refinements and enhancements of the dialogue with the public: we should not underestimate the negative role of the opponents of genetic engineering in plant breeding organized as professional protest corporations, see chapter 3.

1.3. How the internet is influencing the debate

The internet as a worldwide still underestimated literacy practice environment has created a new situation in communication, providing a new dynamic field for research (Koutsogiannis & Mitsikopoulou, 2004). It has created an internet based debate culture with all its ramifications from classic email over blogs and better organized facebooks to twitter and this not only in nanotechnology (Kostoff et al., 2006), but also other research realms and E-business (Kanter, 2000). The evolution in this kind of debate is still going on with unprecedented dynamics and is not yet fully understood in all its consequences[5] [6] (Kalman et al., 2002). The hope is, that it will invite to a *collaborative* instead of *confronting* modus (Borland & Wallace, 1999).

Informatics and the new ease to access huge amounts of scientific information on the internet causes a democratization effect on the science debate. But this can only then lead to positive developments, if the new flood of information is also well organized and that people make serious efforts to analyze the available information so that our understanding of complex scientific knowledge can indeed be improved. As Janetzko (Janetzko, 2008) shows, it's not enough to make use of the most common search machines, only professionally organized searches and databases on scientific literature can help and create some limited reliability and sustainability of scientific knowledge. And: clearly, the usual citation clusters among opinion-buddies will not suffice. And it should be emphasized: Electronic ease does not replace the tough job of scholarly reading *and* understanding.

This major shift from paper to electronics is also creating new methods of *quantitative* analysis of scientific work: Scientometrics[7] can provide with caveats and insights in changes of research priorities, reveal citation habits, evaluate journals with new scales etc. (Leydesdorff, 2002, 2008, 2009; Leydesdorff & Wagner, 2009). A typical example is given in the analysis of the coming and going of the Frankenfood myth (Leydesdorff & Hellsten, 2006), with a somewhat surprisingly early and sharp peak of appearances of the word Frankenfood in websites for 1998, followed by a sharp decline to virtually zero two years later.

Scientometrics can do much more, (Aizen et al., 2004) have shown the potential of a sophisticated statistical analysis combined with modeling of community interactions in the web: Besides tracking just the description-to-acquisition behavior of users scientometrics can do much more by longer observation periods which offers the chance to make richer inferences about both group and individual user intentions – trends of intruding into human behavior and making conclusions, which are actually beyond Orwells imagination. Yet we should have no illusions, since a lot of work and application is already going on in the marketing and advertisement scene, which has also a often manifested interest in knowledge accumulation methods (Cavaller, 2009; Cavaller & Aubertin, 2008). It is somehow amazing to realize that the academic world in most fields of specialization have not yet

[2] ICGEB biosafety page http://www.icgeb.org/~bsafesrv/
[3] UNIDO biosafety class in Gent, Belgium http://binas.unido.org/wiki/index.php/UG
[4] Cornell University biosafety information center
http://www.safetybio.agri.kps.ku.ac.th/index.php?option=com_content&task=view&id=328&Itemid=42
[5] Bruns: Blogs, Wikipedia, Second Life, and Beyond: http://www.peterlang.com/index.cfm?vID=68866&vLang=E&vHR=1&vUR=2&vUUR=1
[6] IEE Computer Society http://www.computer.org/portal/web/csdl/doi/10.1109/52.991324
[7] Scientometrics Wikipedia: http://en.wikipedia.org/wiki/Scientometrics

reached the realms of professional knowledge accumulation and consolidation – not to speak about an efficient way of reaching out from knowledge accumulation to efficient development of new technology. Scientometrics would have the potential to get instrumentalized in research and development.

A *qualitative* evaluation of science should involve additional elements - see below under peer review in the chapter 2 on regulation.
Deplorably, important networks are often only known in specific reader clusters, these awareness gaps should be minimized. We need knowledge exchange, jumping over geographical and ideology fences.

1.4. Science education and new developments in the internet

In a successful initiative, Ron LaPorte and his group startet in 2002 (LaPorte et al., 2002a) a new educational internet based system: In his view, Journals do not have an exclusive "right" to science. A publication and a scientific presentation do virtually the same thing—they share scientific knowledge. Publication and presentation have been separate but could "morph" into a single entity. This metamorphosis is taking place and is driven by a juggernaut called PowerPoint, Microsoft's graphics and slide presentation software, and today enrichted with more media from Twitter over YouTube to all the numerous blog systems, networking enhanced with RSS etc. More on the Supercourse programme in (Laporte et al., 2006; Laporte et al., 2002b; Linkov, 2006; Linkov et al., 2003; Sa et al., 2003).

1.5. Proposal for a website of websites

There are simply too many websites (see 4.1.) and not enough coordination, so there is a need for networking structures among the most important websites, a *network of networks* with all the fancy new buttons available like RRS etc. There should be a place where people see with one glance on the first page what news they can expect on various important sites.
Those website connection activities need professional support with some secretarial/managerial help. We must work out ways that a broad public can easily reach rebuttals on all the myths, facts and benefits in the debate on green biotechnology. It will be not difficult to establish a platform for a better communication among the most important websites – in the field of agricultural biotechnology there are a few very successful ones, but this is not the whole task. We need to look deeper into the theory of networks in order to be really successful, comprehensive reviews demonstrate how complex the networking task really is (Leicht & Newman, 2008; Newman, 2003).

As for now, this is just an idea and needs to be discussed with internet and website specialists. After all, the leading webmasters and coordinators agree, that it is time to ***enhance collaboration through better communication***, see chapter 4.1. ASK-FORCE.

1.6. How economics are influencing the GM crop debate

The example of the Flavr Savr Tomato demonstrates, that in earlier times even in Europe GM food was well received, but several factors just made it clear that economic success was missing (Sheehy et al., 1988), (Kramer & Redenbaugh, 1994; Redenbaugh et al., 1994). And regulation of this pioneer work needs to get a new look: with modern screening methods, the gene silencing on the molecular level revealed some surprises (Krieger et al., 2008).

Economy plays a very important role in the process of technology acceptance: This can be illustrated with the present day feed import situation in Europe.

First it should be mentioned, that it's the trade policy of Europe still going the wrong way, which causes a lot of difficulties in the transatlantic dialogue: As Graff et al. (Graff & Zilberman, 2004) explain:

"European policies blocking genetically engineered crops are conventionally attributed to the concerns of European consumers, but they can be attributed to the self-interests of European industry and farmers as well. Biotech policies maintained in the name of consumer interests are helping European chemical firms to slow their losses in the global crop protection market and are helping European farmers differentiate their conventional crops on environmental and safety grounds, maintain their agricultural subsidies and win new non-tariff trade protections."

The recent development in feed supplies[8] in the EU provides argumentation, the reports and letters below give excellent examples:

- Food Chain Dossier 2009: http://www.botanischergarten.ch/Feed/Food-Feed-Chain-Dossier-20090616.pdf
- DG AGRI feed report: http://www.botanischergarten.ch/Feed/EC-DG-AGRI-Rep-feed-situation-UnapprovedGMOs-200709.pdf
- EU Report on Pipeline: http://www.botanischergarten.ch/Feed/Stein-EU-Report-GMOpipeline-LLP-2009.pdf
- Letter to the President of the EU Commission Barroso: http://www.botanischergarten.ch/Feed/Letter-big-Producers-Tolerance-Value-Barroso-20090624.pdf

Strict labeling and thus a discrimination of European meat from animals fed with GM crops will soon be impossible as a political goal due to economic reasons - as it is also scientifically not justifiable (Aumaitre, 2004; Flachowsky et al., 2007).

An interesting thesis with economic arguments is given by Paarlberg (Paarlberg, 2006): Today Africa's production of GM crops is exported mainly to other African countries, and this might go on this way in the coming years, so the reasoning that Africans would destroy export opportunities to Europe by developing their own GM crops does not really convince. But in reality there is growing concern: Commercial fear of lost export sales to Europe and East Asia is also a reason for mounting pressure on biosafety approvals in developing countries. Consumer misgivings towards GM food in rich countries combined with restrictive import and labeling policies are prompting GM free agricultural production in developing countries. The long term costs of these negative trends could be enormous (Cohen & Paarlberg, 2002).

In India there is a clearly positive trend visible since some years, after some difficulties in the beginning, because local traits had to be created for the many Indian regions and also because there was right from the beginning a black market with illegal cotton traits developing (which often did better commercially than the legal ones.

The whole complex story has been recently summarized by (Sadashivappa & Qaim, 2009): At the end of the day the profitability of Bt cotton is now uncontested [9]:

*"On average, Bt-adopting farmers **realize pesticide reductions of roughly 40%, and yield advantages of 30-40%. Profit gains are at a magnitude of US $60 per acre**. These benefits have been sustainable over time. Farmers' satisfaction is reflected in a high willingness to pay for Bt seeds. Nonetheless, in 2006 Indian state governments decided to establish price caps at levels much lower than what companies had charged before. This intervention has further increased farmers' profits, but the impact on aggregate Bt adoption was relatively small. Price controls might have negative long-term implications, as they can severely hamper private sector incentives to invest in new technology." (Sadashivappa & Qaim, 2009).*

[8] Lawrence in the Guardian 20091016: http://www.botanischergarten.ch/Regulation/Lawrence-Too-late-shut-door-Guardian-20091016.pdf

[9] Müller-Jung Frankfurter Allgemeine: http://www.botanischergarten.ch/Cotton/Mueller-FAZ-Cotton-2007-eng-1.pdf

2. Regulation of GM crops

2.1. General views on the dialogue related to regulation of GM crops.

The dialogue between scientists and regulators is very complex, as accurately described by Saner (Saner, 2007). This should be a reminder that it's not about facts alone:

"It should be clear without explanation that each and every rational decision is a combination of facts and values – a decision requires judgment. The agents of judgment are, of course, people, and this leads us to an entirely different interface – that between scientists and policy-makers."

We should keep this in mind when we concentrate here on the *science* of GM crop regulation. See also the analysis of the debate in 1.1. These philosophical thoughts of Saner are the basis of the discursive methodology for complex decision making processes, (Rith & Dubberly, 2007a; Rittel & Weber, 1973).

A valid overview on the regulatory science and tracability related to GM crops has been published by Gasson & Burke (Gasson & Burke, 2001; Phillips, 2003), it is not the intention to repeat these reviews.

2.2. The political economy of biotechnology regulation in agriculture

An in-depth analysis of how politics is influenced by multiple factors of discursive processes, influenced by economics, has been developed by Graff et al. (Graff et al., 2009a). They are giving highly differentiated insights in the network of self-interests with some interesting examples of units influencing in their own interest the debate on GM crops: Opponents of genetically engineered crops and also industrial units fearing losses in pesticide sellings. Often these important socio-economic elements in the regulatory debate are neglected and it seems to be difficult for all the regulatory analysis to bring together socio-economic *and* molecular plant breeding aspects.

Graff, G., G. Hochman, et al. (2009) The Political Economy of Agricultural Biotechnology Policies. AgBioForum 12, 1-13 DOI: http://www.agbioforum.org/v12n1/v12n1a04-graff.htm AND http://www.botanischergarten.ch/Regulation/Graff-Political-Economy-Policies-2009.pdf

"This article develops a political-economy framework to analyze the formation of agricultural biotechnology policies. Going beyond accounts that largely attribute differences between US and European regulatory environments to consumer attitudes, we consider the impact of what amounts to a Schumpeterian process of "creative destruction" across the entire range of relevant economic sectors and interests. The analysis suggests that in Europe and in some developing countries a "strange bedfellows" constellation of concentrated economic interests (including incumbent agrochemical manufacturers, certain farm groups, and environmental protest activists) act in rational self-interest to negatively characterize GM technology in the public arena and to seek regulations that block or slow its introduction. In contrast, those interests most likely to experience welfare gains from biotechnology are the more diffused and less informed--including consumers and small farmers. The most profound implications of overregulation of agricultural biotechnology are (1) delays in the global diffusion of proven technologies, resulting in a lower rate of growth in the global food supply and higher food prices, and (2) disincentives for investing in further R&D, resulting in a slowdown in innovation of second generation technologies anticipated to introduce broad consumer and environmental benefits." (Graff et al., 2009a)

Ayal & Hochman (Ayal & Hochman, 2009), started in some intricate experimental setups working on the cognitive processes underlying choice behavior. With a mix of behavioral actions combined with opinion polls they found that people *do not rely on limited arguments only, but tend to integrate all acquired information into their choice processes*. This could explain the delay in such opinion finding and decision making processes influencing politics over years, described in the Gartner hype cycles, see 1.1.

Although this would be an epic theme, we shall concentrate here more on the debate of the *science* of regulation and some discursive elements.

2.3. Peer review in the biosafety science debate on regulation

Before we start talking about regulation, a word on the science debate, which depends on the process of peer review, which maybe flawed in many ways, but there is no alternative in sight, despite some attempts to change this situation like the proposal to involve respected science journalists. But there are objections: journalists might become part of the system (Fransen, 2007), and they may simply not have the scientific expertise as demonstrated recently (Waltz, 2009). There is also the danger of undue influence by units sponsoring scientific journals: see also the debate around the withdrawal[10] of six Australia based Elsevier "fake" journals sponsored by the pharmaceutical industry (Goldacre, 2009; Smith, 2003, 2005). This kind of influence might still be under control, and peer review is usually functioning in an unbiased way - but the difficulties are deep-rooted, and it's a constant fight for quality, as is summarized comprehensively by Scott (Scott, 2007). The quality of biotechnological research is also influenced by the research environment offered to students and is evaluated in a differentiated way for Europe by Reiss et al. (Reiss & Dominguez Lacasa, 2007). Peer review is a very fragile instrument and needs constant inquiry, as demonstrated also on the wikipedia website on the subject [11]. It should also be seriously considered, that the present day peer review system is basically "faith based", as described with convincing details by (Linkov et al., 2006).

We should also include a new element in the reviews and evaluation of science as proposed by Lubchenco (Lubchenco, 1998): the scientific community should formulate a new *Social Contract for science.*

"This contract would more adequately address the problems of the coming century than does our current scientific enterprise. The contract should be predicated upon the assumptions that scientists will (1) address the most urgent needs of society, in proportion to their importance; (2) communicate their knowledge and understanding widely in order to inform decisions of individuals and institutions; and (3) exercise good judgment, wisdom, and humility. The paper concentrates, according to the zeitgeist of the publication date, too much on environmental issues alone, today we should put into the center of your science strategy debates humanity as a whole – and this means to take care of the most urgent needs, namely to work on the eradication of hunger."

On another thread, the negotiated conclusions of the Royal Commission of New Zealand, where the author has been an invited external expert [12] have been highly respected and have lead to rather decontracted and reasonable proceedings on how to regulate GM crops in New Zealand. Still, the discourse is continuing now: Again, it is visible that the discourse is less confrontational and may lead to innovative solutions in the future (Rogers-Hayden & Campbell, 2003):

"The debate about genetic modification (GM) can be seen as characteristic of our time. Environmental groups, in challenging GM, are also challenging modernist faith in progress, and science and technology. In this paper we use the case of New Zealand's Royal Commission on Genetic Modification to explore the application of science discourses as used by environmental groups. We do this by situating the debate in the framework of modernity, discussing the use of science by environmental groups, and deconstructing the science discourses evident within environmental groups' submissions to the Commission. We find science being called into question by the very movement that has relied on it to fight environmental issues for many years. The environmental groups are challenging the traditional boundaries of science, for although they use science they also present it as a culturally embedded activity with no greater epistemological authority than other knowledge systems. Their discourses, like that of the other main actors in the GM debate, are thus part of the constant re-negotiation of the cultural construct of 'science'."

However, this process should not be mollified on the costs of hard science. The line between science and pseudo-science is often difficult to draw.

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[10] http://www.elsevier.com/wps/find/authored_newsitem.cws_home/companynews05_01203

[11] Wiki website on peer review: http://en.wikipedia.org/wiki/Peer_review

[12] Website Royal Commission of genetic modification: http://www.mfe.govt.nz/issues/organisms/index.html

An interesting new aspect has been introduced by the Supercourse Group with Faina Linkov and Ron LaPorte: (Linkov et al., 2007). It is true that quality control of internet texts need rethinking, and it is also important to analyze in a critical way peer review of print material: Their comments can be summarized as follows: High quality internet distributed lectures are not basically different from written science publications, they also must be documented and references properly. A further element could be a method of quality management introduced originally for the industry by Edwards Deming [13], who very successfully taught management and quality control also in Japan in the fifties.

On 6 October 2009, Hans Küng, Josef Wieland and Klaus Leisinger presented the Declaration of a NEW GLOBAL BUSINESS ETHOS at the United Nations in New York[14]. Although coming from a pharmaceutical company like Novartis, multinational seed companies will (or should) most likely join.

Coming back to the peer review on the quality of scientific papers, all the above statements do not mean to say goodbye to the factual and methodological scrutiny per se – even if a paper is already published. With a focus on the GM food safety research Chassy & Parrott (Chassy & Parrott, 2009) summarize the criterions on how to judge whether a food study is believable or not: (a) Making sure the samples tested are comparable samples. (b) Testing composition to make sure the tests and controls are comparable. (c) The need for an acceptable balanced and nutritious diet. (d) Why the dose is important. (e) What statistics do and don't tell us. (f) The importance of peer review and scientific publication, (g) Guidelines for dealing with conflicting information. (h) Ethical considerations. A very important additional point is emphasized by Kostoff (Kostoff, 2002): "Multiple technical experts should average out individual bias and subjectivity". Two blatant examples of lack of peer review properly done are, among others, discussed in ASK-FORCE:

- The case of Bt endo-toxins supposedly affecting aquatic organisms by Rosi-Marshall et al. (Rosi-Marshall et al., 2007a)[15] , the comments of Ammann in (Sinha, 2009):
  "Studies that look at non-obvious risks are a welcome addition to the literature, say critics, but poorly conducted studies do more harm than good. "It's just bad science," says Ammann. "There are a lot of scientists producing these studies in a very sloppy way. They bolster public fear yet do nothing to resolve conflicts or move the field forward." And:
  "But the authors aren't to blame, says Klaus Ammann, emeritus professor at the University of Bern in Switzerland. They are merely the latest victims of what has become the political gerrymandering of science to bolster and support anti-GM sentiment in Europe. "The Austrian government had exhausted all legal avenues to ban cultivation of GM crops," Ammann says. "The Ministry of Health decided to avoid the peer-review process and announce study results at a conference, hide the data from scientists, and let the activists run amok with the help of uncritical media." Indeed, in the ensuing months the Austrian government has backpedaled. The Ministry of Health responded to a request to interview Zentek or other authors with the following: "We asked the scientists to reevaluate their statistical analysis. Additionally the external evaluation will soon be started. I kindly ask you to wait with your proposal until the reevaluation is completed."

- The case of a review by Dona & Arvanitoyannis (Dona & Arvanitoyannis, 2009). This review would never pass tests designed by Tang et al. (Tang et al., 2009), which can detect biased filtering of citations and words: According to Tang et al it is important to distinguish between *subjectivity classification* retrieved from opinionated and factual statements, and combine it with a multi-class *sentiment classification* and to get a better scale by using neutral training examples. An extensive scientific analysis has been placed in ASK-FORCE[16] with critical comments.

[13] Wikipedia of Edward Deming http://en.wikipedia.org/wiki/W._Edwards_Deming
[14] Novartis Business Ethos: http://www.novartisstiftung.org/platform/content/element/3177/Newsletter_3-09_2.pdf
[15] ASK-FORCE on Rosi-Marshall et al. 2007b: http://www.efb-central.org/index.php/forums/viewthread/49/
[16] ASK-FORCE on Dona et al. 2009: http://www.efb-central.org/index.php/forums/viewthread/54/

A caveat at the end of this paragraph on peer review: Although it is in principle appropriate to ask ethical questions, we should first concentrate on the scientific assessment of a professional peer review strictly following a factual agenda as (Chassy & Parrott, 2009; Chassy, 2009) are demanding . Only then, when this filter has been passed successfully, then it is important to go into ethical and socio-economic questions. But as often, farmers and the market will regulate efficiently. It is wrong to mix scientific and ethical questions as de Melo et al. and Interman et al. are asking for (de Melo-Martin & Meghani, 2008; Intemann & de Melo-Martin, 2008), the result is then to accept for discussion a paper like the one of (Seralini et al., 2007a), which has been seriously criticized by EFSA (EFSA, 2007a, b, c). Such papers should not be seen as a publication which takes also into an account as a balanced view, because they are flawed in the first place.

2.4. GM- and non-GM-crop differences over-estimated

2.4.1. Early phase of risk assessment

In the wake of molecular breeding, in particular with the first successes of "gene splicing", the safety debates started soon after the discovery of the DNA structure by Watson & Crick (Watson & Crick, 1953a, b; Wilkins et al., 1953), followed by the Asilomar Conference (Berg et al., 1975; Berg & Singer, 1995) - see also some historical accounts (Chassy, 2007; Friedberg, 2007; Klug, 2004). The fascination about the novelty of transgenesis was justified, but also overwhelming, and the many unforeseen scientific breakthroughs following were unprecedented in the history of molecular biology. Unfortunately, the enthusiasm also lashed back in an overacting in risk assessment, when the first GM crops went into production. The debate on how GM crops should be regulated started very early with an emerging divide between regulation in the US and Great Britain, including later the whole of Europe (Bennett et al., 1986; National-Research-Council, 1989). Some more traces of early disputes about regulatory decisions in the US and in Great Britain can be seen in letters to Nature in 1992: (Lehrman, 1992; Mundell, 1992). Some support tighter regulation including field biosafety assessments, others fear strangulation of biotechnology research. During the wake of the Cartagena Biosafety Protocol most countries adopted (around 2003) the European way of risk analysis of genetic engineering, emphasizing process oriented regulation versus product oriented regulation.

The seemingly absolute novelty of genetic engineering on the molecular level has been contested already in the early days of molecular biology in the 1930s and 1950s with the discovery of cellular systems for genome restructuring discovered with the classic papers of McClintock (McClintock, 1930, 1953) and with later commentaries of Fedoroff (Fedoroff, 1994; Fedoroff et al., 1995), also summarized under 'natural genetic engineering' (Lewin, 1983; Shapiro, 1997).

2.4.2. Molecular processes similar in natural mutation and transgenesis

Genetic engineering has been brought into evolutionary perspective of natural mutation by authorities such as Werner Arber: his view remains scientifically uncontested that molecular processes in transgenesis and natural mutation are basically similar (Arber, 1994, 2000, 2002, 2003, 2004). The same claim is made with a more organismal view by Hackett (Hackett, 2002).

It is therefore no surprise that a natural transgene species has been discovered in a widespread grass genus (Ghatnekar et al., 2006).

Recent publications demonstrate, that transgenesis e.g. has less impact on the transcriptome of the wheat grain than traditional breeding (Batista et al., 2008; Baudo et al., 2006; Shewry et al., 2007), (more details: (Ammann, 2008, 2009b)).

One should also take into account, that many of the conventional breeding methods such as colchicination (Awoleye et al., 1994; Barnabás et al., 1999) and radiation mutation breeding (Reynolds et al., 2000) can be obviously more damaging to the genome, and it is in addition not possible to clearly define what impact the un-targeted process could have caused. Or, on the other hand, as (Molnar et al., 2009) have demonstrated, irradiation-induced wheat - Ae. biuncialis intergenomic translocations will facilitate the successful introgression of drought tolerance and other alien traits into bread wheat. In their review (Schouten & Jacobsen, 2007) criticized the biased statements of (Latham et al., 2006; Wilson et al., 2006) who focus unjustified on transgenesis alone when describing unwelcome mutations. Still, it has to be admitted that repair mechanisms on the DNA level are powerful (Baarends et al., 2001; Dong et al., 2002; Morikawa & Shirakawa, 2001). It is thus not logical that opposition within organic farming towards genetic engineering is now expanding also to some of those conventional breeding methods, some go even so far as to reject marker assisted breeding – typically for the organic agriculture scene, this trend is based on the myth of "intrinsic integrity of the genome", for which term it is not possible in the literature to find a proper scientific definition based on comparisons (Ammann, 2008). The addition of rejected breeding methods would ultimately lead to an absurd situation, where most of the modern time traits would have to be rejected and breeding would be forced to virtually start from scratch.

Basically, many of the first generation GM crops should be today subject to a professional debate on *deregulation*, and there is good and sturdy reason to state that many of these GM crops should not have been treated in such a special way in the first place, they can be compared in their risk potential to many crops created with traditional methods.

This should not be misunderstood as a plea for general deregulation of GM crops, rather for a strictly science based risk based regulation.

2.4.3. Dissent over differences between GM- and non-GM crops causes transatlantic regulatory divide

This actually includes a critical questioning about some basic rules of the United Nations Convention on Biological Diversity (CBD): transgenic crops of the first generation should not have been *generally* subjected to regulation purely based on the *process* of transgenesis alone; rather it would have been wiser to have a close look at the *products* in each case, as John Maddox already proposed in 1992 in an editorial in Nature (Anonymous, 1992). This is also the view of Canadian regulators (Andree, 2002; Berwald et al., 2006; Macdonald & Yarrow, 2002), where the *novelty* of the crop is the primary trigger for regulation. This transatlantic contrast has been commented by many (Bennett et al., 1986; Kalaitzandonakes et al., 2005; Ramjoue, 2007a, b; Snyder et al., 2008; Thro, 2004), and although for many years a solution and mediation seemed to be too difficult, contrasts can be overcome:

In a letter[17] to the executives of the Convention on Biological Diversity (CBD), the Public Research and Regulation Initiative (PRRI) is asking for a scientific discussion in order to exempt a list of GM crops from the expensive regulatory process for approval, here only the final statement:

*"Bearing in mind that the **method of transformation itself is neutral**, i.e. that there are no risks related to process of transformation, PRRI believes that there are several types of LMOs and traits for which - on the basis of the characteristics of the host plant, the functioning of the inserted genes and experience with the resulting GMO - **it can be concluded that they are as safe as its conventional counterpart with respect to potential effects on the environment, taking also into account human health**. "*

[17] PRRI letter : http://www.pubresreg.org/index.php?option=com_docman&task=doc_download&gid=490

To be quite explicit, this does not mean to exempt transgenesis from biosafety assessment as a whole, but it should say that "several types of LMOs and traits, where the inserted genes demonstrate in large scale commercialization (of course after risk assessment done in due course) can be deemed as safe as conventional counterparts according to several years of beneficial agricultural practice, should be exempt under article 7.4 of the Cartagena Protocol for further expensive and time consuming risk assessment and regulatory procedures.

In a recent paper, an indiscriminate continuation of food biosafety research is questioned on the basis of all the above arguments by Herman et al. (Herman et al., 2009) with good reason:
"Compositional studies comparing transgenic crops with non-transgenic crops are almost universally required by governmental regulatory bodies to support the safety assessment of new transgenic crops. Here we discuss the assumptions that led to this requirement and lay out ***the theoretical and empirical evidence suggesting that such studies are no more necessary for evaluating the safety of transgenic crops than they are for traditionally bred crops.****"*

2.4.4. Perspectives for solutions, a synthesis of divergent views

These new perspectives create hope, that solutions can be found:

In a first phase some of the widespread transgenic crops like transgenic maize with the Cry1Ab endotoxin should be exempt from regulation, which is indeed possible according to art. 7.4 in the Cartagena Protocol. In COP-MOP5[18] 2010 in Japan it should be possible, to amend the protocol with the introduction of a dynamics which allows to start the regulatory process with an initial phase focusing on the process of transgenesis, first following procedures proposed for non-target insects by (Raybould, 2010; Romeis et al., 2008), but in due time shifting later the focus on the product, making it possible to abbreviate the regulatory process wherever possible and feasible. The ultimate goal of new regulatory concepts should be to minimize obstacles for new and urgent necessities in crop development, such as Swaminathan et al. and Raven et al. are proposing (Kesavan & Swaminathan, 2008; Raven et al., 2006).

A conceptual framework is proposed by IFPRI/ISNAR in 2002, the International Service for National Agricultural Research (McLean et al., 2002), a careful evaluation of process-based versus product-based triggers in regulatory action can also lead to a merger of both seemingly so contrasting concepts into a legalized decision making process on which trigger should be chosen in a case by case strategy:

"Process-based triggers are the rule in almost all countries that have developed national biosafety regulatory systems; there are exceptions, however, where the novelty of the trait determines the extent of regulatory oversight and not the process by which the trait was introduced. While such a product-based approach to defining the object of regulation is truest to the scientific principle that biotechnology is not inherently more risky than other technologies that have a long and accepted history of application in agriculture and food production, it is less prescriptive than process-based regulatory systems."

Many of the debates on those two concepts suffer from a lack of clear-cut definitions, it will be important to have a close look at the Canadian regulatory system and the definition of PNTs (Plants with Novel Traits). In Canada, the trigger for risk-assessment is the *novelty* of the plant rather than the *methods* used to produce it. The difficulties start there, where a clear definition of PNTs is needed to come to a decision: It means that plants produced using recombinant DNA techniques, chemical mutagenesis, cell fusion, cis-genics or any other in-vitro technique leading to a novel trait, need to undergo risk assessment in the Canadian system. No wonder the Canadian definition of

[18] Fifth meeting of the Conference of the Parties serving as the Meeting of the Parties to the Cartagena Protocol on Biosafety (COP-MOP 5), 11 – 15. 10. 2010 Nagoya, Japan http://bch.cbd.int/protocol/meetings/

novel traits is rather wordy, but remains broad minded:
"A plant variety/genotype possessing characteristics that demonstrate neither familiarity nor substantial equivalence to those present in a distinct, stable population of a cultivated seed in Canada and that have been intentionally selected, created or introduced into a population of that species through a specific genetic change."

Conclusions:
There can be no doubt that product-based regulatory approaches are truest to the scientific principle that biotechnology is not inherently more risky than other technologies that have a long and accepted history of application in agriculture and food production, it is also less prescriptive than process-based systems, see McLean et al. (McLean et al., 2002).

3. The costs and lost benefits of overregulation

3.1. The issue

The Cartagena Protocol on Biosafety (CPB) has now been adopted by 157 parties[19]. It still builds on the principle that GM crop plants might bare risks in contrast to the conventional crops: Objective [20] of CPB. The huge apparatus on risk assessment based on this protocol is building on the principle, that the mechanism of transgenicity is totally artificial and is not found in nature. Modern molecular science insights have proven the contrary, as shown in ASK-FORCE AF-9 on the molecular basis of transgenesis. This results in maintaining to an asymmetric risk assessment of innovation of GM crops. The possible exemption of widespread GM crops in Art. 7.4[21] is not even considered officially up to now.

3.2. Summary

An excellent summary graph is given in (Graff et al., 2009b) in fig. 1b: innovations active in the R&D pipeline were growing at an increasing rate during the period before 1998, but declined after 1998. Apart from competition of reasonably close non-transgenic substitutes the authors consider one regulatory reason to be the main culprit: The halting of regulatory approvals in 1998 in Europe. Although the authors consider the full extent of reasons still to be conjectural, their data suggest that changes in regulatory environment may have been a cause. In a combination of high costs for lost implementation and high costs for regulatory approvals the present state and operational experience has grown into a major obstacle of modern crop breeding.

Commentary from Table 1: The primary survey combined records from scientific publications, field trial records and regulatory filings to identify 558 transgenic plants with quality improvements and determine how far they had progressed through stages of R&D by 2004, including those that had only been published in the scientific literature; those that had reached initial field trials (defined as having completed 1–3 field trials), mid-stage field trials (4–9 field trials) or advanced field trials (>10); those that had entered regulatory filings; and those that were commercialized. The secondary survey canvassed expectations of firms and analysts about the likelihood and time frame for future commercialization of transgenic product quality innovations. Complete one-to-one correspondence between individual observations of the two surveys was not possible.

[19] Cartagena Protocol on Biosafety, adoption : http://www.cbd.int/biosafety/signinglist.shtml
[20] Cartagena Protocol on Biosafety, objective: http://www.cbd.int/biosafety/articles.shtml?a=cpb-01
[21] Cartagena Protocol on Biosafety, Article 7: http://www.cbd.int/biosafety/articles.shtml?a=cpb-07

3.3. Costs and lost benefits worldwide and Europe

An excellent summary graph is given in (Graff et al., 2009b) in fig. 1b: innovations active in the R&D pipeline were growing at an increasing rate during the period before 1998, but declined after 1998. Apart from competition of reasonably close non-transgenic substitutes the authors consider one regulatory reason to be the main culprit: The halting of regulatory approvals in 1998 in Europe. Although the authors consider the full extent of reasons still to be conjectural, their data suggest that changes in regulatory environment may have been a cause.

The full extent of the GM crop development pipeline can be evaluated in websites like the Information Systems for Biotechnology [22] alone from the U.S.A., there are (23. Oct. 2009) 14204 notifications with 1586 full field release permits registered in this Database.

Overall, the present day regulatory regime detains public research in molecular breeding considerably due to enormously high regulation costs, more information about this effect for the development of GM trees in Strauss and McLean (McLean & Charest, 2000; Strauss et al., 2009), the abstract:

*"**Against** the Cartagena Protocol and widespread scientific support for a case-by-case approach to regulation, the Convention on Biological Diversity has become a platform for imposing broad restrictions on research and development of all types of transgenic trees."*

Some comprehensive tables on the massive costs of regulation of the major commodity crops are given by Kalaitzandonakes (Kalaitzandonakes et al., 2007): The compliance costs for herbicide tolerant maize alone has been calculated based on the events available in 2006 for the United States: They amount to 6,180,000–14,510,000 US$, a sum most likely to be prohibitive for any trait developed by a public institution.

Another case is reported by Piero Morandini from Italy: A scientific assessment on a field trial on Bt maize is delayed in publication by the Italian Government, although (or because?) it yields very positive results: [23] [24]

"The grain yield data (tons/ha, GM crop vs. their conventional counterparts) were rather spectacular: 15.9 vs. 11.1 and 14.1 vs. 11.0, translating into a 43 and 28% yield increases for the P67 and Elgina, respectively. These data have already been released by the INRAN (National Institute for Research on Food and Nutrition, a research institution funded and run by the government) in 2006, albeit without the emphasis they deserved.

*The delay in properly communicating these data can be considered as a very costly omission. In fact, taking into account the total area of maize cultivation in Italy together with yield differences, maize prices and pest pressure, **these data translate into a forfeited value of between roughly € 300 million and € 1 billion a year because Italian farmers are not allowed to plant Bt maize.**"*

The present day regulatory "apartheid" of high tech farming versus organic farming, large scale farming against smallholders seriously hampers the development of GM crops which could foster a more ecological production (Ammann, 2008, 2009a).

3.4. Costs and lost benefits in developing countries

Even more drastically in the developing world, there is regulatory legislation in place hindering the development of transgenic crop breeding for the benefit of the poor, Driessen, Herring, Paarlberg (Driessen, 2005; Herring, 2007; Paarlberg, 2009; Paarlberg, 2002).

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[22] ISB, Information Systems of Biotechnology: Field Test Releases in the US: http://www.isb.vt.edu/cfdocs/fieldtests1.cfm

[23] Morandini Press Release 20071211: http://www.botanischergarten.ch/ASK-FORCE-NEWS-Maize-Lombardia/Morandini-press-release-20071211.pdf

[24] Morandini, Polenta: http://www.botanischergarten.ch/ASK-FORCE-NEWS-Maize-Lombardia/Morandini-polenta_25-04-08.pdf

Doubling agricultural research investment per se (no regulatory costs included in the calculation), would reduce poverty in Sub-Saharan Africa by 9% according to Alene & Coulibaly (Alene & Coulibaly, 2009). But these prospects are seriously hindered and as a result practically nullified by the exorbitantly high regulatory costs during the implementation phase.
Moreover, GM-free private standards set up by food companies and distributors in developed countries have influenced biosafety policymaking in developing countries: Gruère & Sengupta (Gruère & Sengupta, 2009) found 29 cases where private importers have affected policy decisions in numerous countries due to irrational fear of export-losses. This is based on two generally misleading premises: (1) Europe or Japan represents the only market for exports, and (2) non-GM segregation is too costly. It is amazing to realize, that many of the cases rely on unpublicized lobbying activities, and because of the lack of comprehensive evidence, many cases do not provide straightforward evidence of causality links between importers or traders and policy decisions. There is evidence that development of GM crops in Africa is mainly based on public research, and that the private sector only reluctantly invests in projects for developing countries, although the situation is getting better in the last few years (Cohen, 2005; Spielman et al., 2007).

A blatant case of eco-imperialism is reported from Zambia[25], where the Norwegian Government has partly sponsored a 400'000$ laboratory, for which GENOK, a well known anti-biotech NGO[26],[27] has contributed equipment and training, thus guaranteeing a research policy hostile to GM crops, in accordance with the official policy of the Zambian government, who denominates GM crops as poisonous. Typically enough, the laboratory's priority will be to detect and search for genetically modified seeds and crops. Former Zambian researcher Ed. Rybicki, now working in Cape Town, said "that the lab would better serve Zambia and the whole region by looking at genuine threats, studying local biodiversity and even making transgenic crops themselves"[28].

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Gruère and Smale (Gruere et al., 2007; Smale et al., 2008) report in a carefully calculated assessment, that if rice cultures in India, Bangladesh, Indonesia and the Philippines would be based on present day GM traits, the benefits amount to 4'331 million US-dollars. For the United States, an earlier assessment calculates similar sums of benefits related to the introduction of biotechnology in agriculture (Falck-Zepeda et al., 2000).

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[25] Andrew Apel in GMobelus: http://www.gmobelus.com/news.php?viewStory=234
[26] Controversy between GENOK and Roush on an alleged case of maize pollen allergy: http://www.botanischergarten.ch/Allergy/Traavik-Roush-Philippines-controversy-2004.pdf
[27] Vidal, Guardian: http://www.guardian.co.uk/science/2004/feb/27/gm.science
[28] Scidev news: http://www.scidev.net/en/news/zambia-s-molecular-biology-lab-fully-functioning-a.html?utm_source=link&utm_medium=rss&utm_campaign=en_news
[29] ISB, Information Systems of Biotechnology: Field Test Releases in the US: http://www.isb.vt.edu/cfdocs/fieldtests1.cfm

There has been much more written about regulatory costs and its negative follow-ups, her only a small selection of important papers (Antle, 1999; Graff & Zilberman, 2004; Kochetkova, 2006; Laget & Cantley, 2001; Pray et al., 2006; Raybould, 2010; Shelton, 2003).

3.5. The Golden Rice development hampered through over-regulation. Biofortification as an ideal sustainable way of foreign aid in agriculture.

In the case of the Golden Rice this tedious and costly regulation forced upon the regulatory authorities by the CBD solely based on the process of transgenesis has serious ethical consequences[30] (Bradford et al., 2005b; Kalaitzandonakes et al., 2007). A delay of the introduction of the biofortified rice is directly causing each year hundreds of thousands of children to die or to go blind due to severe vitamin A deficiency. Unreasonable and unscientific regulatory obstacles cause massive delay in approvals, especially in developing countries of S.E. Asia (Atanassov, 2004; Bouis, 2007; Depee et al., 1995; Humphrey et al., 1998; Humphrey et al., 1992; Mayer et al., 2008; Miller, 2009; Potrykus, 2003; Qaim et al., 2008; Qaim & Stein, 2008; Qaim et al., 2007; Stein et al., 2008; Stein et al., 2007a; Stein & Qaim, 2007; Stein et al., 2006, 2007b).

Last but not least it should be emphasized that specifically related to the developing world we should refrain from the old myths that international corporate companies are dominating the field – on the contrary: Public Research is responsible for 85% of crop developments, 7% private local companies, and only 1% multinational companies according to figures from Cohen (Cohen, 2005), supported by FAO statistics (Dhlamini et al., 2005). The myth that patenting rules are seriously hampering the spread of helpful biotech crops in poor countries has been seriously contested (Atkinson et al., 2003; Beachy et al., 2002; Krattiger & Mahoney, 2006).

As an example: the Golden Rice project will result into biofortified rice traits which will be distributed to the farmers free of royalties. More about the subject can be found in the important and comprehensive Handbook of Intellectual Property Rights of Krattiger et al. 2007 (Krattiger, 2007), and more: (Delmer et al., 2003; Lawson, 2004; Singh et al., 2009; Wright, 2008).

Biofortification programs are prone to get the highest index numbers in the evaluation system for foreign aid programs of Lempert (Lempert, 2009): Biofortification of indigenous landraces by systematically crossing-in the valuable and royalty free traits to enhance the nutritional value is certainly one of the best ways to sustainably help indigenous people suffering from any kind of malnutrition. In all cases known the technology transfer is royalty free, secured by contracts.

Use of an indicator to assess the quality and success of developing aid projects defined by (Lempert, 2009) reveals that most of the major NGO and UN actors in the field of development are actually providing *relief* rather than *development* and are creating *dependency by treating symptoms* rather than *long-term solutions*. The indicator points to the specific areas where they need to improve in order to fulfill sustainability criteria including tests of whether aid distorts financial markets and business competition, erodes appropriate government functions, and reverses colonial institutions and ideologies that interfere with sustainable consumption within a resource base.
Estimates in costs for vitamin A capsules are clearly incompatible with the living standard in developing countries, a major distribution campaign would result in millions of dollars: Neidecker-Gonzales (Neidecker-Gonzales et al., 2007) produced in their study the following figures: "Total costs are lowest (roughly US$0.50 per capsule) in Africa, where wages and incomes are lowest, US$1 in developing countries in Asia, and US$1.50 in Latin America. Overall, this study derives a much higher global estimate of costs of around US$1 per capsule."

[30] See documentation in AgBioWorld : http://www.agbioworld.org/biotech-info/topics/goldenrice/index.html

A bibliography of publications of the Golden Rice and Biofortification demonstrates the importance of this field of research, out of a general bibliography of 1640 references a list of over 200 important papers is assembled.[31]

It should be mentioned, that biofortification strategies are also proposed for feed (Gressel & Zilberstein, 2003): Straw from harvested crops can be adapted to higher quality feeding straw for cattle.

Conclusions drawn by Ingo Potrykus (Potrykus, 2009)

"The huge potential of plant biotechnology to produce more, and more nutritive, food for the poor will be lost, if GMO-regulation is not changed from being driven by "extreme precaution" principles to being driven by "science-based" principles.
Changing societal attitudes, including the regulatory processes involved, is extremely important if we are to save biotechnology, in its broadest applications, for the poor, so that public institutions in developing as well as industrialized countries, can harness its power for good."

4. The dispute between scientists and opponents today

4.1. The role of some activist NGOs in the debate

There is an important need for dialogue with regulators, the public and specifically consumers, since the new technology emerging from modern life science is affecting all aspects of human life, including food, reproduction etc. We do have an unfortunate trend towards irrational and antiscience argumentation in the GM crop dispute, as clearly diagnosed by (Taverne, 2005a) in his book "The March of Unreason), see also (Durant, 2005; Taverne, 2005b).

This said, we should not create misunderstandings: There is no room for appeasement politics today when it comes to the activist NGOs like Greenpeace[32] and Friends of the Earth[33], or websites like the Institute of Science in Society (I-SIS)[34] and GM-Watch[35]. Those professional organizations have proven repetitiously not to be interested in peer reviewed science in a debate on the science and the socio-cultural issues. They rather rely on un-confirmed reports in order to follow their own ideological and commercial interests. Any rational discourse with such organizations would be very welcome, but needs to be based on the latest peer reviewed science. Their usual tactics is to appeal on fear. A good example from Greenpeace has been described on the EFB forum website[36] about baseless accusations that 1600 sheep have died from feeding Bt cotton leafs. Another blatant example has been launched recently on You Tube[37], full of misinformation and hatred against multinational seed corporations – sometimes activists make up pseudoscientific spoofs, which are seemingly dead serious[38]. An critique on the distorted picture on Indian cotton cultivation by NGOs is given by Herring (Herring, 2008) with lots of figures, facts and extensive documentation. We are also confronted with violence - activities clearly documented and justifiably named and pursued as terrorism (Marris, 2006). Also in Europe

[31] Bibliography on Golden Rice papers assembled by Klaus Ammann : http://www.botanischergarten.ch/Golden-Rice/Bibliography-Golden-Rice-WOS-KA-20091008-links-abstracts.pdf
[32] Greenpeace International: http://www.greenpeace.org/international/
[33] Friends of the Earth: http://www.foe.co.uk/
[34] Institute of Science in Society: http://www.i-sis.org.uk/index.php
[35] GM Watch: http://www.gmwatch.org/
[36] EFB-website on Greenpeace myth in India: http://www.efb-central.org/index.php/forums/viewthread/13/
[37] YouTube story: http://www.youtube.com/watch?v=1H9WZGKQeYg
[38] A classic scaremonger spoof: http://nanotransformation.com/

there are regularly occurring field destructions (Atkinson & Urwin, 2008), which hamper seriously biosafety research – what an irony! Eco-terrorism is not confined to Europe, problems of such kind also are very real in the United States (Leader & Probst, 2003): According to the Federal Bureau of Investigation (FBI), the Earth Liberation Front, together with its sister organization, the Animal Liberation Front (ALF) has committed from 1997 to 2003 more than 600 criminal acts that have resulted in more than $43 million in damages. Moreover, attacks have been perpetrated in virtually every region of the US against a wide variety of targets.

More chagrin emerges from the mounting pressure from within the academia, where for instance university leaders ordered to cease field research on GM crops which is unwelcome in the eyes of the extremists, as happened at a German university[39] and there are serious complaints about the difficult atmosphere for biotech researchers in Germany (Rauschen, 2009).

Another symptomatic row is presently taking place in India, related to the approval of Bt brinjal, where activists in a desperate attempt to stop the regulatory approval of Bt brinjal with outrageous rumors like: GM brinjal will render the soil sterile, but contradictions have been posted as well.[40]

As an exemplary dispute, you can also follow the exchange of letters between the Public Research and Regulation Initiative (PRRI) and Friends of the Earth (FoE) under these links: PRRI letter to FoE [41], Answer of FoE to PRRI [42] and answer of PRRI to FoE [43] (there was no reply of FoE to follow up). Some of those anti-GMO activist groups get hefty funding from governments in the EU as documented accurately by Andrew Apel and his GMobelus website: Europe's massive funding of world-wide activism[44].

The current set of arguments of GM crop opponents is often an mix of anti-American, anti-global, post-modern and even anti-science notions, (Borlaug, 2000), a strategy which has now been taken over very successfully by NGOs like Greenpeace and Friends of the Earth as global actors. These leading protest forces have helped, particularly in Europe, to build up a post-modern negative picture of biotechnology as a whole (Hemming, 2006). In this light it is easy to act as 'opinion leaders' with pseudoscientific arguments. The feedback mechanisms through the media and a network of citations of all the flawed stories make it possible for the global opponents to maintain confirmation of negation mechanisms. We are in a situation where the opponents already try to claim victory, penetrate highest political levels in governments and international organizations like the United Nations, some produce strikingly flawed reports on GM crops.

An analytical article about media and NGO activities in New Zealand has been published by Motion & Weaver (Motion & Weaver, 2005): by attracting media attention through dramatic protests Greenpeace risks to jeopardize its reputation. The abstract:

"The challenges of attracting positive media attention are likened to a contest in which various organizations attempt to promote and circulate their version of events; however, this is particularly difficult when attempting to circulate less established, unpopular or critical knowledge. Although complying with, and managing, news values is an important starting point, the need to move beyond news values to consider the commercial values and realities of media organizations is highlighted. In this paper, a case study is undertaken of the Greenpeace media relations in New Zealand when a proposed controversial expiry of a moratorium to release genetically modified organisms into the environment. The predicament for Greenpeace is that in attracting media attention through dramatic protests it risks jeopardizing its reputation as a credible

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[39] Miller in Wallstreet Journal: http://www.botanischergarten.ch/Discourse/Miller-Wallstreet-Europe-20080624.pdf

[40] Agbios website Brijal story: http://agbios.com/main.php?action=ShowNewsItem&id=11087 and the contradiction: http://biospectrumindia.ciol.com/content/CoverStory/10901091.asp and see also the ISAAA brief on Brinjal: http://www.isaaa.org/resources/publications/briefs/38/download/isaaa-brief-38-2009.pdf

[41] PRRI letter to FoE: http://pubresreg.org/index.php?option=com_docman&task=cat_view&gid=52&dir=DESC&order=name&limit=5&limitstart=5

[42] Answer of FoE: http://pubresreg.org/index.php?option=com_docman&task=cat_view&gid=52&dir=DESC&order=name&limit=5&limitstart=0

[43] Answer of PRRI: http://pubresreg.org/index.php?option=com_docman&task=cat_view&gid=52&dir=DESC&order=name&limit=5&limitstart=5

[44] Andrew Apel: EU-Funding downloaded from www.GMobelus.org http://www.botanischergarten.ch/Fundamentalists/Apel-EU-Funding-2009.pdf

news source that can influence the framing of news stories. Insights are offered into the need for organizations to understand and manage the story or knowledge to be circulated and comply with contradictory news values."

Related to this paragraph on NGOs it is necessary to write a word on the press: newspapers and other media usually are mirroring what is important in the public debate, and the NGOs are clever in manipulating both the public and the press, after all, it is easy to provoke with fear and scaremongering and the majority of journalists of all calibers are also committed to their own product, position and its commercial situation.

A classic example is the coming and going of the Frankenfood Myth[45]. Interestingly enough, this myth had its sharp peak in the press statistics around 1998, and since then it has vanished nearly completely from the headlines (Leydesdorff & Hellsten, 2006).

Those mechanisms have been precisely described by Burke for the situation in Great Britain some years ago (Burke, 2004). But it is also clear that in the last 5 years more balanced voices appear in the press, although there is no room to extend this topic here, just one recent example from the London Times may suffice[46].

4.2. The GM crop battle, the dispute among scientists, the use of strong language

First, let us not forget some words of Antony Shelton (Shelton, 2003), the most important words can translate into a slogan: "Quality of science must back up personal opinions", the abstract:

"In agricultural biotechnology there are roles and responsibilities of scientists, scientific journals, the public media, public agencies, and those who oppose or advocate a specific technology and serious consequences for science in general when those roles and responsibilities go awry. Scientists may feel the pressure of competition, especially in an academic setting. Personal views may continue to decide which issues one will work on, but the quality of science must back up those personal opinions. Common sense tells us that scientific inquiry and the publication and reporting of results to the scientific community and general population should be performed with high standards of ethical behavior, regardless of one's personal perspective on agricultural biotechnology"

One of the arising problems is, that there has been recently a tendency to mollify peer review for the sake of politically correct so-called "critical views" of genetic modification of crops, with some blatant examples of flawed pseudo-critical papers having passed for publication in highly respected scientific journals – a few examples have been commented by (Miller et al., 2008). Some of those papers just passed due to flawed peer review, others passed despite rejection by some peer scientists, obviously for the sake of public debate (and – for the promotion of the journal) see as an example the justifications of the editor in chief of Lancet Richard Horton to go ahead with the publication of Pusztai's rat experiments (Horton, 1999a, b, c; Horton, 1999d; Horton, 1999e). More details about this controversy see in ASK-FORCE on Pusztai[47], soon to be replaced by a much more extensive text on how the issue unfolded and what impact it had.

It is only between 2005 and 2009 that a certain fatigue of new negative arguments against GM crops is developing, and it is interesting to note that opponents now shift their emphasis on negative arguments in socio-economics. But this might also be the reason why in a desperate routine of repetitious 'negative' GM crop stories get into journals, often also on rehashed events which have been clearly rebutted scientifically many years before. Those 'news stories' often pass uncontested and get printed in "news"-media due to a mix of short memory effects of uninformed people of all kind, or worse: they are purposefully repeated by activists counting on short memory of press and

[45] Frankenfood Myth: http://en.wikipedia.org/wiki/The_Frankenfood_Myth
[46] Financial Times: Gates Foundation 20091016: http://www.botanischergarten.ch/Developing/Blas-FT-Gates-Shifts-Aid-20091016.pdf
[47] ASK-FORCE on Pusztai: http://pubresreg.org/index.php?option=com_content&task=view&id=61

public. A strange effect should also be mentioned, that scientists, who defend good science in biosafety research, sometimes get blamed because they use straightforward language when criticizing flawed papers. The most recent example has been published by Nature (Waltz, 2009), see the comments in a contribution of ASK-FORCE[48] on a flawed paper on aquatic organisms supposedly harmed by Bt toxins of GM maize by Rosi-Marshall (Rosi-Marshall et al., 2007a). There are several controversial hints in this Nature story put forward by a science journalist not specialized, nor experienced in the hot scientific regulatory debate on GM crops, suggesting that to criticize flawed papers with strong language is detrimental to the progress of scientific research. This statement was supported by interviewed writers such as Chapela[49] and Schubert[50] who defend independent scientific whistle blowers, but who themselves have a proven negative agenda about GM crops, and in the case of Schubert often do not really dig into the rich and available food safety literature (Schubert is a pharmacist); some additional publications on the controversy in Nature Biotechnology: (Bradford et al., 2005a; Bradford et al., 2005b; Schubert, 2005). Schubert tries to apply regulatory regimes developed in the pharmaceutical industry to the regulation of GM food, which is scientifically wrong. The latest controversy on gene flow of Mexican maize starts a renewed debate on the reliability of PCR texts for the detection of GM maize (E. BITOCCHI, 2009; Marris, 2005; Mercer & Wainwright, 2008; Mijangos-Cortés et al., 2007; Ortiz-Garcia et al., 2005a; Ortiz-Garcia et al., 2005b; Ortiz-Garcia et al., 2006; Pineyro-Nelson et al., 2009; Rowell & Ammann K. (Comments), 2009; SCHOEL & FAGAN, 2009; Snow, 2009; Soleri et al., 2005) and Chapela does not really make a convincing figure. His strong anti-GM-crop agenda is there well documented.

In the meanwhile, several letters to the editor have been written commenting the feature of Emily Waltz in Nature [51], the majority not supporting her thesis.

Incidentally: Strong language has been used before in the history of science, remember some really bitter and hefty disputes about the history of discovery of the double helix structure of DNA between Watson and Crick (Friedberg, 2007), who both later made their peace again.

Other numerous examples of a fight out in the open are documented about evolution when Darwin proposed his revolutionary ideas. Two citations of strong language may suffice: In a debate on natural selection (Punnett, 1928) writes on a dispute with William Bateson:

"By these admission almost the last shred of that teleological fustian with which Victorian philosophy loved to clothe the theory of evolution is destroyed. Those who would proclaim that whatever is right will be wise henceforth to base this faith frankly on the impregnable rock of superstition and to abstain from direct appeals to natural fact."

Another clear example of sharp and relentless scientific controversy with strong language has been described in detail by Strick (Strick, 1999), among the numerous juicy examples:

"His [Bastian's] tone was sharp in response to Huxley's public accusations that his technique was sloppy (a much more high-powered attack than Huxley ever adopted in private when attempting to correct young scientists). Huxley replied with an equally sharp tone, now saying sweepingly that "what Bastian got out of his tubes was exactly what he put into them," i.e. contaminants".

And one last word about strong language: The word "abuse" has been printed by Nature in the Battlefield paper (Waltz, 2009) very prominently in the subtitle, when attacking a group of authors

[48] ASK-FORCE on Rosi-Marshall et al. 2007b: http://www.efb-central.org/index.php/forums/viewthread/49/

[49] See blog of Rowell and comments of K.Ammann: http://www.botanischergarten.ch/Geneflow/Rowell-Immoral-Maize-and-Comment-Ammann-20091125.pdf

[50] GMO Pundit Schubert and Answer by David Tribe: http://gmopundit.blogspot.com/2006/02/david-schubert-alleges-systematic.html

[51] Letters to the editor about the featue in Nature of Emily Waltz: http://www.botanischergarten.ch/Discourse/Waltz-Battle-Field-Letters-2009.pdf

including me who criticize flawed papers in the GM crop debate with harsh words – what an irony! – And to be quite clear: no complaints from my side….

4.3. Negative effects in food and environmental safety do (or should) not pass peer review

It is fact, that for some years basically no new arguments against agricultural biotechnology on an agronomic base can be put forward for the most widespread crops which ran through multiple regulatory processes in many countries. Some critical science journalists question the strategies and behavior of the global opposition players. In a kind of last bid questionable reviews are published, either containing lots of negative *assumptions* (Hilbeck & Schmidt, 2006) or containing or reviewing flawed data or statistics, or questionable conclusions: (Marshall, 2007) (Dona & Arvanitoyannis, 2009; Rosi-Marshall et al., 2007b; Seralini et al., 2007b), often in disrespect (or complete ignorance) of the internationally approved rules of biosafety experiments established by the OECD (OECD, 1998a, b) and also by avoiding the citation of certain peer reviewed references. Many of those papers have been or will be treated in ASK-FORCE[52], where you can view 7 new ASK-FORCE contributions recently updated, for more details see 4.1.

It also must be said (remember Saner's statements at the beginning of this chapter), that vested interests can be spotted with some biosafety researchers, who are in need of research grants and thus paint a negative picture on biosafety, they symptomatically have difficulties to distinguish between the 'nice-to knows' and the 'need-to knows.' Example: the ASK-FORCE contribution[53] on the publication of (Lovei et al., 2009), a paper which is flawed in several ways. It has been completely rebutted by Shelton et al. (Shelton et al., 2009) , the questions asked in the Lovei paper are irrelevant for Bt maize cultivation, since the Bt-toxin-technology is overwhelmingly beneficial for majority of non-target insects (Candolfi et al., 2004; Marvier et al., 2007; Naranjo, 2009; Wolfenbarger et al., 2008). One of the major flaws of the Lovei paper is that they used low quality prey for their laboratory feeding studies. A thorough analysis of risk assessment research has been recently published by Raybould (Raybould, 2010): We need to carefully distinguish between basic ecological research and purposeful and targeted risk assessment research which concentrates on the real agronomic risks (Ammann et al., 2004).

The question and negative answer given in the letter[54] of PRRI to the Secretariat of CBD is fully justified, *and PRRI stands ready to expand on the points made in this letter.*

"1. Are there LMOs or traits that have caused adverse effects?
***No**. Since the first application of genetic modification in the 80s, many thousands of field trials have been conducted with GM organisms (to date mostly plants), and since 1996 many hundreds of millions of hectares have been planted with GM crops by many millions of farmers and consumed by hundreds of millions of consumers in developed and developing countries, without any verifiable reports of adverse effects on the environment or human or animal health.*
In fact, taking a broader look, experience with those GM crops has shown environmental and socio-economic benefits in terms of increases in yield, significant reductions in use of pesticides, fossil fuels and soil erosion, less mycotoxins in grains, as well as increased farmers health and income."

Final remarks: Coming back to the first statement of Saner (Saner, 2007) given under 2.1.: Value laden scientific activity cannot be avoided, but minimized - if you refrain to work with flawed data, with filtered citation lists and with reviews pontificating on negative assumptions. The only remedy is to work with high quality data produced in a methodologically transparent way following international agreement.

5. So, what can we do to enhance acceptability (debate improvements)?

[52] ASK-FORCE EFB-Link http://www.efb-central.org/index.php/forums/viewforum/26/
[53] ASK-FORCE contribution on Lovei et al. 2009: http://www.efb-central.org/index.php/forums/viewthread/55/
[54] PRRI Letter to CBD: http://www.pubresreg.org/index.php?option=com_docman&task=doc_download&gid=490

Foremost, it is important to *shift from pro-reactive to proactive mode*. This does not automatically mean to filter away negative views on GM crops and to organize a eulogy on the benefits, the pro-active mode should actually engage a new mode of debate, which is more discursive, more structured and definitely concentrates on a solution oriented decision making process. It's time for action – as far as a strict scientific view is allowing this. There are several websites working hard on sorting out the strictly science oriented messages in biotechnology, as mentioned below. We should not, as it often happens, in our struggle against the negative pseudo facts focus on the risk alone and thus trap ourselves in a negativistic perspective.
Rather we should address in a balanced way also the obvious (or lost) benefits. But this alone will not provoke a turnaround. This shift must be embedded in a discourse with concerned people and organizations and it must clearly oppose untruthful strategies of the global protest corporations and thus also refrain from using the same counter tactics. One of the appropriate organizations for this activity will be the two platforms: (1) Public Research and Regulation Initiative PRRI[55] run by public researchers and (2) also the European Federation of Biotechnology[56], so that public science will get a more important place in the international regulatory debate (but also where private seed companies are not fundamentally battled in a naïve neo-Marxist scheme). In many meetings strictly based on science and organized by PRRI both platforms are well received. The project outline can be described as follows:

5.1. ASK-FORCE organization and related websites

There is a flood of papers which cast doubt on the GM crops already regulated in many countries. Most (not all) of these papers are written in a bad quality, either with flawed methodologies not internationally agreed upon, or with conclusions which are not supported by the data. There are also many reviews published, in a scientific style, but unfortunately either with a strongly biased set of references or with unsupported assumptions and doubtful conclusions – contradicting peer reviewed publications often not cited.

Within an EU project with Marc van Montagu and Piet van der Meer, which has been granted to PRRI a blog was launched with the name ASK-FORCE on the PRRI website[57] under the guidance of the author and secretarial help of Kim Meulenbroeks (until 2008) and presently Zuzana Kulikova . A list of about 130 items[58] has been compiled with international help (comments welcome) and will be entered step by step in the grid of the following 6 chapters.
(1)General (2)Human & Animal Health (3)Environmental Safety (4)Agriculture (5)Public Perception (6)Developing Countries.

The draft ASK-FORCE pieces are sent to a list of experts: The steering committee of PRRI[59], the Executive Board of EFB[60] and to Experts of AgBioWorld[61]. All three lists contain some of the best specialists on green biotechnology from all around the world for reviewing and commenting.
Some first renewed examples are given in parallel also on the renewed ASK-FORCE website of the European Federation of Biotechnology.[62]

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[55] Public Research and Regulation Initiative PRRI http://www.pubresreg.org/
[56] European Federation of Biotechnology (EFB): http://www.efb-central.org/
[57] PRRI ASK-FORCE website: http://pubresreg.org/index.php?option=com_content&task=blogcategory&id=70&Itemid=71
[58] General list of planned ASK-FORCE contributions: http://www.botanischergarten.ch/ASK-FORCE-Strategy/ASK-FORCE-General-List-20090911.pdf
[59] Steering committee of PRRI: http://pubresreg.org/index.php?option=com_content&task=view&id=13&Itemid=51
[60] Executive Board of EFB: http://www.efb-central.org/index.php/Main/the_executive_board
[61] Expert group of AgBioWorld: http://www.agbioworld.org/experts/index.html
[62] ASK-FORCE general forum on EFB-website: http://www.efb-central.org/index.php/forums/viewforum/26/

In order to become more pro-active, we need to develop forward looking strategies. It is up to the scientists to ask questions to the opposition, and in particular to the professional distorters of the scientific facts. This must escalate into public campaigns if (what is to be expected) those specific questions are ignored. Carefully built contacts with science writers are important here.

There is close collaboration foreseen between the major active networks, such as (list still incomplete)

- Prakash's AgBio View http://www.agbioworld.org/
- Andrew Apel's GMobelus http://www.gmobelus.com/index.php
- Kristina Sinemus' and Gerd Spelsperg's GMO Safety, http://www.gmo-safety.eu/en/ English and German, supported by the German Ministry of Science,
- EU-funded news website GMO compass http://www.gmo-compass.org/eng/home/
- Doug Powell's AGNET now found a new host: Bites, Save food http://bites.ksu.edu/
- David Tribe's GMO-Pundit http://gmopundit.blogspot.com/ (ca. 5000 hits per month)
- Robert Derham's Check Biotech http://www.checkbiotech.org/ (more than 1 million visitors per month, including CheckOrphan, BioEnergy and GreenBio)
- The British Sense About Science http://www.senseaboutscience.org/ which contains lots of similar elements as the ones ASK FORCE wants to cover.
- Clive James' ISAAA http://www.isaaa.org/ a website promoting GM crops worldwide with ca. 600'000 subscribers.
- For French speaking people in Switzerland, there is a WICKI maintained by Jean-Pierre Zrÿd http://ogm.wikidot.com/forum/start
- For the German and French speaking people in Switzerland there is information available at the Internutrition http://www.internutrition.ch/ website maintained by Jan Lucht.
- European Federation of Biotechnology, re-opened blog ASK-FORCE of EFB, ca. 5000 mail addresses http://www.efb-central.org/index.php/forums/viewforum/26/
- Public Research and Regulation Initiative www.pubresreg.org several hundred mail addresses
- AgbioForum http://www.agbioforum.missouri.edu/ peer reviewed contributions, up to now 12 Volumes
- Much more: Annotated List of Sites Related to Agricultural/Environmental Biotechnology http://www.isb.vt.edu/cfdocs/indexlinks.cfm needs to be checked and selected additions possible.
- ANBIO, National Biosafety Association of Brazil http://www.anbio.org.br/english/index.html
- With 60'000 Addresses.
- REDBIO, http://www.redbio.org/ most South American Countries involved
- Crop Life International http://www.croplife.org/ CropLife International is a global federation representing the plant science industry and a network of regional and national associations in 91 countries.
- AgBiotech Databases, http://cls.casa.colostate.edu/Transgeniccrops/links.html © Copyright Department of Soil and Crop Sciences at Colorado State University, 1999-2004. All Rights Reserved.
- Another resource of possible websites Degrassi, G., Alexandrova, N., & Ripandelli, D. (2003) Databases on biotechnology and biosafety of GMOs. Environ. Biosafety Res., 2, 3, pp 145-160 http://dx.doi.org/10.1051/ebr:2003012 AND http://www.botanischergarten.ch/Regulation/DeGrassi-Databases-Biotechnology-Biosafety-2003.pdf
- List of science journalists available through AgBioView and ASK-FORCE

5.2. Long term discourse and decision making processes

Let me first be quite clear that I think a dialogue with the professional protest corporations is, as a rule, a waste of time (specifically Greenpeace and Friends of the Earth, not to mention some other organizations). Their only interest is to keep the pot cooking and make sure that the population remains in a state of fear. They should be addressed with a confrontational strategy, which is included in ASK-FORCE. Often such NGOs get the willful help of the press, which acts according to the old proverb *"evil always fascinates – goodness rarely entertains",* see also the arguments produced by Moore (Moore, 2006). While some press products concentrate on mirroring public concerns, a press more or less close to boulevard strives to foster its marketing with the help of sensational headlines, creating stories which sell better, but indirectly they are exacerbating the problems. We are also not going to talk about a special discourse, as described by Erjavec (Erjavec & Erjavec, 2009) related to the politics of the EU commission.

Nevertheless we have to address all segments of the public with its concerns, feelings and interests. And the discourse we are going to concentrate on is solution oriented. This should be done according to the discursive rules of the management strategies of the second generation, the *Systems*

Approach (see under 4.3.). As a basic reference with description and citations see the classic book of Churchman (Churchman, 1979). If we follow some ground rules, this should not be too complicated:

5.3. The Second Generation Systems Approach as a new decision making process

Instead of making questionable concessions (example: "let's not talk about transgenic crops" as often done by Nestlé and Unilever, with notable exceptions[63] within these two companies!), the dialogue should be organized in an atmosphere of *'Active Listening'* [64] and understanding - in which, apart from the strict rules of scientific argumentation we should send signals that the new technologies also trigger socio-economic and cultural feedbacks. This will be the key to solve *Wicked Problems* [65], which contain also socio-cultural elements besides a set of hard, often contradictory facts (Rittel & Weber, 1973). In his usual cynic and pointed way, George Bernard Shaw defined the ultimate problem in the dialogue between scientists and lay people: *"Every profession is a conspiracy against the laity"*.

It is not about the usual stakeholder meetings, this is about instigating modern planning processes of the second generation in evidence based but open ended decision making processes. This *Systems Approach of the second generation* contrasts to linear planning with pre-determined targets and dominating deontic thinking (e.g. of the industrial corporations and government agencies), *the Systems Approach of the first generation* (Example: Apollo moon landing with clear target).

The rationale of new management and decision making processes

These new strategies should dissolve the traditional stakeholder concept in favor of a much more efficient system respecting *different kinds of knowledge* and other rules (such knowledge differentiation is also known from learning processes, which are related to our decision making dynamics (Blackmore, 2007).

There are more practical reasons to employ into the Systems Approach and its concept of different kinds of knowledge as Zwart (Zwart, 2007) rightly emphasizes: Ever since we have realized that the low number of human genes (approximately 22'500) cannot be interpreted as a narcissistic offence, since organisms are so highly complex, including the emerging consciousness of our human brain, genomics takes us now beyond a genetic deterministic understanding of life, this must have consequences for societal research and debate as well. Policies for self-improvement will increasingly rely on the use of complex interpretation. *Therefore, the emphasis in our discourse must shift from issues such as genetic manipulation and human enhancement to issues involved in governance of novel forms of information.* The same can be said on the side of agriculture. Ikerd (Ikerd, 1993) develops with the means of the systems approach a more holistic picture of agricultural management.

(Fairclough, 2009) as a linguist gives an in depth and critical analysis on discourse related to globalization with lots of facets and again with a totally different set of terminology, he also presents negative examples of discourse: Objectivism treats globalization as simply objective fact, which discourse may either illuminate or obscure, represent or misrepresent. In the Churchman systems approach there is no such thing as an objective approach, rather it is objectivation.

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[63] Brabeck-Lethmathe, Chairman of Nestlé: http://www.botanischergarten.ch/Nestle/Brabeck-Finfact-Irland-Interview-2009.pdf
[64] Active Listening: http://www.botanischergarten.ch/Discourse/Rogers-Farson-ActiveListening-1957.pdf
[65] Conklin: http://www.cognexus.org/id29.htm

Ideologism focuses upon how particular discourses of globalization systematically contribute to the legitimation of a particular global order which incorporates asymmetrical relations of power such as those between and within countries.

Scoones et al. (Scoones, 2008) come to similar conclusions as the Churchman school related to agricultural policy: the paper explores the national and transnational character of mobilization against GM crops in India, South Africa and Brazil in the ten-year period to 2005. The paper argues for a better understanding of national political and economic contexts which must be taken into account, alongside on how the GM debates articulate with other foci for activism and the complex and often fragile nature of alliances that make up activist networks. It is important to understand that the debate about GM crops has become a much wider one: about the future of agriculture and small-scale farmers, about corporate control and property rights and about the rules of global trade see also the new report of the Royal Society (Royal-Society, 2009). In sum, a debate should not just focus on the pros and cons of a particular set of technologies – after all, they have proven safe, - it's more about politics and values and the future of agrarian society. Again we see the plea for the complexity of *'wicked problems'* to be solved.

The downside is that those planning processes of the second generation are time consuming and need a careful and tedious procedure in developing the most important *zero-step* – before such decision making can be started. It also implies an exchange of knowledge between the parties beforehand, in order to minimize *hidden agendas*. It also must be emphasized that those decision making processes do not lead necessarily to a pre-defined goal, they are often *open-ended* and demand flexibility among the discourse participants, who need to remain open-minded.

The more questions we are asking the more answers are possible and vice versa. Limitations of technological solutions are always hidden in the open ecological and social systems: Just compare the (in)famous case of DDT sprayings in the past (Tren & Bate, 2001; Weissmann, 2006; WHO, 2005). Today it is clear that with linear planning DDT has been banned for ecological and health reasons, not considering the wider argument field of malaria prophylaxes: This inconsiderate DDT ban has caused millions of malaria deaths in Africa. Today, reasonable domestic use of DDT has again lowered the malaria threat measurably.
Constraints in possible secondary effects in ecology should be examined carefully: This is well demonstrated in the case of the Monarch larvae being killed by Bt-Maize-Pollen, the result of a laboratory study published in Nature (Losey, 1999) where the subsequent press interpretation got way out of proportion – even though the author Losey himself warned about the limitations of this small lab study. Would researchers have asked the farmers, they would have been able to say that feeding time of the young larvae do rarely overlap with the time of pollen shed of maize, and that the plants the Monarchs are feeding upon are fiercely fought as a weed. Subsequent field studies revealed that there is no problem arising from extensive Bt maize planting for the monarch larvae (Gatehouse et al., 2002).

- In order to tackle with wicked problems you need to go through *an extensive process of argumentation*, also called objectification, not to be mixed up with an "objective approach" to the problem.

There is rational planning, but there is no way to start to be rational, one should always start a step earlier, since there are important trends and facts which will make straightforward rational thinking

and acting in solving wicked problems useless. It is not the theory component, but rather the political component of the knowledge, which determines the vector of the action. This is the *zero-step* so important in the publications of Horst Rittel.

As an example: The fact, that experts can be wrong and farmers know better in certain situations in agriculture because they are better observers out in the field and because they are very experienced in traditional knowledge (Ammann, 2007).

The knowledge needed in solving wicked planning problems is not concentrated in a single head. It is absolutely essential to let all partners be involved in the problem solution process, which includes part of the population (mainly farmers organisations and consumer organisations), the Governmental Regulators, the Non-Governmental Organisations, the Life Science Companies and the Scientists. There is no monopoly of knowledge. Having illustrated the difficulties in solving wicked problems, we need a new approach in problem solving, in order to avoid the pitfalls of ignoring bottom up feedbacks.
You only can keep to this rule if you are also following another important rule: All partners in the planning process have to avoid hidden agendas, which is certainly eased by a minimum amount of respect paid to each other partner. Nobody should be criticised for speaking up in his own interest.

A caveat: It would be naive to just believe in the discursive capacities of the civil society, on the contrary: as Gerhards (Gerhards, 1997) has shown, that Habermas' support for the discursive model is based on the assumption, that actors of the civil society argue much more discursive and on a higher level of rationality than other collective actors do. But the empirical results show that actors of the civil society are even less discursive than other actors.

It is primarily the paradox of rationality which has been severely underestimated in the systems approach of the first generation when tackling with *wicked problems*.

How to Solve Wicked Problems in Biotechnology and the Environment

What we need in such cases is an action oriented approach. Risk Assessment and Management must be seen as a planning strategy of the second generation in developing a professional framework for *decision making*.

Strategies have to be developed to recognise the consequences of our doing on one side, and to specify our knowledge on the other side. This knowledge has to be gained step by step and case by case: If we want to clearly distinguish our present state knowledge from appropriate decisions to be made *not* based on our views and opinions, we need to go through the following steps.

- What is the problem?
- What do we want?
- What are the alternatives?
- How do we compare them?
- How can we reach the solution?

All participants need to keep in mind that there are *various types of planning knowledge* (arranged according to the 5 questions asked above):
Examples given here are lumped together as simple keyword-illustrations, taken out of their context in real planning examples, they cannot be regarded as an example of a realistic situation, this would be exactly the task of a planning process of the second generation.

- *Factual knowledge* is the knowledge of what actually happens (quantitative data or empirical, observational data). Gene flow species by species / region by region / facts about insect resistance in agriculture.
- *Deontic Knowledge*, the very important knowledge of what ought to be. The knowledge about new crops which enhance agricultural production / new agricultural techniques to avoid erosion / new biological approaches to fight insect pests etc.
- *Explanatory Knowledge* explains why things are so or why certain effects will happen. Here already you start to determine the direction of the solution. The way Bt proteins are acting on specific pest and beneficial insects / what are the main reasons of unwelcome erosion effects / mechanisms of vertical gene flow / mechanisms of resistance development.
- *Instrumental knowledge* on how to steer certain processes, on how to achieve certain goals, knowledge which needs to be balanced against regulation and safety. The way how to build Bt and other genes into crops and how to stabilise them / how to avoid vertical gene flow / how to avoid unwelcome soil erosion / how to avoid early upcoming pest resistance.
- *Conceptual knowledge* which would allow avoiding conflicts before they pop up. This is the knowledge about complex situations, taking into account all previous kinds of knowledge and also weighting them against arguments coming from open ecological

and societal systems. Concepts about transgenic crops compatible to the ideas of a sustainable agriculture. Lawyers and judges also may work with this kind of procedural knowledge.

You need to go through an *extensive, time consuming process of argumentation*, also called objectification, not to be mixed up with an "objective approach" to the problem. The hopes of this process are:

- to forget less, to raise the right issue
- to look at the planning process as a sequence of events
- to stimulate doubt by raising questions, to avoid short-sighted explicitness
- to control the delegation of judgement: Experts have no absolute power, scientific knowledge is important, but always limited.

There is no such thing as 'scientific planning'.

- Solving practical problems as to develop sustainable transgenic crops cannot be dealt with by "scientification of planning". Dealing with wicked problems is always political because of its deontic premises (means that you have to involve knowledge what ought to be) and because we deal with traditional knowledge. Science only generates factual, instrumental and in the best case explanatory knowledge.
- The planner (here the manager of an action plan) is not primarily an expert, but a *"mid-wife of problem solving",* a teacher more than a doctor. Moderate optimism and careful, seasoned disrespect, casting doubt is a virtue, not a disadvantage of an action plan manager.
- The planning process of wicked problems has to be understood as an *argumentative process*, it should be seen as a venture (or even adventure) within a conspiracy framework, where one cannot anticipate all the consequences of plans.
- Systems methods of the *second generation* are trying to make this deliberation explicit, to support it and to find means in order to make this process more powerful and to get it under better control *for all participants.* Methods like the computer based argument mapping systems of can be helpful (Conklin, 2003).
- It helps making such processes more successful, if they are conducted in the spirit of the *Symmetry of Ignorance* (Fischer, 2000) – this is the secret of the active listening which often leads to acceptable outcomes and trust.

This seems to be a rather theoretical approach with lots of restrictive rules, but actually it is on the contrary an opening for much more freedom in dialogue. Also it is more practical and efficient in creating results and contrasts with the traditional stakeholder concept where hidden agendas prevail in often disguised authoritarian structures. Such discursive processes are described in detail (Ammann, 2004; Ammann & Papazova Ammann, 2004; Rith & Dubberly, 2007a, b; Rith et al., 2007; Rittel, 1984; Rittel & Weber, 1973; Rittel & Webber, 2005; Schmidt et al., 2004). A comprehensive and voluminous monograph on risk related debate methods has been published by Renn (Renn, 2008), see especially the texts related to risk communication with essays 7 and 8 and chapter 8 on risk participation with numerous references, but notably lacking completely the papers on the 'Systems Approach' of the Churchman/Rittel/Webber school.

In a French paper the origin of negatively connoted words in the debate on GM crops like 'contamination', 'pollution', 'Frankenfood' etc. Moirand (Moirand, 2003), clearly revealing the links to negative events like BSE, dioxin scandals and of course Tchernobyl etc., thus explaining new words like 'mad soya' and 'mad colza' in the media. Moirand concludes that a new type of discourse is needed, but – as well as Renn (Renn, 2008) – does not refer to the very pragmatic and promising systems approach of Churchman and Rittel.

There are many more schools promoting discourse and new decision making processes, also in specialized journals, only a few can be summarized here for space reason: (Beer, 2004; Bonfadelli et al., 2002; Chen, 1975; Chiapello & Fairclough, 2002; Clark, 2000; Fairclough, 2009; Feldman & Lowe, 2008; Galtung & Ruge, 1965; Gaskell et al., 2000; Huang & Newell, 2003; Irwin, 2006; Iyengar et al., 2009; Moirand, 2003; Motion & Leitch, 1996; Newman, 2003; Priest et al., 2003; Renn, 2006; Saner, 2007; Schuman & Presser, 1980; Vaughan, 1995; von Grebmer & Omamo, 2007).

See Patrick Moore's practical examples of decision making processes solving environmental and sustainability problems in forestry, consult his own website Green Spirit [66] . These processes need time: Patrick Moore has gone successfully through such processes in the difficult task of reconciliation between the needs of timber production and environmental constraint, he needed months of debate to come to reasonable decisions (Moore, 2000a, b).

Another good example on how group discourses have good learning effects, has been described by Snyder et al. (Snyder et al., 2008): Although the U.S. government has assured stakeholders of their safety, the EU continues to be an outspoken opponent. This can largely be attributed to a lack of trust in the regulatory process, and especially a cynical perspective on the underlying science and institutions that govern approval. Such disparities were illustrated in 2003 when the United States donated GM maize to aid African countries stricken by

[66] Green Spirit website of Patrick Moore: http://www.greenspirit.com/index.cfm

famine. Under purported EU threats, negative propaganda by NGOs and stressing retaliatory trade sanctions, African officials refused the aid. An examination of this episode contrasts the potential discord between those affected and those who formulate government policy. Using resources from both sides of the debate, this scenario summarizes the pertinent issues regarding EU's refusal to the import transgenic crops. A group discussion and debate protocol was developed for facilitating small group and entire class consideration of the scenario while strengthening student critical thinking skills.

It helps, if you prepare carefully scenarios before people start the process, a method which has been successfully applied to the reconciliation processes in South Africa after abolishing apartheid by Adam Kahane as one of the principal mediators (Kahane, 2004). He also followed another wise rule: **Should only people participate in such processes who are part of the problem**. Another excellent example of long term discourse is described in many aspects by von Grebmer et al. (von Grebmer & Omamo, 2007):

"By working collectively the process will be more open, transparent, inclusive and accountable, and sensitive to the normative dimensions of the issues critical to the participants. The themes and processes outlined in this article set the stage for the discussions, internally and between countries, that will shape the policies of agricultural biotechnology in the region. If the dialogue can frame the discussion and be enriched by the information generated from actions taken, it can sustain the interest and commitment of the stakeholders, and more successfully direct biotechnology toward reducing hunger and poverty in the region."

Conclusions: only a multifaceted dialogue over a considerable time span will lead to success. The internet scene is developing fast and new communication software tools are available now, so careful scrutiny for such a network of networks need to be done first, and the big players like Google and competing networks should be consulted as well.

Personal experience in dialogue with many networkers reveals that sometimes important networks are only known in specific clusters, these lacunas should be closed for many reasons – see chapter 1.3. Knowledge exchange, jumping over national fences and coordination will be a follow-up effect, without even declaring it to be the goal of such activity. As for now, this is just an idea and needs to be discussed with internet and website specialists. After all, the leading webmasters and coordinators agree, that it is time to ***enhance collaboration through better communication.***

ASK-FORCE can contribute to this process in making sure, that professional peer reviewed risk assessment papers are fed into the dialogue processes and in ideally fed into a life decision making process with relevant participants.

6. Cited Literature

Adams, J. (1995) Risk Taylor & Francis,, Bristol PA 19007-1598, USA,, IS: 1857280679, pp 228

Aizen, J., Huttenlocher, D., Kleinberg, J., & Novak, A. (2004)
Traffic-based feedback on the web. Proceedings of the National Academy of Sciences of the United States of America, 101, Suppl 1, pp 5254-5260
10.1073/pnas.0307539100 AND http://www.pnas.org/content/101/suppl.1/5254.abstract AND http://www.botanischergarten.ch/Discourse/Aizen-Traffic-based-Feedback-web-2004.pdf

Alene, A.D. & Coulibaly, O. (2009)
The impact of agricultural research on productivity and poverty in sub-Saharan Africa. Food Policy, 34, 2, pp 198-209

Ammann, K. (2004)
The Role of Science in the Application of the Precautionary Approach,. *In Molecular Farming, Plant-made Pharmaceuticals and Technical Proteins* (eds R. Fischer & S. Schillberg), Vol. 1, pp. 291-302. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim

Ammann, K. (2007)
Reconciling Traditional Knowledge with Modern Agriculture: A Guide for Building Bridges. *In Intellectual Property Management in Health and Agricultural Innovation a handbook of best practices, Chapter 16.7* (ed A. Krattiger, Mahoney, R.T.L., Nelsen, L., Thompson, G. A., Bennett, A.B., Satyanarayana, K., Graff, G.D., Fernandez, C., Kowalsky, S.P.), pp. 1539-1559. MIHR, PIPRA, Oxford, U.K. and Davis, USA

Ammann, K. (2008)
Feature: Integrated farming: Why organic farmers should use transgenic crops. New Biotechnology, 25, 2, pp 101 - 107

Ammann, K. (2009a)
Biodiversity and GM crops. *In Environmental Impact of Genetically Modified/Novel Crops,released in March, 423p* (eds N. Ferry & A.M.R. Gatehouse), pp. 28 CAB International, Wallingford, Oxfordshire

Ammann, K. (2009b)
Feature: Why farming with high tech methods should integrate elements of organic agriculture. accepted, corrected proof. New Biotechnology, 4, pp

Ammann, K. & Papazova Ammann, B. (2004)
Factors Influencing Public Policy Development in Agricultural Biotechnology. *In RISK ASSESSMENT OF TRANSGENIC CROPS.* (ed S. Shantaram), Vol. 9, pp. 1552. Wiley and Sons, Hoboken, NJ, USA.P. Christou & H. Klee Handbook of Plant Biotechnology

Ammann, K.i., Wolfenbarger, L., Andow DA. and Hilbeck, A., Nickson, T., Wu, F., Thompson, B., & Ammann, K. (2004)
Biosafety in agriculture: is it justified to compare directly with natural habitats ? Frontiers in Ecology, Forum: GM crops: balancing predictions of promise and peril, 2, pp 154-160

Andree, P. (2002)
The biopolitics of genetically modified organisms in Canada. Journal of Canadian Studies-Revue D Etudes Canadiennes, 37, 3, pp 162-191

Anonymous (1992)
Products pose no special risks just because of the processes used to make them. Nature, 356, 6364, pp 1-2

Antle, J.M. (1999)
Benefits and costs of food safety regulation. Food Policy, 24, 6, pp 605-623

Arber, W. (1994)
MOLECULAR EVOLUTION: COMPARISON OF NATURAL AND ENGINEERED GENETIC VARIATIONS. Pontifical Academy of Sciences Scripta Varia, 103, pp 90-101

Arber, W. (2000)
Genetic variation: molecular mechanisms and impact on microbial evolution. Fems Microbiology Reviews, 24, 1, pp 1-7

Arber, W. (2002)
Roots, strategies and prospects of functional genomics. Current Science, 83, 7, pp 826-828

Arber, W. (2003)
Elements for a theory of molecular evolution. Gene, 317, 1-2, pp 3-11

Arber, W. (2004)
Biological evolution: Lessons to be learned from microbial population biology and genetics. Research in Microbiology, 155, 5, pp 297-300

Atanassov, A.B., A. Brink, J. Burachik, M. Cohen, J.I. Dhawan, V. Ebora, R.V. Falck-Zepeda, J. Herrera-Estrella, L. Komen, J. Low, F.C. Omaliko, E. Odhiambo, B. Quemada, H. Peng, Y. Sampaio, M.J. Sithole-Niang, I. Sittenfeld, A. Smale, M. Sutrisno, Valyasevi, R. Zafar, Y. Zambrano, P. (2004)

To Reach the Poor: Results from the ISNAR-IFPRI Next Harvest Study on Genetically Modified Crops, ISNAR-IFPRI, Washington, D.C., International Food Policy Research Institute. pp EPTD Discussion Paper No. 116 (Report)

Atkinson, H.J. & Urwin, P.E. (2008)
Europe needs to protect its transgenic crop research. Nature, 453, 7198, pp 979-979

Atkinson, R.C., Beachy, R.N., Conway, G., Cordova, F.A., Fox, M.A., Holbrook, K.A., Klessig, D.F., McCormick, R.L., McPherson, P.M., Rawlings, H.R., Rapson, R., Vanderhoef, L.N., Wiley, J.D., & Young, C.E. (2003)
Public sector collaboration for agricultural IP management including corrigendum of fig. on front page of text, vol. 302, 5648, pp 1152-1152. Science, 301, 5630, pp 174-175

Aumaitre, A. (2004)
Safety assessment and feeding value for pigs, poultry and ruminant animals of pest protected (Bt) plants and herbicide tolerant (glyphosate, glufosinate) plants: interpretation of experimental results observed worldwide on GM plants. Italian Journal of Animal Science, 3, 2, pp 107-121

Awoleye, F., Vanduren, M., Dolezel, J., & Novak, F.J. (1994)
NUCLEAR-DNA CONTENT AND IN-VITRO INDUCED SOMATIC POLYPLOIDIZATION CASSAVA (MANIHOT-ESCULENTA CRANTZ) BREEDING. Euphytica, 76, 3, pp 195-202

Ayal, S. & Hochman, G. (2009)
Ignorance or Integration: The Cognitive Processes Underlying Choice Behavior. Journal of Behavioral Decision Making, 22, 4, pp 455-474
10.1002/bdm.642

Baarends, W.M., van der Laan, R., & Grootegoed, J.A. (2001)
DNA repair mechanisms and gametogenesis. Reproduction, 121, 1, pp 31-39

Barnabás, B., Obert, B., & Kovács, G. (1999)
Colchicine, an efficient genome-doubling agent for maize (Zea mays L.) microspores cultured in anthero. Plant Cell Reports, 18, 10, pp 858-862

Batista, R., Saibo, N., Lourenco, T., & Oliveira, M.M. (2008)
Microarray analyses reveal that plant mutagenesis may induce more transcriptomic changes than transgene insertion. Proceedings of the National Academy of Sciences of the United States of America, 105, 9, pp 3640-3645

Baudo, M.M., Lyons, R., Powers, S., Pastori, G.M., Edwards, K.J., Holdsworth, M.J., & Shewry, P.R. (2006)
Transgenesis has less impact on the transcriptome of wheat grain than conventional breeding. Plant Biotechnology Journal, 4, 4, pp 369-380

Beachy, R., Bennetzen, J.L., Chassy, B.M., Chrispeels, M., Chory, J., Ecker, J.R., Noel, J.P., Kay, S.A., Dean, C., Lamb, C., Jones, J., Santerre, C.R., Schroeder, J.I., Umen, J., Yanofsky, M., Wessler, S., Zhao, Y.D., & Parrott, W. (2002)
Divergent perspectives on GM food. Nature Biotechnology, 20, 12, pp 1195-1196

Beardmore, J.A. (1997)
Transgenics: autotransgenics and allotransgenics. Transgenic Research, 6, 1, pp 107-108

Beer, S. (2004)
Reflections of a cybernetician on the practice of planning. Kybernetes, 33, 3-4, pp 767-773
10.1108/03684920410523689

Bennett, D., Glasner, P., & Travis, D. (1986) The Politics of Uncertainty Routledge & Kegan Paul plc., IS: 0-7102-0503-1, pp 218

Berg, P., Baltimore, D., Brenner, S., Roblin, R.O., & Singer, M.F. (1975)
SUMMARY STATEMENT OF ASILOMAR CONFERENCE ON RECOMBINANT DNA-MOLECULES. Proceedings of the National Academy of Sciences of the United States of America, 72, 6, pp 1981-1984
<Go to ISI>://WOS:A1975AG70300001 AND http://www.botanischergarten.ch/History/Berg-Summary-Statement-Asilomar-1975.pdf

Berg, P. & Singer, M. (1995)
THE RECOMBINANT-DNA CONTROVERSY - 20 YEARS LATER. Bio-Technology, 13, 10, pp 1132-1134

Berwald, D., Carter, C.A., & Gruere, G.P. (2006)
Rejecting new technology: The case of genetically modified wheat. American Journal of Agricultural Economics, 88, 2, pp 432-447

Blackmore, C. (2007)
What kinds of knowledge, knowing and learning are required for addressing resource dilemmas?: a theoretical overview. Environmental Science & Policy, 10, 6, pp 512-525

Bonfadelli, H., Dahinden, U., & Leonarz, M. (2002)
Biotechnology in Switzerland: high on the public agenda, but only moderate support. Public Understanding of Science, 11, 2, pp 113-130

Borland, N. & Wallace, D. (1999)

Environmentally Conscious Product Design: A Collaborative Internet-based Modeling Approach. Journal of Industrial Ecology, 3, 2-3, pp 33-46

Borlaug, N.E. (2000)
Ending world hunger. The promise of biotechnology and the threat of antiscience zealotry. Plant Physiology, 124, 2, pp 487-490

Bouis, H.E. (2007)
The potential of genetically modified food crops to improve human nutrition in developing countries. Journal of Development Studies, 43, 1, pp 79-96

Bradford, K.J., Gutterson, N., Parrott, W., Van Deynze, A., & Strauss, S.H. (2005a)
Regulatory regimes for transgenic crops - Response. Nature Biotechnology, 23, 7, pp 787-789

Bradford, K.J., Van Deynze, A., Gutterson, N., Parrott, W., & Strauss, S.H. (2005b)
Regulating transgenic crops sensibly: lessons from plant breeding, biotechnology and genomics. Nature Biotechnology, 23, 4, pp 439-444

Burke, D. (2004)
GM food and crops: what went wrong in the UK? Many of the public's concerns have little to do with science. Embo Reports, 5, 5, pp 432-436
10.1038/sj.embor.7400160

Candolfi, M.P., Brown, K., Grimm, C., Reber, B., & Schmidli, H. (2004)
A faunistic approach to assess potential side-effects of genetically modified Bt-corn on non-target arthropods under field conditions. Biocontrol Science and Technology, 14, 2, pp 129-170

Cavaller, V. (2009)
Scientometrics and patent bibliometrics in RUL analysis: a new approach to valuation of intangible assets. Vine, pp 80-91
10.1108/03055720910962461

Cavaller, V. & Aubertin, C. (2008)
Elements of Scientometrics and Patent Bibliometric-Analysis for the Estimated Remaining Useful Life (RUL) in the Valuation of Intangible Assets. Proceedings of the 5th International Conference on Intellectual Capital and Knowledge Management & Organisational Learning, pp 87-95
<Go to ISI>://WOS:000260973300011 AND
http://books.google.ch/books?id=YpAVZPlwoIsC&printsec=frontcover#v=onepage&q=&f=false

Chassy, B. & Parrott, W. (2009)
Is This Study Believable? Examples from Animal Studies with GM Foods. . In In Agricultural Biotechnology, , pp. 9, University of California, Davis, Davis, California http://www.agribiotech.info/details AND http://www.botanischergarten.ch/Peer-Review/Chassy-Parrott-Believable-2009.doc

Chassy, B.M. (2007)
The history and future of GMOs in food and agriculture. Cereal Foods World, 52, 4, pp 169-172
10.1094/cfw-52-4-0169

Chassy, B.M. (2009)
Global Regulation of Transgenic Crops. *In Molecular Genetic Approaches to Maize Improvement*, pp. 107-124

Chen, G.K.C. (1975)
WHAT IS SYSTEMS-APPROACH. Interfaces, 6, 1, pp 32-37

Chiapello, E. & Fairclough, N. (2002)
Understanding the new management ideology: a transdisciplinary contribution from critical discourse analysis and new sociology of capitalism. Discourse & Society, 13, 2, pp 185-208

Churchman, C.W. (1979) The Systems Approach and its Ennemies and: [Commented German transl.: Der Systemansatz und seine "Feinde," with an Introduction by the editor and translator, Werner Ulrich, ed. and transl., Paul Haupt, Bern, 1981]. Basic Books, New York, pp

Clark, C.E. (2000)
Differences between public relations and corporate social responsibility: An analysis. Public Relations Review, 26, 3, pp 363-380

Cohen, J.I. (2005)
Poorer nations turn to publicly developed GM crops. Nature Biotechnology, 23, 1, pp 27-33

Cohen, J.I. & Paarlberg, R. (2002)
Explaining restricted approval and availability of GM crops in developing countries. AgBiotechNet, 4, pp 1-6
http://www.joelcohen.org/pdf/RestrictedApproval.pdf AND http://www.botanischergarten.ch/Developing/Cohen-Explaining-Restricted-GM-crops-2002.pdf

Conklin, J. (2003)
Electronic Source: Wicked Problems and Fragmentation, published by: CogNexus Institute

de Melo-Martin, I. & Meghani, Z. (2008)

Beyond risk - A more realistic risk - benefit analysis of agricultural biotechnologies. Embo Reports, 9, 4, pp 302-306 10.1038/embor.2008.39

Delmer, D.P., Nottenburg, C., Graff, G.D., & Bennett, A.B. (2003)
Intellectual property resources for international development in agriculture. Plant Physiology, 133, 4, pp 1666-1670 10.1104/pp.103.028993

Depee, S., West, C.E., Muhilal, Karyadi, D., & Hautvast, J. (1995)
Lack of Improvement in Vitamin-a Status with Increased Consumption of Dark-Green Leafy Vegetables. Lancet, 346, 8967, pp 75-81

Dhlamini, Z., Spillane, C., Moss, J., Ruane, J., Urquia, J., & Sonnino, A. (2005)
Status of Research and Application of Crop Technologies in Developing Countries, Preliminary Assessment, FAO pp 62 FAO Reports Rome (Report)

Dona, A. & Arvanitoyannis, I.S. (2009)
Health Risks of Genetically Modified Foods. Critical Reviews in Food Science and Nutrition, 49, 2, pp 164 - 175

Dong, C.M., Whitford, R., & Langridge, P. (2002)
A DNA mismatch repair gene links to the Ph2 locus in wheat. Genome, 45, 1, pp 116-124

Driessen, P.L. (2005) Eco-Imperialism: Green Power · Black Death Academic Foundation (March 15, 2006) IS: ISBN-10: 817188427X ISBN-13: 978-8171884278 pp

Durant, J. (2005)
The march of unreason: Science, democracy, and the new fundamentalism. Nature, 435, 7040, pp 277-278 10.1038/435277a

E. BITOCCHI, L.N., M. ROSSI, D. RAU, E. BELLUCCI, A. GIARDINI, A. BUONAMICI, G. G. VENDRAMIN, R. PAPA, (2009)
Introgression from modern hybrid varieties into landrace populations of maize Zea mays ssp. mays in central Italy. Molecular Ecology, 18, 4, pp 603-621

EFSA (2007a)
Press release: EFSA reaffirms its risk assessment of genetically modified maize MON 863 maize, European Food Safety Authority pp 5 (Report)

EFSA (2007b)
Safety and nutritional assessment of GM plants and derived food and feed: The role of animal feeding trials. Safety and nutritional assessment of GM plants and derived food and feed: The role of animal feeding trials, 46, Supplement 1, pp S2-S70

EFSA (2007c)
Statement of the Scientific Panel on Genetically Modified Organisms on the analysis of data from a 90-day rat feeding study with MON 863 maize, European Food Safety Authority pp 5 (Report)

Erjavec, K. & Erjavec, E. (2009)
Changing EU agricultural policy discourses? The discourse analysis of Commissioner's speeches 2000-2007. Food Policy, 34, 2, pp 218-226

Fairclough, N. (2009)
Language and globalization. Semiotica, 173, 1-4, pp 317-342 10.1515/semi.2009.014

Falck-Zepeda, J.B., Traxler, G., & Nelson, R.G. (2000)
Surplus distribution from the introduction of a biotechnology innovation. American Journal of Agricultural Economics, 82, 2, pp 360-369

Fedoroff, N. (1994)
MCCLINTOCK,BARBARA (JUNE 16, 1902 SEPTEMBER 2, 1992). Proceedings of the American Philosophical Society, 138, 3, pp 431-445

Fedoroff, N., Schlappi, M., & Raina, R. (1995)
EPIGENETIC REGULATION OF THE MAIZE SPM TRANSPOSON. Bioessays, 17, 4, pp 291-297

Feldman, M. & Lowe, N. (2008)
Consensus from controversy: Cambridge's biosafety ordinance and the anchoring of the biotech industry. European Planning Studies, 16, 3, pp 395-410 10.1080/09654310801920532

Fischer, G. (2000)
Symmetry of ignorance, social creativity, and meta-design. Knowledge-Based Systems, 13, 7-8, pp 527-537

Flachowsky, G., Aulrich, K., Bohme, H., & Halle, I. (2007)
Studies on feeds from genetically modified plants (GMP) - Contributions to nutritional and safety assessment. Animal Feed Science and Technology, 133, 1-2, pp 2-30

Fransen, R. (2007)
Peer review: too much of a good thing? Scientist, 21, 9, pp 18-18

Friedberg, E.C. (2007)
The writing life of James D. Watson. Adler Museum Bulletin, 33, 2, pp 3-16
10.1016/j.tox.2006.05.020

Galtung, J. & Ruge, M.H. (1965)
THE STRUCTURE OF FOREIGN-NEWS - THE PRESENTATION OF THE CONGO, CUBA AND CYPRUS CRISES IN 4 NORWEGIAN NEWSPAPERS. Journal of Peace Research, 2, 1, pp 64-91

Gaskell, G., Allum, N., Bauer, M., Durant, J., Allansdottir, A., Bonfadelli, H., Boy, D., de Cheveigne, S., Fjaestad, B., Gutteling, J.M., Hampel, J., Jelsoe, E., Jesuino, J.C., Kohring, M., Kronberger, N., Midden, C., Nielsen, T.H., Przestalski, A., Rusanen, T., Sakellaris, G., Torgersen, H., Twardowski, T., Wagner, W., Olofsson, A., & Oehman, S. (2000)
Biotechnology and the European public. Nature Biotechnology, 18, 9, pp 935-938

Gasson, M. & Burke, D. (2001)
Scientific perspectives on regulating the safety of genetically modified foods. Nat Rev Genet, 2, 3, pp 217-222

Gatehouse, A.M.R., Ferry, N., & Raemaekers, R.J.M. (2002)
The case of the monarch butterfly: a verdict is returned. Trends in Genetics, 18, 5, pp 249-251

Gerhards, J. (1997)
The discursive versus the liberal public sphere: An empirical critique of Jurgen Habermas' concept of the public sphere. Kolner Zeitschrift Fur Soziologie Und Sozialpsychologie, 49, 1, pp 1-&

Ghatnekar, L., Jaarola, M., & Bengtsson, B.O. (2006)
The introgression of a functional nuclear gene from Poa to Festuca ovina. Proceedings: Biological Sciences, 273, 1585, pp 395 - 399

Goldacre, B. (2009)
Peer review is flawed but the best we've got, The Guardian pp (The Guardian Article)
http://www.botanischergarten.ch/Peer-Review/Goldacre-Peer-Review-Flawed-2009.pdf AND
http://www.botanischergarten.ch/Peer-Review/Goldrace-Comments-2009.pdf

Graff, G., Hochman, G., & Zilberman, D. (2009a)
The Political Economy of Agricultural Biotechnology Policies. In AgBioForum, Vol. 12, pp. 1-13
http://www.agbioforum.org/v12n1/v12n1a04-graff.htm AND http://www.botanischergarten.ch/Regulation/Graff-Political-Economy-Policies-2009.pdf

Graff, G. & Zilberman, D. (2004)
Explaining Europe's Resistance to Agricultural Biotechnology. UPDATE, Agricultural and Resource Economics, 7, 5, pp 4
http://www.agecon.ucdavis.edu/extension/update/articles/v7n5_1.pdf

Graff, G.D., Zilberman, D., & Bennett, A.B. (2009b)
The contraction of agbiotech product quality innovation. Nature Biotechnology, 27, 8, pp 702-704
10.1038/nbt0809-702

Gressel, J. & Zilberstein, A. (2003)
Let them eat (GM) straw. Trends in Biotechnology, 21, 12, pp 525-530

Gruere, G., Bouët, A., and , & Mevel., S. (2007)
Genetically Modified Food and International Trade: The Case of India, Bangladesh, Indonesia and the Philippines, IFPRI pp 60 IFPRI Discussion Paper 00740, Washington (Report)

Gruère, G. & Sengupta, D. (2009)
GM-free private standards and their effects on biosafety decision-making in developing countries. Food Policy, 34, 5, pp 399-406

Hackett, P. (2002)
Genetic Engineering: What are We Fearing? Transgenic Research, 11, 2, pp 97-99

Harms, U. (2002)
Biotechnology education in schools. Electronic Journal of Biotechnology, 5, 3, pp 205-211

Hemming, D. (2006)
Swiss vote encourages Austria's anti-GM stance. Outlook on Agriculture, 35, 1, pp 82-82

Herman, R.A., Chassy, B.M., & Parrott, W. (2009)
Compositional assessment of transgenic crops: an idea whose time has passed. Trends in Biotechnology, In Press, Corrected Proof, pp
http://www.sciencedirect.com/science/article/B6TCW-4X26XP1-1/2/bcfd547d5f12695fc76c4fc5886ba9fc

Herring, R.J. (2007)

The genomics revolution and development studies: Science, poverty and politics. Journal of Development Studies, 43, 1, pp 1 - 30

Herring, R.J. (2008)
Whose numbers count? Probing discrepant evidence on transgenic cotton in the Warangal district of India International Journal of Multiple Research Approaches, 2, pp 145-159

Hilbeck, A. & Schmidt, J.E.U. (2006)
Another view on Bt Proteins – How Specific are They and What Else Might They Do? Biopesticides International, 2, 1, pp 1-50

Horton, R. (1999a)
Genetically modified foods: "absurd" concern or welcome dialogue? The Lancet, 354, 9187, pp 1314-1315

Horton, R. (1999b)
GM food debate - Editors Reply. The Lancet, 354, 9191, pp 1729-1729

Horton, R. (1999c)
Health risks of genetically modified foods, Editorial, reply to Mitchell and Bradbury, Lancet, p. 1769. The Lancet, 353, 9167, pp 1811-1811

Horton, R. (1999d)
Scientific misconduct: exaggerated fear but still real and requiring a proportionate response. The Lancet, 354, 9172, pp 7-8
http://www.sciencedirect.com/science/article/B6T1B-3X1VTFN-17/2/c2f2f0da6e1ab75b90c3b1e28d4e1dce

Horton, R. (1999e)
Secret society - Scientific peer review and Pusztai's potatoes. Tls-the Times Literary Supplement, 5046, pp 8-9
<Go to ISI>://000084597900005 AND http://www.botanischergarten.ch/Pusztai/Horton-Secret-Society-Times-1999.pdf

Huang, J.C. & Newell, S. (2003)
Knowledge integration processes and dynamics within the context of cross-functional projects. International Journal of Project Management, 21, 3, pp 167-176

Humphrey, J.H., Agoestina, T., Juliana, A., Septiana, S., Widjaja, H., Cerreto, M.C., Wu, L.S.F., Ichord, R.N., Katz, J., & West, K.P. (1998)
Neonatal vitamin A supplementation: effect on development and growth at 3 y of age. American Journal of Clinical Nutrition, 68, 1, pp 109-117

Humphrey, J.H., West, K.P., & Sommer, A. (1992)
Vitamin-a-Deficiency and Attributable Mortality among under-5-Year-Olds. Bulletin of the World Health Organization, 70, 2, pp 225-232

Ikerd, J.E. (1993)
The need for a system approach to sustainable agriculture. Agriculture, Ecosystems & Environment, 46, 1-4, pp 147-160

Intemann, K.K. & de Melo-Martin, I. (2008)
Regulating scientific research: should scientists be left alone? Faseb Journal, 22, 3, pp 654-658
10.1096/fj.07-9077LSF

Irwin, A. (2006)
The politics of talk: Coming to terms with the 'new' scientific governance. Social Studies of Science, 36, 2, pp 299-320
10.1177/0306312706053350

Iyengar, S., Hahn, K.S., Bonfadelli, H., & Marr, M. (2009)
"Dark Areas of Ignorance" Revisited Comparing International Affairs Knowledge in Switzerland and the United States. Communication Research, 36, 3, pp 341-358
10.1177/0093650209333024 AND http://crx.sagepub.com/cgi/content/abstract/36/3/341

James, C. (2009)
Global Status of Commercialized Biotech/GM Crops: 2008, Brief 39, Executive Summary, Vol. Brief 39, pp. 20. ISAAA

Kahane, A. (2004) Solving Tough Problems: An Open Way of Talking, Listening, and Creating New Realities Berrett-Koehler Publishers, San Francisco, IS: 1-57675-293-3, pp 150 p.

Kalaitzandonakes, N., Alston, J.M., & Bradford, K.J. (2007)
Compliance costs for regulatory approval of new biotech crops. Nature Biotechnology, 25, 5, pp 509-511

Kalaitzandonakes, N., Marks, L., & Vickner, S.S. (2005)
Sentiments and acts towards genetically modified foods. International Journal of Biotechnology, 7, 1-3, pp 161-177
http://www.inderscience.com/search/index.php?action=record&rec_id=6452&prevQuery=&ps=10&m=or

Kalman, M.E., Monge, P., Fulk, J., & Heino, R. (2002)
Motivations to resolve communication dilemmas in database-mediated collaboration. Communication Research, 29, 2, pp 125-154

Kanter, R.M. (2000)
Are you ready to lead the e-cultural revolution? Inc, 22, 2, pp 43-44

Keller, D. (2009)
Start talking to each other!' - dialogue as key to biotechnology's future in Europe. New Biotechnology, In Press, Corrected Proof, pp

Kesavan, P.C. & Swaminathan, M.S. (2008)
Strategies and models for agricultural sustainability in developing Asian countries. Philosophical Transactions of the Royal Society B-Biological Sciences, 363, pp 877-891

Klug, A. (2004)
The Discovery of the DNA Double Helix. Journal of Molecular Biology, 335, 1, pp 3-26

Kochetkova, T. (2006)
The transatlantic conflict over GM food: Cultural background. Ethics and the Politics of Food, pp 325-329

Kostoff, R. (2002)
Citation analysis of research performer quality. Scientometrics, 53, 1, pp 49-71

Kostoff, R.N., Stump, J.A., Johnson, D., Murday, J.S., Lau, C.G.Y., & Tolles, W.M. (2006)
The structure and infrastructure of the global nanotechnology literature. Journal of Nanoparticle Research, 8, 3-4, pp 301-321

Koutsogiannis, D. & Mitsikopoulou, B. (2004)
The Internet as a glocal discourse environment - A commentary on "Second language socialization in a bilingual chat room" by Wan Shun Eva Lam and "Second language cyberhetoric: A study of Chinese L2 writers in an online usenet group" by Joel Bloch. Language Learning & Technology, 8, 3, pp 83-89

Kramer, M.G. & Redenbaugh, K. (1994)
Commercialization of a Tomato with an Antisense Polygalacturonase Gene - the Flavr Savr(Tm) Tomato Story. Euphytica, 79, 3, pp 293-297

Krattiger, A. & Mahoney, R.T. (2006)
Intellectual property and public health. Bulletin of the World Health Organization, 84, 5, pp 340-340

Krattiger, A., Mahoney, R.T.L., Nelsen, L., Thompson, G. A., Bennett, A.B., Satyanarayana, K., Graff, G.D., Fernandez, C., Kowalsky, S.P., ed. (2007)
Intellectual Property Management in Health and Agricultural Innovation a handbook of best practice, pp 1539-1559, MIHR, PIPRA, Oxford, U.K. and Davis, USA, IS: ISBN-13: 978-1-4243-2027-1

Krieger, E.K., Allen, E., Gilbertson, L.A., Roberts, J.K., Hiatt, W., & Sanders, R.A. (2008)
The Flavr Savr tomato, an early example of RNAi technology. Hortscience, 43, 3, pp 962-964

Laget, P. & Cantley, M. (2001)
European responses to biotechnology: Research, regulation, and dialogue. Issues in Science and Technology, 17, 4, pp 37-42

LaPorte, R.E., Linkov, F., Villasenor, T., Sauer, F., Gamboa, C., Lovalekar, M., Shubnikov, E., Sekikawa, A., & Sa, F.R. (2002a)
Papyrus to PowerPoint (P 2 P): metamorphosis of scientific communication. British Medical Journal, 325, 7378, pp 1478-1481 <Go to ISI>://WOS:000180188600027 AND http://www.botanischergarten.ch/Peer-Review/LaPorte-Papyrus-Powerpoint-2002.pdf

Laporte, R.E., Omenn, G.S., Serageldin, I., Cerf, V.G., & Linkov, F. (2006)
A scientific supercourse. Science, 312, 5773, pp 526-526

Laporte, R.E., Sekikawa, A., Sa, E.R., Linkov, F., & Lovalekar, M. (2002b)
Infopoints - Whisking research into the classroom. British Medical Journal, 324, 7329, pp 99-99

Latham, J.R., Wilson, A.K., & Steinbrecher, R.A. (2006)
The mutational consequences of plant transformation. Journal of Biomedicine and Biotechnology, 2006, pp 1-7
Article ID 25376, no Volume

Lawson, C. (2004)
Patents and the CGIAR system of International Agricultural Research Centres' germplasm collections under the International Treaty on Plant Genetic Resources for Food and Agriculture. Australian Journal of Agricultural Research, 55, 3, pp 307-313
10.1071/ar03161

Leader, S.H. & Probst, P. (2003)
The earth liberation front and environmental terrorism. Terrorism and Political Violence, 15, 4, pp 37-58
10.1080/09546550390449872

Lehrman, S. (1992)
OVERREGULATION COULD DAMAGE UNITED-STATES BIOTECHNOLOGY, SAYS REPORT. Nature, 359, 6396, pp 569-569

Leicht, E.A. & Newman, M.E.J. (2008)
Community structure in directed networks. Physical Review Letters, 100, 11, pp
10.1103/PhysRevLett.100.118703

Lempert, D.H. (2009)
A Dependency in Development Indicator for NGOs and International Organizations. Global Jurist, 9, 2, pp Article 6 10.2202/1934-2640.1296 AND http://www.botanischergarten.ch/Developing/Lempert-Dependency-Development-Indicator-2009.pdf

Lewin, R. (1983)
A Naturalist of the Genome. Science, 222, 4622, pp 402-405

Leydesdorff, L. (2002)
Indicators of structural change in the dynamics of science: Entropy statistics of the SCI Journal Citation Reports. Scientometrics, 53, 1, pp 131-159

Leydesdorff, L. (2008)
Caveats for the use of citation indicators in research and journal evaluations. Journal of the American Society for Information Science and Technology, 59, 2, pp 278-287
10.1002/asi.20743

Leydesdorff, L. (2009)
How are New Citation-Based Journal Indicators Adding to the Bibliometric Toolbox? Journal of the American Society for Information Science and Technology, 60, 7, pp 1327-1336
10.1002/asi.21024

Leydesdorff, L. & Hellsten, I. (2006)
Measuring the meaning of words in contexts: An automated analysis of controversies about 'Monarch butterflies,' 'Frankenfoods,' and 'stem cells'. Scientometrics, 67, 2, pp 231-258

Leydesdorff, L. & Wagner, C. (2009)
Macro-level indicators of the relations between research funding and research output. Journal of Informetrics, 3, 4, pp 353-362 10.1016/j.joi.2009.05.005

Linden, A. & Fenn, J. (2003)
Understanding Gartner's Hype Cycles, Gartner Research pp 12 Strategic Analysis Report (Report)

Linkov, F. (2006)
I. The Intemet-based supercourse system. Journal of Public Health Policy, 27, 4, pp 442-443

Linkov, F., Lovalekar, M., & LaPorte, R. (2006)
Scientific journals are 'faith based': is there science behind peer review? Journal of the Royal Society of Medicine, 99, 12, pp 596-598

Linkov, F., Lovalekar, M., & LaPorte, R. (2007)
Quality control of epidemiological lectures online: Scientific evaluation of peer review. Croatian Medical Journal, 48, 2, pp 249-255

Linkov, F., Shubnikov, E., Husseini, A.S., Lovalekar, M., & LaPorte, R. (2003)
Globallsation of prevention education: a golden lecture. Lancet, 362, 9395, pp 1586-1587

Losey, J.E., Raynor L. S. and Carter M. E. (1999)
Transgenic pollen harms Monarch larvae. Nature, 399, pp 214

Lovei, G.L., Andow, D.A., & Arpaia, S. (2009)
Transgenic Insecticidal Crops and Natural Enemies: A Detailed Review of Laboratory Studies. Environmental Entomology, 38, pp 293-306

Lubchenco, J. (1998)
Entering the century of the environment: A new social contract for science. Science, 279, 5350, pp 491-497

Macdonald, P. & Yarrow, S. (2002)
Regulation of Bt crops in Canada, Iguassu Falls, Brazil Academic Press Inc Elsevier Science, 8th International Colloquium on Invertebrate Pathology and Microbial Control/35th Annual Meeting of the SIP/6th International Conference on Bacillus Thuringiensis, Ed. pp 93-99
10.1016/s0022-2011(03)00059-4

Magnan, A. (2003)
Refeudalizing the public sphere: "Manipulated publicity" in the Canadian debate on GM foods, Halifax, CANADA Univ Alberta, Annual Meeting of the Canadian-Sociology-and-Anthropology-Association (CSAA), Ed. pp 25-53

Marris, E. (2005)
Four years on, no transgenes found in Mexican maize. Nature, 436, 7052, pp 760-760

Marris, E. (2006)
Environmental activism: In the name of nature. Nature, 443, 7111, pp 498-501

Marshall, A. (2007)

GM soybeans and health safety—a controversy reexamined, additional texts. Nature Biotechnology, 25, 9, pp 981-987

Marvier, M., McCreedy, C., Regetz, J., & Kareiva, P. (2007)
A Meta-Analysis of Effects of Bt Cotton and Maize on Nontarget Invertebrates. Science %R 10.1126/science.1139208, 316, 5830, pp 1475-1477

Mayer, J.E., Pfeiffer, W.H., & Beyer, P. (2008)
Biofortified crops to alleviate micronutrient malnutrition. Genome studies and Molecular Genetics, edited by Juliette de Meaux and Maarten Koornneef / Plant Biotechnology, edited by Andy Greenland and Jan Leach, 11, 2, pp 166-170

McClintock, B. (1930)
A cytological demonstration of the location of an interchange between two non-homologous chromosomes of Zea mays. Proceedings of the National Academy of Sciences of the United States of America, 16, pp 791-796
<Go to ISI>://WOS:000201970600143 AND http://www.botanischergarten.ch/Genomics/McClintock-Cytological-Interchange-Location-1930.pdf

McClintock, B. (1953)
Induction of Instability at Selected Loci in Maize. Genetics, 38, 6, pp 579-599

McHughen, A. (2007)
Public perceptions of biotechnology. Biotechnology Journal, 2, 9, pp 1105-1111:10.1002/biot.200700071

McLean, M.A. & Charest, P.J. (2000)
The regulation of transgenic trees in North America. Silvae Genetica, 49, 6, pp 233-239

McLean, M.A., Frederick, R.J., Traynor, P.L., Cohen, J.I., & Komen, J. (2002)
A Conceptual Framework for Implementing Biosafety: Linking Policy, Capacity, and Regulation, ISNAR, International Service for National Agricultural Research pp 1-12 ISNAR Briefing Papers Washington DC. (Report)
ftp://ftp.cgiar.org/isnar/publicat/bp-47.pdf AND http://www.botanischergarten.ch/Regulation/McLean-Conceptual-Framework-ISNAR-47-2002.pdf

Mercer, K.L. & Wainwright, J.D. (2008)
Gene flow from transgenic maize to landraces in Mexico: An analysis. Agriculture, Ecosystems & Environment, 123, 1-3, pp 109-115

Mijangos-Cortés, J., Corona-Torres, T., Espinosa-Victoria, D., Muñoz-Orozco, A., Romero-Peñaloza, J., & Santacruz-Varela, A. (2007)
Differentiation among Maize (Zea mays L.) Landraces from the Tarasca Mountain Chain, Michoacan, Mexico and the Chalqueño Complex. Genetic Resources and Crop Evolution, 54, 2, pp 309-325

Miller, H., Morandini, P., & Ammann, K. (2008)
Is biotechnology a victim of anti-science bias in scientific journals? Trends in Biotechnology, Electronic Prepublication Febr. 17, 2008, Hardcopy available in March, pp 122-125

Miller, H.I. (2009)
A golden opportunity, squandered. Trends in Biotechnology, 27, 3, pp 129-130

Moirand, S. (2003)
Communicative and cognitive dimensions of discourse on science in the French mass media. Discourse Studies, 5, 2, pp 175-206

Molnar, I., Benavente, E., & Molnar-Lang, M. (2009)
Detection of intergenomic chromosome rearrangements in irradiated Triticum aestivum - Aegilops biuncialis amphiploids by multicolour genomic in situ hybridization. Genome, 52, 2, pp 156-165
10.1139/g08-114

Moore, A. (2006)
Bad science in the headlines - Who takes responsibility when science is distorted in the mass media? Embo Reports, 7, 12, pp 1193-1196
10.1038/sj.embor.7400862

Moore, P. (2000a)
A challenge: Protect biodiversity and produce wood. Journal of Forestry, 98, 8, pp A2-A3

Moore, P. (2000b)
Trees are the answer. Forest Products Journal, 50, 10, pp 12-19

Morikawa, K. & Shirakawa, M. (2001)
Three-dimensional structural views of damaged-DNA recognition: T4 endonuclease V, E. coli Vsr protein, and human nucleotide excision repair factor XPA (vol 460, pg 257, 2000). Mutation Research-DNA Repair, 485, 3, pp 267-268

Motion, J. & Leitch, S. (1996)
A discursive perspective from New Zealand: Another world view. Public Relations Review, 22, 3, pp 297-309

Motion, J. & Weaver, C.K. (2005)

The Epistemic Struggle for Credibility: Rethinking media relations. Journal of Communication and Management, 9, 3, pp 246-255
DOI: 1108/13632540510621579

Mundell, I. (1992)
Britain wrestles with EC rule on modified organisms. Nature, 359, 6396, pp 569-569

Naranjo, S.E. (2009)
Impacts of Bt crops on non-target invertebrates and insecticide use patterns. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources,, 4, 11, pp 23 pp

National-Research-Council (1989) Field Testing Genetically Modified Organism. Framework for Decisions, Committee on Scientific Evaluation of the Introduction of Genetically Modified Microorganisms and Plants into the Environment, National Research Council edn. The National Academy Press, pp 184

Neidecker-Gonzales, O., Nestel, P., & Bouis, H. (2007)
Estimating the global costs of vitamin A capsule supplementation: A review of the literature. Food and Nutrition Bulletin, 28, pp 307-316

Newman, M.E.J. (2003)
The structure and function of complex networks. Siam Review, 45, pp 167-256

OECD (1998a)
407 Repeated Dose 28-Day Oral Toxicity Study in Rodents, Adopted by the Council on 27th July 1995 pp OECD GUIDELINE FOR THE TESTING OF CHEMICALS (Report)
http://www.botanischergarten.ch/OECD/OECD-Repeated-Dose-Toxicity-407.pdf

OECD (1998b)
408 Repeated Dose 90-Day Oral Toxicity Study in Rodents (Updated Guideline, adopted 21st September 1998) pp (Report)
http://www.botanischergarten.ch/OECD/OECD-Repeated-90day-on-Rodents-408-1998.pdf AND complete list under
http://caliban.sourceoecd.org/vl=3523981/cl=15/nw=1/rpsv/cw/vhosts/oecdjournals/1607310x/v1n4/contp1-1.htm

Ortiz-Garcia, S., Ezcurra, E., Schoel, B., Acevedo, F., Soberon, J., & Snow, A.A. (2005a)
Absence of detectable transgenes in local landraces of maize in Oaxaca, Mexico (2003-2004) correction (vol 102, pg 12338, 2005). Proceedings of the National Academy of Sciences of the United States of America, 102, 50, pp 18242-18242 10.1073/pnas.0509529102 AND <Go to ISI>://WOS:000234010500064 AND http://www.botanischergarten.ch/Geneflow/Ortiz-Garcia-Gene-Flow-correction-2005.pdf

Ortiz-Garcia, S., Ezcurra, E., Schoel, B., Acevedo, F., Soberon, J., & Snow, A.A. (2005b)
Reply to Cleveland et al.'s "Detecting (trans)gene flow to landraces in centers of crop origin: lessons from the case of maize in Mexico". Environmental Biosafety Research, 4, 4, pp 209-215

Ortiz-Garcia, S., Ezcurra, E., Schoel, B., Acevedo, F., Soberon, J., & Snow, A.A. (2006)
Transgenic maize in Mexico. Bioscience, 56, 9, pp 709-709

Osseweijer, P. (2006a)
Imagine projects with a strong emotional appeal. Nature, 444, 7118, pp 422-422

Osseweijer, P. (2006b)
A new model for science communication that takes ethical considerations into account - The Three-E Model: Entertainment, Emotion and Education. Science and Engineering Ethics, 12, 4, pp 591-593

Osseweijer, P. (2006c) A Short History of Talking Biotech, Fifteen years of iterative action research in institutionalising scientists' engagement in public communication VRIJE UNIVERSITEIT, Amsterdam, IS: ISBN-10: 90-809691-33 ISBN-13: 978-90-809691-31, pp

Paarlberg, R. (2006)
Are genetically modified (GM) crops a commercial risk for Africa? International Journal of Technology and Globalisation, 2, 1-2, pp 81-92

Paarlberg, R. (2009)
The Ethics of Modern Agriculture. Society, 46, 1, pp 4-8

Paarlberg, R.L. (2002)
The real threat to GM crops in poor countries: consumer and policy resistance to GM foods in rich countries. Food Policy, 27, 3, pp 247-250

Phillips, P.W.B. (2003)
Traceability and trade of genetically modified food. Biotechnology: Science and Society at a Crossroad, 15, pp 141-154

Pineyro-Nelson, A., van Heerwaarden, J., Perales, H.R., Serratos-Hernandez, J.A., Rangel, A., Hufford, M.B., Gepts, P., Garay-Arroyo, A., Rivera-Bustamante, R., & Alvarez-Buylla, E.R. (2009)
Transgenes in Mexican maize: molecular evidence and methodological considerations for GMO detection in landrace populations. Molecular Ecology, 18, 4, pp 750-761

Potrykus, I. (2003)

Nutritionally enhanced rice to combat malnutrition disorders of the poor. Nutrition Reviews, 61, 6, pp S101-S104

Potrykus, I. (2009)
CONSTRAINTS TO BIOTECHNOLOGY INTRODUCTION FOR POVERTY ALLEVIATION. In Transgenic Plants for Food Security in the Context of Development (eds I. Potrykus & M. Sanchez Sorondo), pp. 3-4. The Pontifical Academy of Sciences, Vatican City Casina Pio IV

Pray, C.E., Bharat, R., Jikun, H., Ruifa, H., Prajakta, B., & Huazhu, Z. (2006)
Costs and enforcement of biosafety regulations in India and China. International Journal of Technology and Globalisation, 2, 1-2, pp 137-57
Issn 1476-5667

Priest, S.H., Bonfadelli, H., & Rusanen, M. (2003)
The "trust gap" hypothesis: Predicting support for biotechnology across national cultures as a function of trust in actors. Risk Analysis, 23, 4, pp 751-766

Punnett, R.C., ed. (1928)
Scientific Papers of William Bateson, R.C. Punnett, Cambridge University Press, Cambridge,

Qaim, M., Pray, C.E., & Zilberman, D. (2008)
Economic and Social Considerations in the Adoption of Bt Crops. Integration of Insect-Resistant Genetically Modified Crops within IPM Programs, pp 329-356

Qaim, M. & Stein, A.J. (2008)
Economic consequences of Golden Rice. In Invited presentation at the Fourth Conference of the European Plant Science Organisation, Toulon (Cote d'Azur), France http://www.epsoweb.org/catalog/conf2008.htm AND http://www.botanischergarten.ch/Golden-Rice/Qaim-Economic-Consequences-Epso-Abstract-2008.pdf

Qaim, M., Stein, A.J., & Meenakshi, J.V. (2007)
Economics of biofortification. Contributions of Agricultural Economics to Critical Policy Issues, pp 119-133

Ramjoue, C. (2007a)
The transatlantic rift in genetically modified food policy. Doctoral Thesis, University of Zurich, Zurich Thesis, pp 263
10.1007/s10806-007-9047-8

Ramjoue, C. (2007b)
The transatlantic rift in genetically modified food policy. Journal of Agricultural & Environmental Ethics, 20, 5, pp 419-436

Ramon, D., Diamante, A., & Calvo, M.D. (2008)
Food biotechnology and education. Electronic Journal of Biotechnology, 11, 5, pp 7
10.2225/vol11-issue5-fulltext-7

Rauschen, S. (2009)
German GM research - a personal account. Nat Biotech, 27, 4, pp 318-319

Raven, P., Fauquet, C., Swaminathan, M.S., Borlaug, N., & Samper, C. (2006)
Where next for genome sequencing? Science, 311, 5760, pp 468-468

Raybould, A.F. (2010)
Reducing uncertainty in regulatory decision-making for transgenic crops: More ecological research or shrewder environmental risk assessment? GM crops, 1, 1, pp 1-7

Redenbaugh, K., Hiatt, W., Martineau, B., & Emlay, D. (1994)
REGULATORY ASSESSMENT OF THE FLAVR-SAVR TOMATO. Trends in Food Science & Technology, 5, 4, pp 105-110

Reich, K.H. (2008)
Science-and-religion/spirituality/theology dialogue: What for and by whom? Zygon, 43, 3, pp 705-718

Reiss, T. & Dominguez Lacasa, I. (2007)
Benchmarking national biotechnology policy across Europe: a systems approach using quantitative and qualitative indicators. Research Evaluation, 16, pp 331-339

Renn, O. (2006)
Risk communication - Consumers between information and irritation. Journal of Risk Research, 9, 8, pp 833-849
10.1080/13669870601010938

Renn, O. (2008) Risk Governance, Coping with Uncertainty in a Complex World Earthscan, London, Sterling,VA, IS: ISBN: 978-1-84407-291-0 hardback: 978-1-84407-292-7 paperback, pp

Reynolds, M.P., van Ginkel, M., & Ribaut, J.M. (2000)
Avenues for genetic modification of radiation use efficiency in wheat. Journal of Experimental Botany, 51, pp 459-473

Rith, C. & Dubberly, H. (2007a)
Horst W. J. Rittel's Writings on Design: Select Annotations. Design Issues, 23, 1, pp 75-77

Rith, C. & Dubberly, H. (2007b)
Why Horst W. J. Rittel Matters. Design Issues, 23, 1, pp 72-74

Rith, C., Durham, S., Protzen, J.P., & Dubberly, H. (2007)
Bibliography of Horst W. J. Rittel. Design Issues, 23, 1, pp 78-88

Rittel, H. (1984)
Second Generation Design Methods. *In Developments in Design Methodology* (ed N. Cross), pp. 317-327. John Wiley & Sons, New York

Rittel, H. & Weber, M. (1973)
Dilemmas in a general theory of planning. Policy Sciences, 4, pp 155-169

Rittel, H.W.J. & Webber, M.R. (2005)
Dilemmas in a general theory of planning. Policy Sciences, 4, 2, pp 155-169

Rogers-Hayden, T. & Campbell, J.R. (2003)
Re-negotiating Science in Environmentalists' Submissions to New Zealand's Royal Commission on Genetic Modification. Environmental Values, 12, pp 515-534

Romeis, J., Bartsch, D., Bigler, F., Candolfi, M., Gielkens, M.C., Hartley, S.E., Hellmich, R., Huesing, J.E., Jepson, P.C., Layton, R.J., Quemada, H., Raybould, A., Rose, R., Schiemann, J., Sears, M.K., Shelton, M., Sweet, J., Vaituzis, Z., & Wold, J.D. (2008)
Assessment of risk of insect-resistant transgenic crops to nontarget arthropods. Nature Biotechnology, 26, 2, pp 203-208

Rosi-Marshall, E.J., Tank, J.L., Royer, T.V., Whiles, M.R., Evans-White, M., Chambers, C., Griffiths, N.A., Pokelsek, J., & Stephen, M.L. (2007a)
Toxins in transgenic crop byproducts may affect headwater stream ecosystems. Proceedings of the National Academy of Sciences of the United States of America, 104, pp 16204-16208
10.1073/pnas.0707177104 AND http://www.pnas.org/cgi/content/abstract/0707177104v2 AND http://www.botanischergarten.ch/Bt/Rosi-Marschall-Bt-Aquatic-2007.pdf

Rosi-Marshall, E.J., Tank, J.L., Royer, T.V., Whiles, M.R., Evans-White, M., Chambers, C., Griffiths, N.A., Pokelsek, J., & Stephen, M.L. (2007b)
Toxins in transgenic crop byproducts may affect headwater stream ecosystems. Proceedings of the National Academy of Sciences %R 10.1073/pnas.0707177104, pp 0707177104

Rowell, A. & Ammann K. (Comments) (2009)
Immoral Maize: Extract from Don't Worry, It's Safe to Eat by Andrew Rowell In Spin-Watch and ASK-FORCE. Spin-Watch and GM-Watch
http://www.spinprofiles.org/index.php/Immoral_Maize:_Extract_from_Don%27t_Worry%2C_It%27s_Safe_to_Eat_by_Andrew_Rowell (original contribution) AND with comments K.Ammann: http://www.botanischergarten.ch/Mexico/Rowell-Immoral-Maize-20090427.pdf

Royal-Society (2009)
Reaping the benefits: science and the sustainable intensification of global agriculture, Royal Society pp 89 RS Policy document 11/09 London (Report)
http://royalsociety.org/displaypagedoc.asp?id=35510

Sa, E.R., Sekikawa, A., Linkow, F., Lovalekar, M., & LaPorte, R.E. (2003)
Open source model for global collaboration in higher education. International Journal of Medical Informatics, 71, 2-3, pp 165-165
10.1016/s1386-5056(03)00108-4

Sadashivappa, P. & Qaim, M. (2009)
Bt Cotton in India: Development of Benefits and the Role of Government Seed Price Interventions. In AgBioForum, Vol. 12, pp. AgBioForum

Saner, M. (2007) A Map of the Interface Between Science & Policy, Staff Papers Received: Communication: Council of Canadian Academies Personal Communication

Schmidt, I., Meurer, M., Saling, P., Kicherer, A., Reuter, W., & Gensch, C.O. (2004)
SEEbalance reg - managing sustainability of products and processes with the socio-eco-efficiency analysis by BASF. Greener Management International, 45, pp 79-94

SCHOEL, B. & FAGAN, J. (2009)
Insufficient evidence for the discovery of transgenes in Mexican landraces. Molecular Ecology, 9999, 9999, pp

Schouten, H.J. & Jacobsen, E. (2007)
Are mutations in genetically modified plants dangerous? Journal of Biomedicine and Biotechnology, pp
10.1155/2007/82612

Schubert, D. (2005)
Regulatory regimes for transgenic crops. Nature Biotechnology, 23, 7, pp 785-787
10.1038/nbt0705-785b

Schuman, H. & Presser, S. (1980)

PUBLIC-OPINION AND PUBLIC IGNORANCE - THE FINE LINE BETWEEN ATTITUDES AND NON-ATTITUDES. American Journal of Sociology, 85, 5, pp 1214-1225

Scoones, I. (2008)
Mobilizing against GM crops in India, South Africa and Brazil. Journal of Agrarian Change, 8, 2-3, pp 315-344

Scott, A. (2007)
Peer review and the relevance of science. Futures, 39, 7, pp 827-845

Sengooba, T., Grumet, R., Hancock, J., Zawedde, B., Kitandu, L., Weebadde, C., Karembu, M., Kenya, E., Meredia, K., Nampala, P., Ochanda, J.O., Quemada, H., & Rubindamayugi, M. (2009)
Biosafety education relevant to genetically engineered crops for academic and non-academic stakeholders in East Africa. Electronic Journal of Biotechnology, 12, 1, pp
10.2225/vol12-issue1-fulltext-6

Seralini, G.E., Cellier, D., & de Vendomois, J.S. (2007a)
New Analysis of a Rat Feeding Study with a Genetically Modified Maize Reveals Signs of Hepatorenal Toxicity. Archives of Environmental Contamination and Toxicology, pp 596-602

Seralini, G.E., Cellier, D., & de Vendomois, J.S. (2007b)
New Analysis of a Rat Feeding Study with a Genetically Modified Maize Reveals Signs of Hepatorenal Toxicity. Archives of Environmental Contamination and Toxicology, pp

Shapiro, J.A. (1997)
Genome organization, natural genetic engineering and adaptive mutation. Trends in Genetics, 13, 3, pp 98-104

Sheehy, R.E., Kramer, M., & Hiatt, W.R. (1988)
REDUCTION OF POLYGALACTURONASE ACTIVITY IN TOMATO FRUIT BY ANTISENSE RNA. Proceedings of the National Academy of Sciences of the United States of America, 85, 23, pp 8805-8809

Shelton, A., Naranjo, S., Romeis, J., Hellmich, R., Wolt, J., Federici, B., Albajes, R., Bigler, F., Burgess, E., Dively, G., Gatehouse, A., Malone, L., Roush, R., Sears, M., & Sehnal, F. (2009)
Setting the record straight: a rebuttal to an erroneous analysis on transgenic insecticidal crops and natural enemies. Transgenic Research, 18, 3, pp 317-322
10.1007/s11248-009-9260-5 and http://www.springerlink.com/content/q7hk642137241733/ AND
http://www.botanischergarten.ch/Bt/Shelton-Setting-Record-Straight-Lovei-2009.pdf

Shelton, A.M. (2003)
Considerations for conducting research in agricultural biotechnology. Journal of Invertebrate Pathology, 83, 2, pp 110-112

Shewry, P.R., Baudo, M., Lovegrove, A., & Powers, S. (2007)
Are GM and conventionally bred cereals really different? Trends in Food Science & Technology, 18, 4, pp 201-209

Showalter, E. (1997) Hystories Columbia University Press, New York, IS: 0-231-10458-8, pp 244

Singh, A., Hallihosur, S., & Rangan, L. (2009)
Changing landscape in biotechnology patenting. World Patent Information, pp 219-25
10.1016/j.wpi.2009.03.004

Sinha, G. (2009)
Up in arms. Nature Biotechnology, 27, 7, pp 592-594

Smale, M., Zambrano, P., Falck-Zepeda, J., Gruere, G., & Matuschke, I. (2008)
The economic impact of transgenic crops in developing countries: a note on the methods. International Journal of Biotechnology, 10, 6, pp ISSN 0963-6048(print)|1741-5020(electronic)

Smith, R. (2003)
Medical journals and pharmaceutical companies: uneasy bedfellows. British Medical Journal, 326, 7400, pp 1202-1205

Smith, R. (2005)
Medical journals are an extension of the marketing arm of pharmaceutical companies. Plos Medicine, 2, 5, pp 364-366
10.1371/journal.pmed.0020138.g001 AND <Go to ISI>://WOS:000229847900002 AND http://www.botanischergarten.ch/Peer-Review/Smith-Medical-Journals-Extention-Companies-2005.pdf

Snow, A. (2009)
Unwanted Transgenes Re-Discovered in Oaxacan Maize. Molecular Ecology, 18, 4, pp 569-571
10.1111/j.1365-294X.2008.04063.x

Snyder, L.U., Gallo, M., Fulford, S.G., Irani, T., Rudd, R., DiFino, S.M., & Durham, T.C. (2008)
European Union's Moratorium Impact on Food Biotechnology: A Discussion-Based Scenario. Journal of Natural Resources and Life Sciences Education, 37, pp 27-31

Soleri, D., Cleveland, D.A., Aragon, F.C., Fuentes, M.R.L., Rios, H.L., & Sweeney, S.H. (2005)

Understanding the potential impact of transgenic crops in traditional agriculture: maize farmers' perspectives in Cuba, Guatemala and Mexico. Environmental Biosafety Research, 4, 3, pp 141-166
<Go to ISI>://BIOSIS:PREV200600466772 AND http://www.botanischergarten.ch/Geneflow/Soleri-Understanding-Potential-Impact-2005.pdf

Spielman, D.J., Cohen, J.I., & Zambrano, P. (2007)
Are developing-country policies and investments promoting research and research partnerships in agricultural biotechnology? International Journal of Biotechnology, 9, 6, pp ISSN 0963-6048(print)|1741-5020(electronic)

Stein, A.J., Meenakshi, J.V., Qaim, M., Nestel, P., Sachdev, H.P.S., & Bhutta, Z.A. (2008)
Potential impacts of iron biofortification in India. Social Science & Medicine, 66, 8, pp 1797-1808

Stein, A.J., Nestel, P., Meenakshi, J., Qaim, M., Sachdev, H., & Bhutta, Z.A. (2007a)
Plant breeding to control zinc deficiency in India: how cost-effective is biofortification? Public Health Nutrition, 10, 5, pp 492-501
10.1017/s1368980007223857

Stein, A.J. & Qaim, M. (2007)
The human and economic cost of hidden hunger. Food and Nutrition Bulletin, 28, 2, pp 125-134

Stein, A.J., Sachdev, H.P.S., & Qaim, M. (2006)
Potential impact and cost-effectiveness of Golden Rice. Nature Biotechnology, 24, 10, pp 1200-1201
10.1038/nbt1006-1200b

Stein, A.J., Sachdev, H.P.S., & Qaim, M. (2007b)
What we know and don't know about Golden Rice. Nature Biotechnology, 25, 6, pp 624-624

Strauss, S.H., Tan, H., Boerjan, W., & Sedjo, R. (2009)
Strangled at birth? Forest biotech and the Convention on Biological Diversity. Nat Biotech, 27, 6, pp 519-527

Strick, J. (1999)
Darwinism and the origin of life: The role of H.C. Bastian in the British spontaneous generation debates, 1868-1873. Journal of the History of Biology, 32, 1, pp 51-92

Sturgis, P. & Allum, N. (2004)
Science in society: re-evaluating the deficit model of public attitudes. Public Understanding of Science, 13, 1, pp 55-74

Sturgis, P., Cooper, H., & Fife-Schaw, C. (2005a)
Attitudes to biotechnology: estimating the opinions of a better-informed public. New Genetics and Society, 24, 1, pp 31-56

Sturgis, P., Roberts, C., & Allum, N. (2005b)
A different take on the deliberative poll - Information, deliberation, and attitude constraint. Public Opinion Quarterly, 69, 1, pp 30-65

Tang, H., Tan, S., & Cheng, X. (2009)
A survey on sentiment detection of reviews. Expert Systems with Applications, pp 10760-73
10.1016/j.eswa.2009.02.063

Taverne, D. (2005a) The March of Unreason Oxford University Press, USA (January 18, 2007), Oxford, IS: ISBN-10: 0199205620 ISBN-13: 978-0199205622, pp 320

Taverne, D. (2005b)
The new fundamentalism, Commentary. Nature Biotechnology, 23, 4, pp 415-416

Taverniers, I., Papazova, N., Bertheau, Y., De Loose, M., & Holst-Jensen, A. (2008)
Gene stacking in transgenic plants: towards compliance between definitions, terminology, and detection within the EU regulatory framework. Environmental Biosafety Research, 7, 4, pp doi:10.1051/ebr:2008018:10.1051/ebr:2008018

Thro, A.M. (2004)
Europe on transgenic crops: How public plant breeding and eco-transgenics can help in the transatlantic debate. Commentary. In AgBioForum, Vol. 7, pp. 142-148

Tren, R. & Bate, R. (2001) Malaria and the DDT Story iea, The Institute of Economic Affairs, London, IS: 0 255 36499 7, pp 112

Vaughan, E. (1995)
The Significance of Socioeconomic and Ethnic Diversity for the Risk Communication Process. Risk Analysis, 15, 2, pp 169-180

von Grebmer, K. & Omamo, S.W. (2007)
Options for a rational dialogue on the acceptance of biotechnology. Biotechnology Journal, 2, 9, pp 1121-1128

Waltz, E. (2009)
Battlefield, Papers suggesting that biotech crops might harm the environment attract a hail of abuse from other scientists, NEWS FEATURE. Nature, 461, pp 27-32
doi:10.1038/461027a

Watson, J.D. & Crick, F.H.C. (1953a)
GENETICAL IMPLICATIONS OF THE STRUCTURE OF DEOXYRIBONUCLEIC ACID. Nature, 171, 4361, pp 964-967

Watson, J.D. & Crick, F.H.C. (1953b)
MOLECULAR STRUCTURE OF NUCLEIC ACIDS - A STRUCTURE FOR DEOXYRIBOSE NUCLEIC ACID. Nature, 171, 4356, pp 737-738

Weissmann, G. (2006)
DDT is back: let us spray! Faseb Journal, 20, pp 2427-2429

WHO (2005)
WHO Position On DDT Use In Disease Vector Control Under The Stockholm Convention On Persistent Organic Pollutants, WHO pp 2 Geneva (Report)

Wilkins, M.H.F., Seeds, W.E., Stokes, A.R., & Wilson, H.R. (1953)
Helical Structure of Crystalline Deoxypentose Nucleic Acid. Nature, 172, 4382, pp 759-762

Wilson, A., Latham, J., & Steinbrecher, R. (2006)
Transformation-induced mutations in transgenic plants: Analysis and biosafety implications. . Biotechnology and Genetic Engineering Reviews 23, 11, pp 1-26

Wolfenbarger, L.L., Naranjo, S.E., Lundgren, J.G., Bitzer, R.J., & Watrud, L.S. (2008)
Bt Crop Effects on Functional Guilds of Non-Target Arthropods: A Meta-Analysis. PLoS ONE, 3, 5, pp e2118

Wright, B. (2008)
Plant Genetic Engineering and Intellectual Property Protection. Agricultural Biotechnology in California Series PUBLICATION, 8186, pp

Zwart, N.H. (2007)
Genomics and self-knowledge: implications for societal research and debate. New Genetics and Society, 26, 2, pp 181-202 10.1080/14636770701466881