27. Advancing the cause in emerging economies

* Professor Klaus Ammann, formerly Director of the Bern Botanical Garden and Professor of the University of Bern, Switzerland

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1. Introduction and overview: The dialogue on the use of GM crops in emerging economies

The deficit model in teaching is out, science in developing countries shows growing valuable assets, and only dialogue and active listening will unearth mutual understanding between local science and local agriculture. Consequently, there is no room for corporate or environmental imperialism. GM crops have their real chance in developing countries in combination with the genomes of landraces and local modern cultivars - provided those dialogue rules are respected and as a result collaborative breeding programs are implemented which meet the local needs of the farmers and give a chance to make use in African agriculture of top notch science as done by researchers of the University of Wageningen: (Slingerland et al., 2003; Slingerland et al., 2006) or in a collaboration between Germany and Namibia (Hoffmann et al., 2007). To search for a *combination* of the various agricultural approaches *adapted to regional and local needs* is the slogan, it's not about painting contrast by campaigning, teaching and preaching about its own convictions, as done by Marsden (Marsden, 2012).

The following sections 2-4 describe the premises for a realistic debate on successful bio-economical approaches: (2: science behind modern breeding, 3. high regulatory costs as a direct follow-up of the 'Genomic Misconception', 4. concepts of sustainability, from agro-ecology to bio-economy), section 5. will close with three success stories of modern agriculture in developing countries.

2. The science behind GM crop breeding: The 'Genomic Misconception': a major reason for the slowdown of regulation and commercialization of GM crops

The contrast between natural selection and transgenesis has been clearly overestimated

There is no difference between natural hybridization and genetic engineering on the level of the molecular processes, this has been emphasized and underpinned with sturdy science years ago (Arber, 1990, 1994; Arber, 2010; Arber W., 1990).

Arber notes: (Arber, 2002)

"Interestingly, naturally occurring molecular evolution, i.e. the spontaneous generation of genetic variants has been seen to follow exactly the same three strategies as those used in genetic engineering. These three strategies are:
(a) small local changes in the nucleotide sequences,
(b) internal reshuffling of genomic DNA segments, and
(c) acquisition of usually rather small segments of DNA from another type of organism by horizontal gene transfer."

However, on the breeding level differences are important and were helpful for the success of the new technologies: Arber continues:

"However, there is a principal difference between the procedures of genetic engineering and those serving in nature for biological evolution. ***While the genetic engineer pre-reflects his alteration and verifies its results, nature places its genetic variations more randomly and largely independent of an identified goal****. Under natural conditions, it is the pressure of natural selection which eventually determines, together with the available diversity of genetic variants, the direction taken by evolution. It is interesting to note that natural selection also plays its decisive role in genetic engineering, since indeed not all pre-reflected sequence alterations withstand the power of natural selection. Many investigators have experienced the effect of this natural force which does not allow functional disharmony in a mutated organism."*

Unfortunately, international biosafety protocols as the Cartagena Protocol and also the European biosafety legislation did not follow the *product-oriented regulation* as suggested by the majority of scientific authorities, rather it followed the regulatory path focusing on the *process* of transgenesis with all its negative aspects. Canada and other countries have chosen with great success the product oriented approach (Smyth & McHughen, 2008)

3. High regulatory costs as an indirect follow-up of the 'Genomic Misconception'

There are signals that biotechnology as a whole is a victim of growing anti-science campaigns (Miller et al., 2008). Many recent publications make a serious plea to lower the regulatory hurdles which are the main cause for exorbitantly high developing costs of commodity crops (Giddings et al., 2012; Kuntz & Ricroch, 2012; Miller, 1994a, b; Potrykus, 2010; Tait & Barker, 2011; Twardowski & Malyska, 2012)

In a letter to the European regulatory specialists Public Regulation and Research Initiative (PRRI) has repeated the urgent plea to lower the regulatory hurdles imposed on a selection of GM plants (PRRI, 20120516). Important Swedish plant scientist launched an open letter for a revision of GM plant regulation, supported by some 500 British scientists: (Jansson Stefan et al., 20111006).

The delays of GM crop approvals go into years for certain traits, basically an intolerable situation (EuropaBio, 20120601). True, another reason for the grotesque delays can be seen in the obscure and too complex decision making structures of European regulatory system, as clearly diagnosed by independent experts (EPEC-SANCO, 2011).

As a result of the wrong focus on the process of transgenesis, opponents of GM crops and food claim lots of detailed critique, constructions of negative "facts" which do not hold critical reviewing and which are also contradicted by the evident success of GM crop planting worldwide. And worse: critical questions are often launched by non-specialists with no deep understanding of the specific science issues as David Schubert, a neurobiologist with flawed arguments, details in Bradford et al. (Bradford et al., 2005b) with their convincing and professional plea of reducing regulatory costs, the critique of Schubert (Schubert, 2005) and the rebuttal, answering properly point by point this critique (Bradford et al., 2005a).

Vested interests of important parties are heavily influencing the negotiations about changes in international regulatory legislation, since many have a clear interest to keep the pot cooking. See the overall analysis of the GM debate in (Arntzen et al., 2003):

"In the corpulent cafe societies of Europe, with their glut of good food, GM stands no chance of being accepted until there is an obvious benefit for consumers, but it is a crime for indifference and hostility to block the development of GM by and for the world's poorest." (Arntzen et al., 2003)

Influential and well funded activist groups (Apel, 2010) like the Norwegian GENOK [1] organize numerous biosafety classes in developing countries with detrimental effects for the perception of modern biotechnology in agriculture (Morris, 2011).

A comprehensive review of the regulatory system of GM crops of the United States has been published by McHughen & Smyth (McHughen & Smyth, 2008), a critical one on Europe by Morris & Spillane (Morris & Spillane, 2010). In a letter to the European regulatory specialists PRRI has repeated the urgent plea to lower the regulatory hurdles imposed on a selection of GM (PRRI, 20120516).

Investment in research and development is discouraged by this situation, and still clearly asymmetric between rich and poor countries, as diagnosed in 1998 by Alston et al. (Alston et al., 1998). More recent statistics from Africa show a good correlation between R&D investment and productivity due to technical progress, rather than due to the still lagging efficiency (Alene, 2010).

As a result (besides often missing research infrastructure), agricultural production in developed countries shows dramatic differences compared to emerging economies of Africa, as illustrated by

[1] GENOK, Center for Biosafety http://www.genok.com/

fig. 1.4 in the report of the Royal Society (Royal-Society, 2009): A lot of work remains to be done if we want to realistically ameliorate the situation. Innovative concepts need to be introduced, always with the focus on local conditions and human development, including both technological and socio-economic innovation.

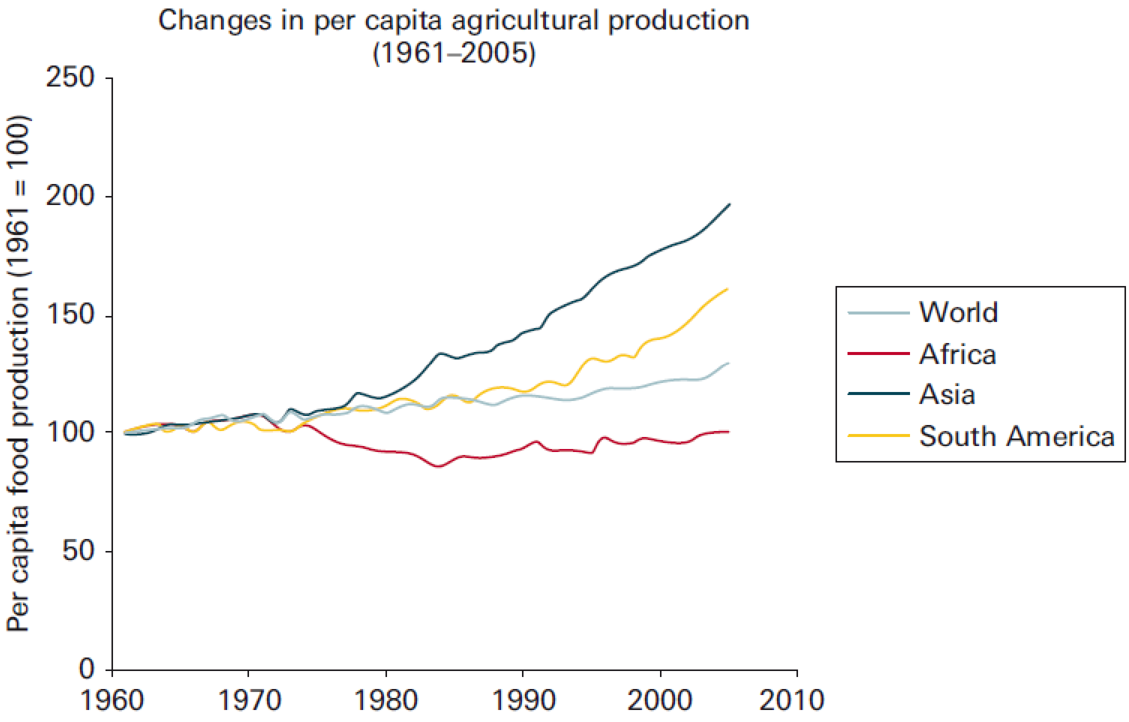


Fig. 1 Changes in per capita agricultural production from the (Royal-Society, 2009)

The trade policy of Europe is still going the wrong way of protectionism, which causes a lot of difficulties in developing countries: 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."

In another paper Graff et al. (Graff et al., 2009) get even more explicit:

"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 selfinterest to negatively characterize GM technology in the public arena and to seek regulations that block or slow its introduction.

As early as 1997 Guasch et al. (Guasch & Hahn, 1997) described precisely the dilemma between high regulatory costs and the urgent need to enhance agricultural production in the developing world – but it did not help – on the contrary, it got worse.

More recent papers document the growing regulatory costs (Antle, 1999; Bernauer et al., 2011; Kalaitzandonakes et al., 2007), Bernauer documents also high protection costs against vandalism in a Swiss field experiment case of more than one million Francs. Kalaitzandonakes tables show regulation costs between 4 to 15 million dollars for well know transgenic traits in Maize and Soybeans. For major commodity crop estimates for global adoption go as high as 100 million dollars. The growing costs are clearly correlated to anti-science campaigns (Miller, 2009). Poorer nations turn to publicly developed crops, the expensive commodity crops of big seed companies are not popular (Cohen, 2005). Anyway most companies prefer fostering humanitarian projects in those countries (Miller-Wallstreet, 20120518).

4. Questions about Concepts of Sustainability from Agro-Ecology to Bio-Economy. Confusion can be reduced with a close Look at the Field Data with Meta Studies.

4.1. Concepts of Sustainable Agriculture

Concepts of sustainability are numerous, and often they are abused as defensive weapons to serve its own ideology. It is useful to study the original Brundtland Report (UN-Report-Common-Future, 1987), since it offers a remarkably broadminded view. Far from being exclusively defensive and retrospective, it explicitly adds the important elements of progress and search for innovation. Sustainable development has been defined in many ways, but the most frequently quoted definition is from *Our Common Future*, the Brundtland Report :

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs"(UN-Report-Common-Future, 1987).

Opponents of GM crops usually refer to the Brundtland report in their attempt to preserve traditional agro-ecology, but they forget the report also envisions a way forward – which asks not only for conservation, but also for the *development* and *management* of sustainable patterns of *production* and *consumption*. One should be aware of an extensive theoretical discussion on a "principle based approach for the evaluation of sustainability" as elaborated by (Hermans & Knippenberg, 2006). They propose, initiated by the Brundtland report, to extend the term sustainability beyond the environmental focus, an intricate philosophical map of intertwined factors of sustainability, where the main elements are justice and resilience.

A move forward to a more pragmatic, more concrete concept of sustainability is offered by the OECD with a focus on agriculture: The declaration of the OECD, authored by Yokoi (Yokoi, 2000) catalogues a range of concrete measures and rules in order to achieve a more sustainable agriculture. It is remarkable, that the proposed indicators do not distinguish between farming with or without transgenic crops. See in particular the Table 11.1 (Yokoi, 2000): it contains a comprehensive list of agricultural sustainability factors, many of them implemented in modern agriculture or ready to be implemented soon.

Agriculture is at the origin of renewable natural resources, including energy. Its worldwide recycling potential remains largely underexploited. Industrial agriculture is often still stuck in the petrochemical age, and organic agriculture panders too much to urban nostalgia and thus wastes its potential to contribute to the solution of the real problems on this planet in a more efficient way. The main goals of sustainable agriculture are indeed "to foster renewable resources, knowledge based agriculture (Trewavas, 2008).

The mistakes on the side of industrial agriculture have been already anticipated by one of the creators of the Green Revolution: Swaminathan (Swaminathan, 1968), cited from (Swaminathan, 2001) published early warnings on unwelcome developments related to the Green Revolution:

"The initiation of exploitive agriculture without a proper understanding of the various consequences of every one of the changes introduced into traditional agriculture, and without first building up a proper scientific and training base to sustain it, may only lead us, in the long run, into an era of agricultural disaster rather than one of agricultural prosperity."

4.2. The Controversy about Agro-Ecology

The eco-imperialist attitude towards farmers in the developing world should be seen critically by (Paarlberg, 2000, 2006, 2008; Paarlberg, 2009a, b; Paarlberg, 2010). He, and many other authors cast doubts on the frequent claims (and this is supported by this author), that agro-ecology-based production strategies would be better for smallholder farmers than solutions including modern breeding, a claim which is not supported by data: The fact is, that some 80% of farmers from the developing world who have adopted GM crops are smallholder farmers making considerable economic profits with the technology (Brookes & Barfoot, 2007) and (Qaim & Stein, 2009a, b; Qaim et al., 2007)).

The numerous papers by Miguel Altieri (a selection: (Altieri, 1989, 1999, 2000a; Altieri, 2002; Altieri & Letourneau, 1982; Altieri et al., 1983; Altieri & Nicholls, 2003; Altieri & Rosset, 1999; Altieri & Toledo, 2011) offer tempting concepts on agro-ecology with some good elements and ideas, but they are not based on hard production data. Except for one publication (Altieri, 2000b) with focus on production but lacking sufficient details to allow verification, his concepts are more wishful thinking than agricultural reality. Other notorious and often cited examples of seemingly positive yield results by applying agro-ecological methods (even a doubling of yield is claimed) come from Jules Pretty: (Pretty et al., 2011; Pretty et al., 2005). They are efficiently debunked by (Phalan et al., 2006).

a) There is a strong selection bias towards successful projects.
b) Methods used to measure changes in yields, water and pesticide use, and carbon sequestration are poorly explained, and therefore, hard to reproduce
c) Crucially, the study lacks adequate controls, thereby failing to show that it is the introduction of resource-conserving practices which is responsible for reported increases in yield and sustainability.
d) The extent to which these practices provide greater net benefits to farmers than conventional techniques is unclear.

In the answers to the critique of Phalan, Pretty et al. (Pretty et al., 2006) basically admit the weakness of their study, but offer the excuse of unreasonably high costs to overcome the flaws in field data gathering. Nevertheless, Miguel Altieri seems to be 100% convinced that his way is the right one, otherwise it would be hard to understand why he helps fundamentalists to occupy research areas near Berkeley, hindering ag-biotech research with the false accusation, that it is supported by corporate money and he also supports the demonizing of biotech maize: (Brooks, 20120511).

Another sometimes cited paper from Africa, describing a comparative field research with maize cultivation, shows the seemingly positive effects of the push-pull technology, basically a fascinating idea to attract and trap pest insects with the weed Desmodium, but a careful study of the paper shows bias: (Hassanali et al., 2008). It compares a traditional inefficient maize with their own push and pull technology, getting thus a favorable result. If the team would have worked with a modern Bt maize, the result would most probably have been reversed.

Nevertheless: the hard reality today is that we urgently need to produce more - on the basis of enhancing yield dramatically, the gaps are clear, and astonishingly enough those gaps are higher in Eastern and Central Europe than in Africa: (Hengsdijk & Langeveld, 2009) see fig. 3.5 p.14.

4.3. Organic Agriculture versus Biotech-based Agriculture

Organic farming generally gets a largely unjustified bonus especially in Europe, where the market for organic produce is booming, despite of higher prices and despite of the fact that local organic farming does not cover the market demands. This is why imports, even from overseas, are routine today and transport costs hardly influence retail prices. Organic is a buzz word, hardly contested in a fashionable world of wealthy western consumers.

A striking example of a nearly unbeatable positive image of organic food is the dangerous coli-out-break outbreak in Northern Germany in 2011 which had only a low impact in the European press, despite the fact that the event caused more than 50 deaths and hundreds of patients suffering severe and permanent kidney damage. The outbreak is clearly related to organic farming. Nevertheless, it did not harm the organic boom at all. Highly virulent enterohaemorrhagic Escherichia coli (EHEC) strains originating from human feces introduced into organic cultures by liquid manure, in former cases it was liquid manure from cattle. In both cases it was the reason for dozens of uncontrollable outbreaks pointing to serious hygiene problems in organic cultivation. Dozens of papers clearly relate the presence of virulent EHEC to organic farming. In soil, its persistence for many months, if not years has been monitored with hard field data, including a summary of previous scientific results by (Islam et al., 2004a, 2005; Islam et al., 2004b). There are also many publications on recent field research: (Hathaway-Jenkins et al., 2011), (Ongeng et al., 2011a; Ongeng et al., 2011b; Ongeng et al., 2011c) supported by many other papers, they all demonstrate the connection between application of liquid manure and (mostly) organic farming. This tragic recent case in Germany, exacerbated by newly acquired multiple antibiotic resistance genes in the new strains only got a minor echo in the press and the public in Europe. This does not mean that organic farming is dangerous in principle: for instance in Switzerland the hygienic rules are so strict that such deadly infection cases can be virtually excluded.

On the positive side of organic farming there is some pioneering work in developing recycling loops in organic agriculture (Albihn, 2001; Ernst, 2002; Granstedt, 2000a, b; Kirchmann et al., 2005; Korn, 1996; Risgaard et al., 2007; Srivastava et al., 2004) and on indirect effects resulting in better landscape management: (Belfrage et al., 2005; Boutin et al., 2008; Clemetsen & van Laar, 2000; Filser et al., 2002; Hadjigeorgiou et al., 2005; Hendriks et al., 2000; Holst, 2001; Jan

Stobbelaar & van Mansvelt, 2000; Kuiper, 2000; MacNaeidhe & Culleton, 2000; Norton et al., 2009; Potts et al., 2001; Rossi & Nota, 2000; Schellhorn et al., 2008; Skar et al., 2008; Stobbelaar et al., 2000).

There is no reason from a scientific point of view why organic methods of production should not go well together with some of the genetically improved plant varieties (Ammann, 2006, 2007, 2008; Ammann, 2009; Ammann & van Montagu, 2009; deRenobales-Scheifler, 2009; Ronald & Adamchak, 2008; Swaminathan, 2001).

The global success of biotech-based farming has been over well documented many years by International Service for the Acquisition of Agri-biotech Applications (ISAAA) (www.isaaa.org), with its centers in many countries and directed by Clive James. Downloading the latest reports (No. 43) provides a convincing picture that the success is continuing, with the exception of Europe: (James, 2011)

4.4. Comparison of Yield in Organic Farming and Biotech-based Agriculture

Organic agriculture in particular may be part of the solution but it is currently also part of the problem. The most widespread and notoriously negative sides in organic farming are the low yield, documented in many long term monitoring experiments (Mader et al., 2002; Mäder et al., 2002) etc. The paper by (Badgley et al., 2007), often cited by proponents of organic farming, claims high yields, but a closer look at the data reveals cherry picking of yield data and major statistic flaws: instead of averaging the yield data over some years, they simply added (cumulated) the results in some cases, see comments of Alex Avery (Avery, 2007).

The latest blow to the slogan of 'organic farming feeding the world' comes from a meta study published in Nature: (Seufert et al., 2012).

The main graph is convincing and does not need much comment:

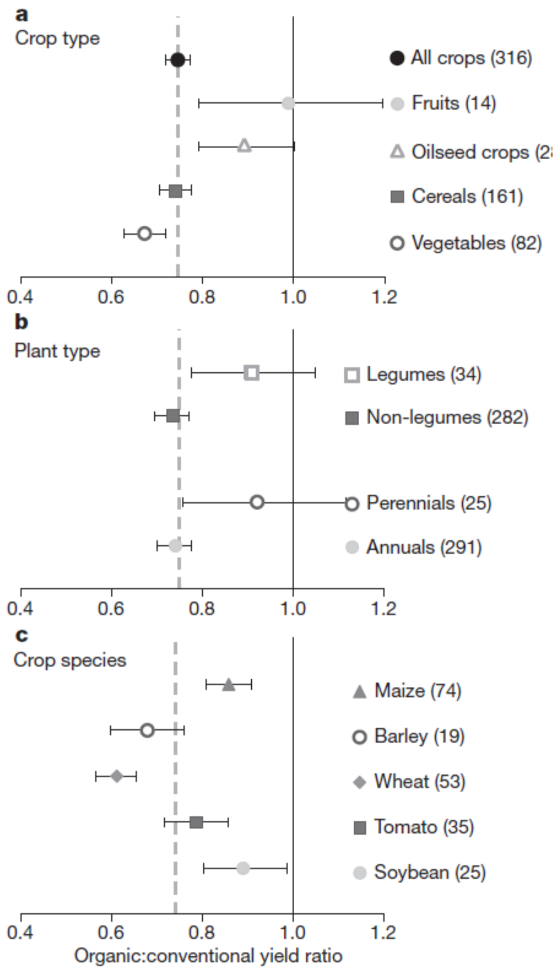
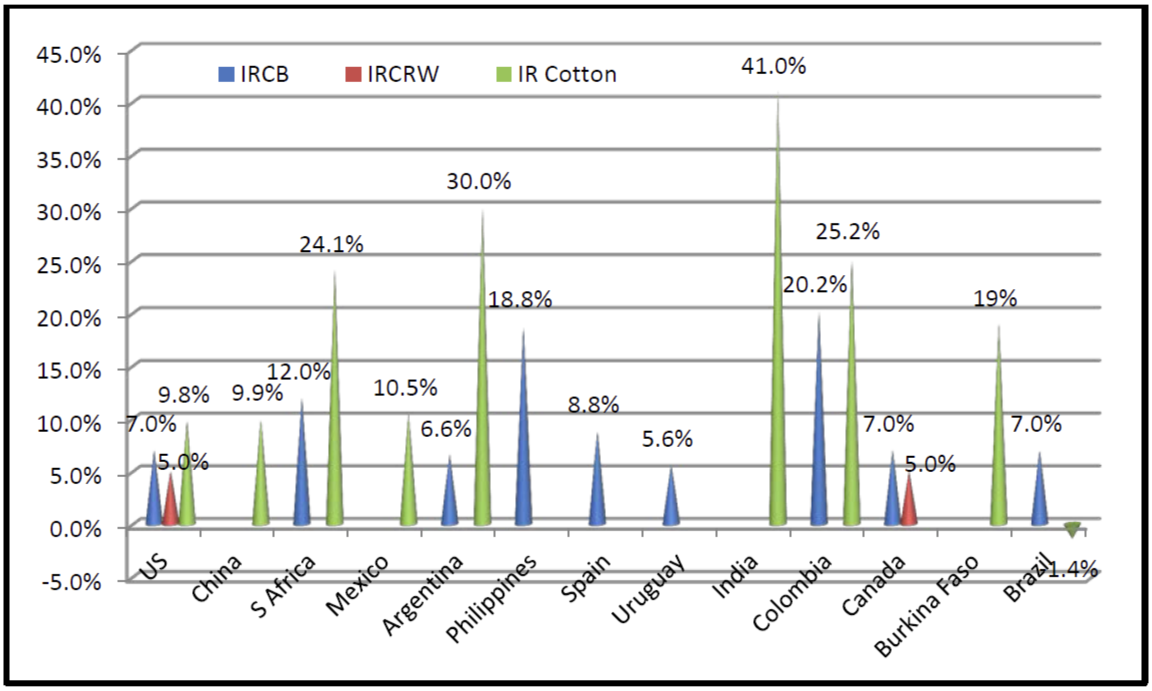


Fig. 2 Influence of different crop types, plant types and species on organic-to-conventional yield ratios. a–c, Influence of crop type (a), plant type (b) and crop species (c) on organic-to-conventional yield ratios. Only those crop types and crop species that were represented by at least ten observations and two studies are shown. Values are mean effect sizes with 95% confidence intervals. Thenumber of observations in each class is shownin parentheses. The dotted line indicates the cumulative effect size across all classes. Fig. 1 from (Seufert et al., 2012)

The conclusions from (Seufert et al., 2012):

"The results of our meta-analysis differ dramatically from previous results (Badgley et al., 2007). Although our organic performance estimate is lower than previously reported[6] in developed countries (220% compared to 28%), our results are markedly different in developing countries (- 43% compared to + 80%). This is because the previous analysis mainly included yield comparisons from conventional low-input subsistence systems, whereas our data set mainly includes data from highinput systems for developing countries". (Seufert et al., 2012)

Quite a different picture is given in a meta study about yield from GM crops, the example of insect resistant GM corn demonstrates a positive result globally:



Notes: IRCB = resistant to corn boring pests, IRCRW = resistant to corn rootworm

Fig. 3 Average yield impact of biotech Insect Resistant traits 1996-2010 by country and trait: The biotech IR traits, used in the corn and cotton sectors, have accounted for 98% of the additional corn production and 99.4% of the additional cotton production. Positive yield impacts from the use of this technology have occurred in all user countries (except GM IR cotton in Australia [2]) when compared to average yields derived from crops using conventional technology (such as application of insecticides and seed treatments). The average yield impact across the total area planted to these traits over the 15 year period since 1996 has been +9.6% for corn traits and +14.4% for cotton traits from Figure 17 in (Brookes & Barfoot, 2012)

A caveat about field trials and monitoring needs to be mentioned here: When you want to find out about the reality on yield and ecology by comparing agricultural strategies, you need to establish good contacts with the farmers and their work by doing intensive field word. Inevitably, there is one important factor which should also be taken into account: There is a possible learning effect and automatic amelioration of field practice when monitoring work by specialists starts. This effect could easily alter results in one of the other direction, independent of the agricultural strategy studied. A study on the complexity of the learning process in the wake of the Green Revolution offers some detailed insight (Foster & Rosenzweig, 1995).

4.5. Focus on Bio-Economics on the Search for the Way forward

Balancing local food production against global agricultural trade will be a challenge, since there will be increasing divergence between food demand and supply (which is stagnating due to insufficient investment in agricultural productivity). As a consequence, there will be pressure

[2] This reflects the levels of *Heliothis* pest control previously obtained with intensive insecticide use. The main benefit and reason for adoption of this technology in Australia has arisen from significant cost savings (on insecticides) and the associated environmental gains from reduced insecticide use (from

not just to enhance local food production but also to increase the share of food that is regionally and globally traded. After all, the food importing countries will be the ones that are most vulnerable to price shocks – and those price dynamics can be even correlated with political riots (Slavo Mac, 20110824).

The economic basis should be important, but local social networking and life need to be taken into account as well and protected from hidden protectionism under the false premise of import bans for GM crops.

It is shocking to discover, that according to (Peterson E. Wesley F. Author & Brink L. Reviewer, 2010) we spend a billion dollars a day on agricultural subsidies, in a very asymmetric way which results in a nearly perfect agricultural protectionism for the developed world.

Considering the complexity of the global challenges in sustainable food production, we should not rely on an ideological, rather than a pragmatic understanding of sustainable agriculture. Sustainable agriculture must be based on efficient resource-management that makes effective use of the new opportunities of the global knowledge economy and combines the best of system-oriented organic agriculture with the new tools in precision agriculture and biotechnology. From a scientific point of view there is no reason why organic methods of production should not go well together with genetically improved plant varieties (Ammann, 2006, 2007, 2008; Ammann, 2009; Ammann & van Montagu, 2009; deRenobales-Scheifler, 2009; Ronald & Adamchak, 2008; Swaminathan, 2001).

Even though the Green Revolution was a great success, there were also detrimental effects such as the upsurge of new pest insects, growing insect resistance against widely used pesticides and negative effects on the soil fertility and a rising number of herbicide resistant weeds. Swaminathan was one of the fathers of the Green Revolution who recognized its shortcomings. In his call for an Evergreen Revolution in 2006 (Kesavan & Swaminathan, 2008; Swaminathan, 2006) he argues, that ensuring continuous productivity increases requires a re-thinking of sustainable agriculture: a new emphasis on better infrastructure, crop rotation, sustainable management of natural resources as well as progressive enhancement of soil fertility and overall biodiversity. These are goals can only be achieved by combining traditional *and* high technology knowledge. Logically, detrimental effects like upcoming weed and pest resistance (new resistant species moving into a huge ecological niche) are also likely to become serious problems for large-scale farmers that adopt new high tech (GM)-crops. But these are well-known problems from experience with conventional and traditional agriculture as well (Weed Science, 2012), the only difference is that these resistance problems develop at a lower pace and can be addressed more quickly and more effectively with new technological means available (modern breeding measures, conservation tillage, crop rotation, mixed cropping etc., details are given in (Ammann, 2009)). It is obvious, that many opponents of GM crops want to take advantage of the negative news related to soybean farming in Brazil and Argentina, but those scare stories are based on flawed science and target in an unjustified way genetic engineering as a breeding method. All those negative arguments and the rebuttals, related to soybean farming, are summarized in (Ammann, 20120408).
A comprehensive overview of how sustainability could be organized, is offered by (Reed et al., 2006): The good thing about this scheme is that it is open ended and conceived as a learning process, thus having the near automatic capability of adaptation to local needs.

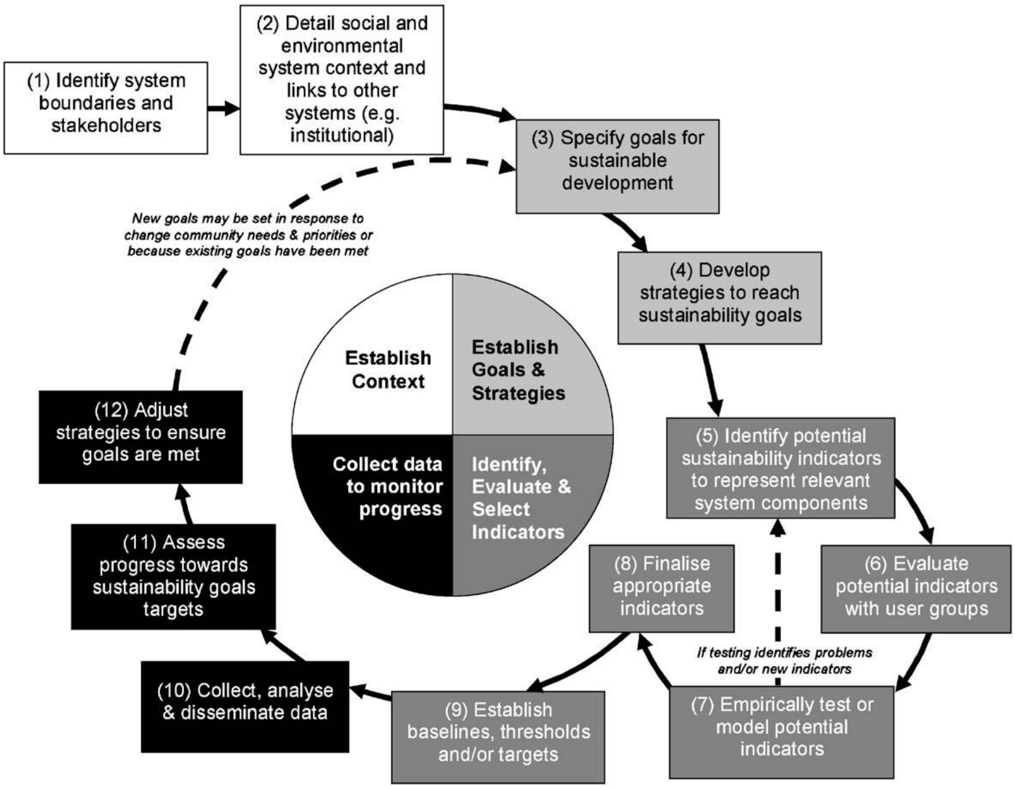


Fig. 4 Adaptive learning process for sustainability indicator development and application, from (Reed et al., 2006).

On a more theoretical level, but in a comparable process spirit (Phillis & Andriantiatsaholiniaina, 2001) have chosen the approach using fuzzy logic, followed by a recent publication within the same framework: (Phillis et al., 2010), giving a truly holistic picture including corporate structures.

"Many people believe that our society is at the crossroads today because of societal and environmental problems of scales ranging from the local to the global. Such problems as global warming, species extinction, overpopulation, poverty, drought, to name but a few, raise questions about the degree of sustainability of our society. To answer sustainability questions, one has to know the meaning of the concept and possess mechanisms to measure it. In this paper, we examine a number of approaches in the literature that do just that. Our focus is on analytical quantitative approaches. Since no universally accepted definition and measuring techniques exist, different approaches lead to different assessments. Despite such shortcomings, rough ideas and estimates about the sustainability of countries or regions can be obtained. One common characteristic of the models herein is their hierarchical nature that provides sustainability assessments for countries in a holistic way. Such models fall in the category of system of systems. Some of these models can be used to assess corporate sustainability." From (Phillis et al., 2010)

5. Three Success Stories of GM Crop Growing and the Reasons Behind

5.1. The Worldwide Success of Herbicide Tolerant Soybean Cultivation.

There are many negative tales about South American soybean growing, most of them outright false or deeply flawed and not respecting basic rules in toxicology experimentation (Ammann, 20120408). Correct laboratory procedures reveal that there are no such problems. A new report by Williams et al. needs no further comments (Williams Amy Lavin et al., 2012), it is a comprehensive answer to all those allegations. From the summary:

"These data demonstrated extremely low human exposures as a result of normal application practices. Furthermore, the estimated exposure concentrations in humans are >500-fold less than the oral reference dose for glyphosate of 2 mg/kg/d set by the U.S. Environmental Protection Agency (U.S. EPA 1993). In conclusion, the available literature shows no solid evidence linking glyphosate exposure to adverse developmental or reproductive effects at environmentally realistic exposure concentrations."(Williams Amy Lavin et al., 2012)

In a preprint, Jerry Green (Green, 2012) gives an overview on the success story of the herbicide tolerant soybean, the graphs do not need further comment. Compared to insect resistance and combined resistance the success of introduction of the GM soybeans has been overwhelming (James, 2011).

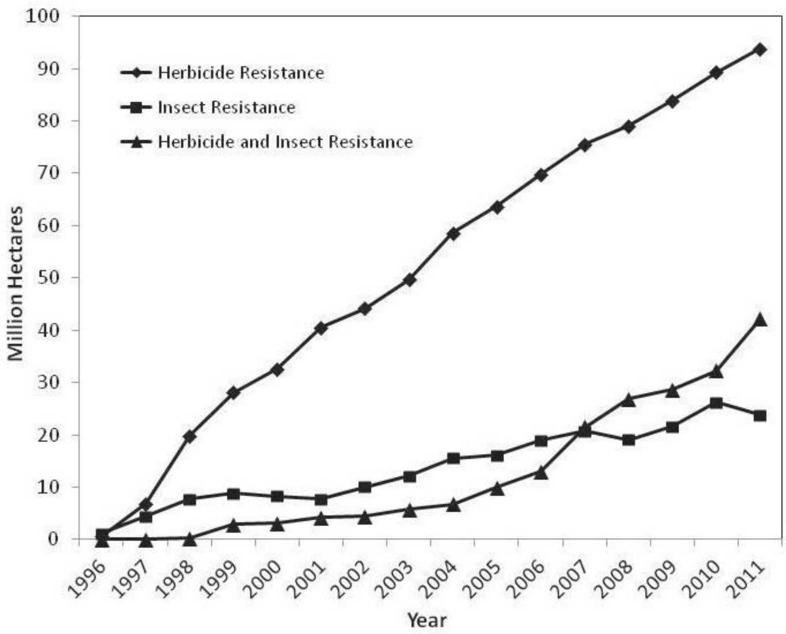


Fig. 5 Adoption of herbicide resistant and insect resistant crops globally from (James, 2011)

The environmental impact is overall clearly reduced due to conservation tilling and the low toxicity of Glyphosate a single graph of (Terrance Hurley M. et al., 2009)

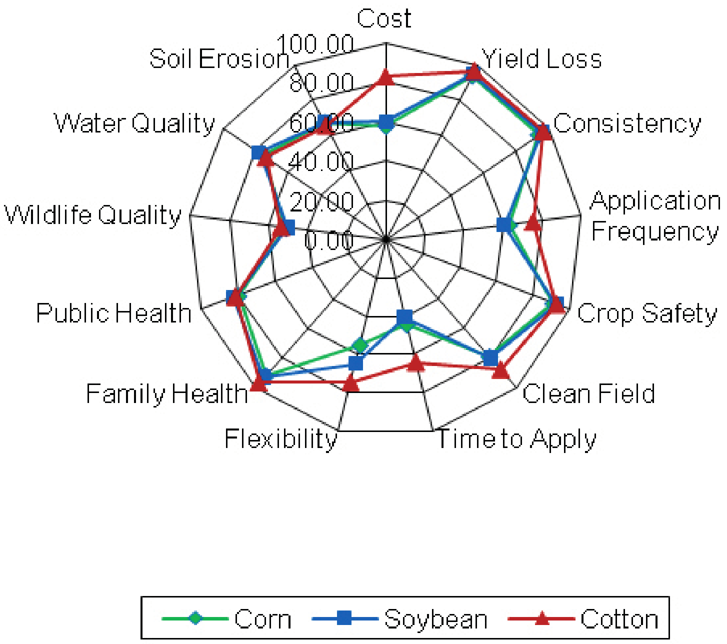


Fig. 6 Percent of of 1,176 corn, soybean and cotton growers reporting various glyphosate resistant crop characteristics that are very important, from (Terrance Hurley M. et al., 2009)

5.2. The introduction of a virus resistant GM bean in Brazil

Another recent knowledge source on the viral resistant bean has been published on the website of Biofortified by (De Souza, 20111018): It documents well an impressive success of Brazilian researchers with their own research and development and approval of a highly useful new virus resistant bean for domestic use.

"Why are virus-resistant beans so important:
Beans are highly nutritious and one of the most important legumes consumed by over 500 million people in Latin America and Africa. In Brazil it is regularly an indispensable item of the everyday diet, often combined with rice and eaten by all social classes in all parts of the nation. They are found in a great variety of types with different sizes, colors and tastes consumed throughout the country. Perhaps, the most typical Brazilian dish is the 'feijoada", a black beans stew. The local consumption is around 16 kg per person every year. Given its high protein (15 to 33%) content besides B vitamins and minerals as iron, calcium and phosphorus, beans provide a high nutritional value meal. Moreover, beans are the major source of protein for the economically disadvantaged." (De Souza, 20111018).

AnBio,(AnBio Brazil, 2011) the Brazilian NGO dealing with biosafety including GE crops, has lots of activities running, among them a special website for highschools including a biology contest: http://www.anbiojovem.org.br/obb/index.php?mod=home&ID= . For more information about the multiple efforts in educating the public, see Traynor et al. (Traynor et al., 2007). Besides AnBio there is also an industry funded group active in biotechnology communication with the public http://www.cib.org.br/index.php under the direction of Alda Lerayer http://www.cib.org.br/sec_executiva.php called Conselho de Informações sobre Biotecnologia with numerous activities and providing scientific literature on the website.

Numerous local media covered the bean approval. It's not only the anti-biotech groups communicating. Scientists, farmers, and even the Ministery of Agric CTNBio made important communication efforts, even using such modern communication tools as twitter http://twitter.com/#!/CTNBio to counterbalance the anti-propaganda.

For example from Xico Graziano, http://www.xicograziano.com.br/ published in the newspaper Estado de Sao Paulo:

"The numbers do not lie, but liars produce numbers. The phrase, attributed to Itamar Franco, applies to the detractors of transgenics. Contrary to its release by CTNBio, the opponents advertise dangers that were never proven, tout to disbelieve in science. Invent reasons, shouting old discredited slogans against biotechnology.

In fact, the Brazilian transgenic crops developed by Embrapa broke the jaw of those who always accuse genetic engineering of serving the multinational large producers. They lost the easy ideological support of "neomarxist" discourse and its anticorporate stance.
Farmers in Brazil these days complain in newspaper interviews that they have to wait too long for the approval process of highly useful crops. See for example a newsflash in Portugese on http://www.youtube.com/watch?v=bI8RWHnZftY.

5.3. The fast adoption of Bt cotton in India

The whole complex story has been recently summarized by (Sadashivappa & Qaim, 2009):

"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)*

At the end of the day the profitability of Bt cotton is now uncontested, see early comments of Müller-Jung Frankfurter Allgemeine: (Mueller-Jung, 2007)

The connection between suicides of Indian farmers and the introduction of GE cotton in India has been thoroughly falsified repeatedly (Gruere et al., 2008; Gruere & Sengupta, 2011). This does not hinder activists like Vandana Shiva from continuing with the same old and cheap propaganda linking GE crops with the sad tradition of farmer suicides in India, which started decades before the introduction of GE crops and beginning activities of multinational seed companies.

A new perspective is open since 2006 for the production of cotton seed oil for human consumption and seed meal for feed), made possible thanks to the detoxification (gossypol) successfully done by modern breeding including genetic engineering (Sunilkumar et al., 2006), see the latest summary on the matter: (Choudhary & Gaur, 2011).

From ISAAA news and highlights 2012 (James, 2011) and (Brookes & Barfoot, 2012)

India celebrated the 10th anniversary of Bt cotton, with plantings exceeding 10 million hectares for the first time, reaching 10.6 million hectares, and occupying 88% of the record 12.1 million hectare cotton crop. The principal beneficiaries were 7 million small farmers growing, on average, 1.5 hectares of cotton. India enhanced farm income from Bt cotton by US$9.4 billion in the period 2002 to 2010 and US$2.5 billion in 2010 alone. Thus, Bt cotton has transformed cotton production in India by increasing yield substantially, decreasing insecticide applications by ~50%, and through welfare benefits, contributed to the alleviation of poverty of 7 million small resource-poor farmers and their families in 2011 alone.

6. Cited literature

Albihn, A. (2001)
Recycling biowaste - Human and animal health problems, Ed. pp 69-75
<Go to ISI>://000174460600011

Alene, A.D. (2010)
Productivity growth and the effects of R&D in African agriculture. Agricultural Economics, 41, 3-4, pp 223-238
<Go to ISI>://WOS:000277084100002 AND http://www.ask-force.org/web/BioEconomy/Alene-Productivity-Growth-Effects-RD-2010.pdf

Alston, J.M., Pardey, P.G., & Roseboom, J. (1998)
Financing agricultural research: International investment patterns and policy perspectives. World Development, 26, 6, pp 1057-1071
<Go to ISI>://WOS:000075374100010 AND http://www.ask-force.org/web/BioEconomy/Alston-Financing-Agricultural-Research-1998.pdf

Altieri, M.A. (1989)
Agroecology - a New Research and Development Paradigm for World Agriculture. Agriculture Ecosystems & Environment, 27, 1-4, pp 37-46
<Go to ISI>://WOS:A1989CN57800004 AND http://www.ask-force.org/web/Biotech-Biodiv/Altieri-Agroecology-New-Research-Paradigm-1989.pdf

Altieri, M.A. (1999)
The ecological role of biodiversity in agroecosystems. Agriculture Ecosystems & Environment, 74, 1-3, pp 19-31
<Go to ISI>://WOS:000082010000003 AND http://www.ask-force.org/web/Biotech-Biodiv/Altieri-Ecological-Role-Biodivesity-1999.pdf

Altieri, M.A. (2000a)
The ecological impacts of transgenic crops on agroecosystem health. Ecosystem Health, 6, 1, pp 13-23
<Go to ISI>://WOS:000086283200005 AND http://www.ask-force.org/web/Biotech-Biodiv/Altieri-Ecological-Impacts-Transgenic-2000.pdf

Altieri, M.A. (2000b)
Enhancing the productivity and multifunctionality of traditional farming in Latin America. International Journal of Sustainable Development and World Ecology, 7, 1, pp 50-61
<Go to ISI>://WOS:000087130400005 AND http://www.ask-force.org/web/Biotech-Biodiv/Altieri-Enhancing-Productivity-2000.pdf

Altieri, M.A. (2002)
Agroecology: The science of natural resource management for poor farmers in marginal environments. Agriculture Ecosystems & Environment, 93, 1-3, pp 1-24
<Go to ISI>://BIOSIS:PREV200300034851 AND http://www.ask-force.org/web/Biotech-Biodiv/Altieri-Agroecology-Science-2002.pdf

Altieri, M.A. & Letourneau, D.K. (1982)
Vegetation management and biological control in agroecosystems. Crop Protection, 1, 4, pp 405-430
http://www.sciencedirect.com/science/article/pii/0261219482900230

Altieri, M.A., Letourneau, D.K., & Davis, J.R. (1983)
Developing Sustainable Agroecosystems. Bioscience, 33, 1, pp 45-49
http://www.jstor.org/stable/1309244 AND http://www.ask-force.org/web/Biotech-Biodiv/Altieri-Developing-Sustainable-Agroecosystems-1983.pdf

Altieri, M.A. & Nicholls, C.I. (2003)
Soil fertility management and insect pests: harmonizing soil and plant health in agroecosystems. Soil & Tillage Research, 72, 2, pp 203-211
<Go to ISI>://WOS:000184217600009 AND http://www.botanischergarten.ch/Biotech-Biodiv/Altieri-Soil-fertility-Pests-2003.pdf

Altieri, M.A. & Rosset, P. (1999)
Ten reasons why biotechnology will not ensure food security, protect the environment and reduce poverty in the developing world. In AgBioForum, Vol. 2, pp. 155-162.1522936X
http://agbioforum.org/v2n34/v2n34a03-altieri.htm AND http://www.botanischergarten.ch/Biotech-Biodiv/Altieri-Ten-Reasons-Biotechnology-1999.pdf

Altieri, M.A. & Toledo, V.M. (2011)
The agroecological revolution in Latin America: rescuing nature, ensuring food sovereignty and empowering peasants. Journal of Peasant Studies, 38, 3, pp 587-612
http://dx.doi.org/10.1080/03066150.2011.582947 AND http://www.ask-force.org/web/Biotech-Biodiv/Altieri-Agriecological-Revolution-Latin-America-2011.pdf

Ammann, K. (2006)
Towards Organo-Transgenic Crops ?, Alexandria, Egypt IAPS, International Association for People-Environment Studies, ENVIRONMENT, HEALTH AND SUSTAINABLE DEVELOPMENT (IAPS 19 Conference Proceedings on CD-Rom), Keynote, Ed. M.K. Tolba, A. Abdel-Hadi & S. Soliman pp http://iaps.scix.net/cgi-bin/works/Show?_id=iaps_19_2006_664

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* (eds A. Krattiger, R.T.L. Mahoney, L. Nelsen, G.A. Thompson, A.B. Bennett, K. Satyanarayana, G.D. Graff, C. Fernandez & S.P. Kowalsky), pp. 1539-1559. MIHR, PIPRA, Oxford, U.K. and Davis, USA The general link to the www.ipHandbook.org. (as of September 2007) AND http://www.botanischergarten.ch/IP/Press-Release-ipHandbook-Online-20071101.pdf, AND the Flyer: http://www.botanischergarten.ch/Patents/ipHandbook-Flyer1.pdf AND chapter 16.7 http://www.botanischergarten.ch/TraditionalKnowledge/Ammann-Traditional-Biotech-2007.pdf free of copyrights AND the exported bibliography with the links: http://www.botanischergarten.ch/TraditionalKnowledge/Exported-Bibliography-links-Ammann-2007.pdf

Ammann, K. (2008)
Feature: Integrated farming: Why organic farmers should use transgenic crops. New Biotechnology, 25, 2, pp 101 - 107
http://www.botanischergarten.ch/NewBiotech/Ammann-Integrated-Farming-Organic-2008.publ.pdf AND DOI: http://dx.doi.org/10.1016/j.nbt.2008.08.012

Ammann, K. (2009)
Feature: Why farming with high tech methods should integrate elements of organic agriculture. New Biotechnology, 25, 6, pp 378-388
http://www.sciencedirect.com/science/article/B8JG4-4WKTX50-1/2/1698b7149ed724fd0a49b3ae49f234ab AND http://www.botanischergarten.ch/Organic/Ammann-High-Tech-and-Organic-2009.pdf

Ammann, K. (20120408)
Glyphosate Information, a Selection, revised version. In ASK-FORCE contribution revised version. Klaus Ammann, Neuchatel http://www.ask-force.org/web/HerbizideTol/Ammann-Glyphosate-Information-20120408.pdf

Ammann, K. & van Montagu, M. (2009)
Organotransgenesis arrives. New Biotechnology, 25, 6, pp 377-377
<Go to ISI>://WOS:000270772100001

AnBio Brazil (2011)
Electronic Source: AnBio, The National Biosafety Association-ANBio, an NGO, http://www.anbio.org.br/

Antle, J.M. (1999)
Benefits and costs of food safety regulation. Food Policy, 24, 6, pp 605-623
http://www.sciencedirect.com/science/article/B6VCB-3XSJF9D-2/2/129aae348864a60bb2e49da9fde85c3e AND http://www.botanischergarten.ch/Regulation/Antle-Benefits-Costs-Food-Safety-Regulation-1999.pdf

Apel, A. (2010)
The costly benefits of opposing agricultural biotechnology. New Biotechnology, 27, 5, pp 635-640
http://www.sciencedirect.com/science/article/B8JG4-504JYNT-1/2/8a13cbba83c6a95c4d584e09eedd26ee AND http://www.ask-force.org/web/Vatican-PAS-Studyweek-Elsevier-publ-20101130/Apel-Andrew-PAS-Costly-Benerfits-Opposing-20101130-publ.pdf

Arber, W. (1990)
3 Impact of Human Civilization on Biological Evolution. *In SCOPE 44 - Introduction of Genetically Modified Organisms into the Environment* (ed H.A.B. Mooney, G.,). COGEN
http://www.scopenvironment.org/downloadpubs/scope44/chapter12.html AND http://www.ask-force.org/web/Regulation/Arber-Impact-Human-Civilization-1990.pdf

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

http://as8978.http.sasm3.net/roman_curia/pontifical_academies/acdscien/archivio/s.v.103_chagas/part3.pdf AND http://www.botanischergarten.ch/Genomics/Arber-Molecular-Evolution-Comparison-PAS-1994.pdf

Arber, W. (2002)
Roots, strategies and prospects of functional genomics. Current Science, 83, 7, pp 826-828
<Go to ISI>://000178662800019 and http://www.botanischergarten.ch/Mutations/Arber-Comparison-2002.pdf

Arber, W. (2010)
Genetic engineering compared to natural genetic variations. New Biotechnology, 27, 5, pp 517-521
http://www.sciencedirect.com/science/article/B8JG4-504JYNT-2/2/a7e6edd02959e1b3167158dd264f24a2 AND http://www.ask-force.org/web/Vatican-PAS-Studyweek-Elsevier-publ-20101130/Arber-Werner-PAS-Genetic-Engineering-Compared-20101130-publ.pdf

Arber W., B.G., Brom S., Campbell A., Caplan A., Cherif-Zahar B. Christiansen, F.B., Crawley, M.J., Davila, G., Drake, J.A., Dwyer, D.F., Faust, R.M., Fenner, F., Flores, M., Goursot, R., Jayaraman, K., Kingsbury, D.T., Levin, D.T., Martinez, E., Melis, R., Mooney, H.A., Palacios, R., Pinero, D., Rayko, E., Romero, E., Skalka, A. M., Timmis, K.N., Van Montagu, M. (1990)
Joint SCOPE/COGENE Statement. *In SCOPE 44 - Introduction of Genetically Modified Organisms into the Environment* (ed H.A.B. Mooney, G.,) http://www.scopenvironment.org/downloadpubs/scope44/contents.html AND http://www.scopenvironment.org/downloadpubs/scope44/statement.html AND http://www.ask-force.org/web/Regulation/SCOPE-44-SCOPE-COGENE-Statement-1990.pdf

Arntzen, C.J., Coghlan, A., Johnson, B., Peacock, J., & Rodemeyer, M. (2003)
GM crops: science, politics and communication. Nature Reviews Genetics, 4, 10, pp 839-843
<Go to ISI>://WOS:000185701800020 AND http://www.ask-force.org/web/Regulation/Arntzen-GM-crops-Science-Politics-2003.pdf

Avery, A. (2007)
Electronic Source: "Organic Abundance" Report: Fatally Flawed, published by: Hudson Institute, Center for Global Food Issues
http://www.botanischergarten.ch/Organic/Avery-Hudson-Institute-organic-rebuttal-2007a.pdf

Badgley, C., Moghtadera, J., Quineroa, E., Zadema, E., Chappella, M.J., Aviles-Vazqueza, K., Samulona, A., & Perfecto, I. (2007)
Organic agriculture and the global food supply, (including rebuttals from Kenneth Cassman and Jim Hendrix). Renewable Agriculture and Food Systems 22, Published online by Cambridge University Press 04Jul2007 pp 86-108
doi:10.1017/S1742170507001640 AND http://www.botanischergarten.ch/Organic/Badgley-Feed-World-2007.pdf AND separate rebuttal of Alex Avery from the Hudson Institute: http://www.botanischergarten.ch/Organic/Avery-Hudson-Institute-organic-rebuttal-2007a.pdf

Belfrage, K., Bjorklund, J., & Salomonsson, L. (2005)
The effects of farm size and organic farming on diversity of birds, pollinators, and plants in a Swedish landscape. Ambio, 34, 8, pp 582-588
<Go to ISI>://000234658200002

Bernauer, T., Tribaldos, T., Luginbühl, C., & Winzeler, M. (2011)
Government regulation and public opposition create high additional costs for field trials with GM crops in Switzerland. Transgenic Research, pp 1-8
http://dx.doi.org/10.1007/s11248-011-9486-x AND http://www.ask-force.org/web/Regulation/Bernauer-Governemtn-Regulation-Additional-Costs.2011.pdf

Boutin, C., Baril, A., & Martin, P.A. (2008)
Plant diversity in crop fields and woody hedgerows of organic and conventional farms in contrasting landscapes. Agriculture Ecosystems & Environment, 123, 1-3, pp 185-193
<Go to ISI>://000251149800020

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
<Go to ISI>://000230427700013 AND http://www.ask-force.org/web/Regulation/Bradford-NB-Reply-2002.pdf

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
<Go to ISI>://000228197300026 AND http://www.ask-force.org/web/Regulation/Bradford-NB-2005.pdf

Brookes, G. & Barfoot, P. (2007)
GM crops: the first ten years - global socio-economic and environmental impacts, PG Economics Ltd, UK pp 106 Dorchester, UK (Report)
http://www.pgeconomics.co.uk/pdf/global_impactstudy_2006_v1_finalPGEconomics.pdf

Brookes, G. & Barfoot, P. (2012)
GM crops: global socio-economic and environmental impacts 1996-2010 PG Economics Ltd, UK pp 187 Dorcester, UK (Report)

http://www.pgeconomics.co.uk/page/33/global-impact-2012 AND http://www.ask-force.org/web/BioEconomy/Brookes-Global-Impact-Study-Final-2012.pdf AND Slides AND slides http://www.ask-force.org/web/BioEconomy/Brookes-Global-Impact-Slides-1996-2009.pdf

Brooks, J. (20120511)
Electronic Source: Researcher Defends His Work on Gill Tract, Says Use of Corn Unfairly Demoni NewsFix http://blogs.kqed.org/newsfix/2012/05/11/researcher-defends-his-work-on-gill-tract-says-work-with-corn-unfairly-demonized/ AND http://www.ask-force.org/web/Fundamentalists/Brooks-Corn-Demonized-Altieri-20120511.pdf

Choudhary, B. & Gaur, K. (2011)
Bt Cotton in India, a Multipurpose Crop, International Service for the Aquisition of Agri-Biotech Applications, Biotech Information Center pp 6 Celebrating 10 Years New Delhi, India (Report)
http://www.isaaa.org/india/media/Bt%20Cotton%20In%20India-A%20Multipurpose%20Crop-9th%20May%202011.pdf

Clemetsen, M. & van Laar, J. (2000)
The contribution of organic agriculture to landscape quality in the Sogn og Fjordane region of Western Norway. Agriculture Ecosystems & Environment, 77, 1-2, pp 125-141
<Go to ISI>://000084356400011

Cohen, J.I. (2005)
Poorer nations turn to publicly developed GM crops. Nature Biotechnology, 23, 1, pp 27-33
<Go to ISI>://000226195700017 AND http://www.botanischergarten.ch/Developing/Cohen-Naturebiotech-2005.pdf AND errata: http://www.botanischergarten.ch/Developing/Cohen-Naturebiotech-errata-2005.pdf

De Souza, L. (20111018)
Electronic Source: Brazilian virus-resistant beans, A homemade, high potential benefit-driven development from the public sector (ed Karl Haro von Mogel), Biofortified: http://www.biofortified.org/2011/10/brazilian-virus-resistant-beans/#more-7511 AND http://www.ask-force.org/web/Brazil/DeSouza-Brazilian-Virus-resistant-GM-Beans-Biofortified-20111018.pdf
http://www.biofortified.org/2011/10/brazilian-virus-resistant-beans/#more-7511 AND http://www.ask-force.org/web/Brazil/DeSouza-Brazilian-Virus-resistant-GM-Beans-Biofortified-20111018.pdf

deRenobales-Scheifler, M. (2009) More sustainable food: Genetically modified seeds in organic farming Junta General del Principado de Asturias Sociedad Internacional de Bioética (SIBI), Gijon, Basque, Spain, pp 119
http://www.sibi.org/ingles/jgp/p2009.htm English, AND http://www.sibi.org/jgp/p2009.htm Spanish AND http://www.botanischergarten.ch/Organic/DeRenobales-Scheifler-GM-Seeds-Organic-2009.pdf AND http://www.araba.ehu.es/p208-content/eu/contenidos/noticia/20100211_mertxe_renobales/eu_np/20100211_mertxe_renobales.html

EPEC-SANCO (2011)
Evaluation of the EU legislative framework in the field of cultivation of GMOs under Directive 2001/18/EC and Regulation (EC) No 1829/2003, and the placing on the market of GMOs as or in products under Directive 2001/18/EC Final Report, pp. 137. European Commission DG Sanco
http://ec.europa.eu/food/food/biotechnology/evaluation/docs/gmo_cultivation_report_en.pdf

Ernst, W.G. (2002)
Global equity and sustainable earth resource consumption requires super-efficient extraction-conservation-recycling and ubiquitous, inexpensive energy. International Geology Review, 44, 12, pp 1072-1091
<Go to ISI>://000181712300002

EuropaBio (20120601)
Undue Delays in the EU Approval of Safe GM Products Status Update of 1 June 2012, EuropaBio pp 1 Brussels (Report)
http://www.europabio.org/filter/agricultural/type/position

Filser, J., Mebes, K.H., Winter, K., Lang, A., & Kampichler, C. (2002)
Long-term dynamics and interrelationships of soil Collembola and microorganisms in an arable landscape following land use change. Geoderma, 105, 3-4, pp 201-221
<Go to ISI>://000173148400004

Foster, A.D. & Rosenzweig, M.R. (1995)
LEARNING BY DOING AND LEARNING FROM OTHERS - HUMAN-CAPITAL AND TECHNICAL CHANGE IN AGRICULTURE. Journal of Political Economy, 103, 6, pp 1176-1209
<Go to ISI>://WOS:A1995TH53200003 AND http://www.ask-force.org/web/Ethics/Foster-Learning-By-Doing-1995.pdf

Giddings, V., Potrykus, I., Ammann K., & Fedoroff, N. (2012)
Confronting the Gordian knot, Opinion. Nature Biotechnology, 30, 3, pp 208-209
http://www.ask-force.org/web/Regulation/Giddings-Confronting-Gordian-Knot-2012.pdf

Graff, G., Hochman, G., & Zilberman, D. (2009)
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

Granstedt, A. (2000a)
Increasing the efficiency of plant nutrient recycling within the agricultural system as a way of reducing the load to the environment experience from Sweden and Finland. Agriculture Ecosystems & Environment, 80, 1-2, pp 169-185
<Go to ISI>://000088678700013

Granstedt, A. (2000b)
Reducing the nitrogen load to the Baltic Sea by increasing the efficiency of recycling within the agricultural system - Experience of ecological agriculture in Sweden and Finland. Landbauforschung Volkenrode, 50, 3-4, pp 95-102
<Go to ISI>://000167558600002

Green, J.M. (2012)
The Benefits of Herbicide-Resistant Crops. Pest Management Science, Accepted Articles, unedited, pp 41
http://dx.doi.org/10.1002/ps.3374 AND http://www.ask-force.org/web/HerbizideTol/Green-Benefits-Herbicicde-Resistant-Crops-2012.pdf

Gruere, G., Methta-Bhatt, P., & Sengupta, D. (2008)
Bt Cotton and Farmer Suicides in India, Reviewing the Evidence. IFPRI-Discussion Paper 00808, pp
http://www.ifpri.org/sites/default/files/publications/ifpridp00808.pdf AND http://www.ask-force.org/web/Cotton/Gruere-Cottron-Suicides-IFPRI-2008.pdf

Gruere, G. & Sengupta, D. (2011)
Bt Cotton and Farmer Suicides in India: An Evidence-based Assessment. Journal of Development Studies, 47, 2, pp 316-337
<Go to ISI>://WOS:000286778300007 AND http://www.ask-force.org/web/Cotton/gruere-bt-cotton-suicides-2011.pdf

Guasch, J.L. & Hahn, R.W. (1997)
The Costs and Benefits of Regulation: Some Implications for Developing Countries
This manuscript was prepared as a background paper for the World Bank, World Development Report, forthcoming in. *In World Development Report, 1997* (ed W.B.R. 1997), pp. 39. World Bank Report 1997
http://www.botanischergarten.ch/Regulation/Guasch-Costs-Benefits-Regulation-Developing-1997.pdf IN:
http://www.botanischergarten.ch/Developing/World-Bank-Development-Report-1997.pdf

Hadjigeorgiou, I., Osoro, K., de Almeida, J.P.F., & Molle, G. (2005)
Southern European grazing lands: Production, environmental and landscape management aspects. Livestock Production Science, 96, 1, pp 51-59
<Go to ISI>://WOS:000232243900005

Hassanali, A., Herren, H., Khan, Z.R., Pickett, J.A., & Woodcock, C.M. (2008)
Integrated pest management: the push-pull approach for controlling insect pests and weeds of cereals, and its potential for other agricultural systems including animal husbandry. Philosophical Transactions of the Royal Society B-Biological Sciences, 363, 1491, pp 611-621
<Go to ISI>://WOS:000252663100012 AND http://www.botanischergarten.ch/Organic/Hassanali-Integrated-Pest-Management-2008.pdf

Hathaway-Jenkins, L.J., Sakrabani, R., Pearce, B., Whitmore, A.P., & Godwin, R.J. (2011)
A comparison of soil and water properties in organic and conventional farming systems in England. Soil Use and Management, 27, 2, pp 133-142
http://dx.doi.org/10.1111/j.1475-2743.2011.00335.x AND http://www.ask-force.org/web/Escherichia/Hathaway-Jenkins-Comparison-Org-conv-2011.pdf

Hendriks, K., Stobbelaar, D.J., & van Mansvelt, J.D. (2000)
The appearance of agriculture: An assessment of the quality of landscape of both organic and conventional horticultural farms in West Friesland. Agriculture, Ecosystems & Environment, 77, 1-2, pp 157-175
http://www.sciencedirect.com/science/article/B6T3Y-3Y21TSP-F/2/1cc4008e3c7d1dace1f0717470b211f4 AND http://www.botanischergarten.ch/Organic/Hendriks-Horticultural-Comparison-2000.pdf

Hengsdijk, H. & Langeveld, J.W.A. (2009)
Yield trends and yield gap analysis of major crops in the world. Werkdocumenten, 170, pp 62
http://content.alterra.wur.nl/Webdocs/WOT/Werkdocumenten/WOTwerkdocument_170.pdf AND http://www.ask-force.org/web/Yield/Hengsdijk-Yield-Trends-World-Wageningen-2009.pdf

Hermans, F. & Knippenberg, L. (2006)
A PRINCIPLE-BASED APPROACH FOR THE EVALUATION OF SUSTAINABLE DEVELOPMENT. Journal of Environmental Assessment Policy & Management, 8, 3, pp 299-319
http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=22503316&site=ehost-live AND http://www.ask-force.org/web/Sustainability/Hermans-Principle-Based-ApproachSustainable-2006.pdf

Hoffmann, V., Probst, K., & Christinck, A. (2007)
Farmers and researchers: How can collaborative advantages be created in participatory research and technology development? Agriculture and Human Values, 24, 3, pp 355-368
http://dx.doi.org/10.1007/s10460-007-9072-2 AND http://www.ask-force.org/web/Regulation/Hoffmann-Farmers-Researchers-Collaborative-2007.pdf

Holst, H. (2001)
Nature conservation and landscape management advice - The integration of nature conservation and landscape management into "goodfarming practice" as a future task. Berichte Uber Landwirtschaft, 79, 4, pp 552-564
<Go to ISI>://000172312100003

Islam, M., Doyle, M.P., Phatak, S.C., Millner, P., & Jiang, X.P. (2004a)
Persistence of enterohemorrhagic Escherichia coli O157 : H7 in soil and on leaf lettuce and parsley grown in fields treated with contaminated manure composts or irrigation water. Journal of Food Protection, 67, 7, pp 1365-1370
<Go to ISI>://000222559700006 AND http://www.botanischergarten.ch/Organic/Islam-Fate-Ecoli-O157-H7-2004.pdf

Islam, M., Doyle, M.P., Phatak, S.C., Millner, P., & Jiang, X.P. (2005)
Survival of Escherichia coli O157 : H7 in soil and on carrots and onions grown in fields treated with contaminated manure composts or irrigation water. Food Microbiology, 22, 1, pp 63-70
<Go to ISI>://000225615400008 AND http://www.botanischergarten.ch/Organic/Islam-Survival-ColiO157H7-2005.pdf

Islam, M., Morgan, J., Doyle, M.P., & Jiang, X.P. (2004b)
Fate of Escherichia coli O157 : H7 in manure compost-amended soil and on carrots and onions grown in an environmentally controlled growth chamber. Journal of Food Protection, 67, 3, pp 574-578
<Go to ISI>://000220077200024 AND http://www.ask-force.org/web/Organic/Islam-Fate-Ecoli-O157-H7-2004.pdf

James, C. (2011)
Brief 43 Global Status of Commercialized Biotech/GM Crops: 2011 Executive Summary, pp. 36. ISAAA nternational Service for the Acquisition of Agri-biotech Applications, Ithaca, N.Y. USA.978-1-892456-52-4
http://www.isaaa.org/resources/publications/briefs/43/executivesummary/pdf/Brief%2043%20-%20Executive%20Summary%20-%20English.pdf AND http://www.ask-force.org/web/ISAAA/ISAAA-Statement-Ammann-Press-20120308.pdf AND http://www.ask-force.org/web/ISAAA/James-Brief43-ISAAA-Executive-Summary.pdf AND http://www.ask-force.org/web/ISAAA/ISAAA-Brief-43-Highlights-2012.pdf AND http://www.ask-force.org/web/ISAAA/ISAAA-Brief-43-slides-2011.pptx AND http://www.ask-force.org/web/ISAAA/ISAAA-in-Brief-May-2011.ppt

Jan Stobbelaar, D. & van Mansvelt, J.D. (2000)
The process of landscape evaluation: Introduction to the 2nd special AGEE issue of the concerted action: “The landscape and nature production capacity of organic/sustainable types of agriculture”. Agriculture, Ecosystems & Environment, 77, 1-2, pp 1-15
http://www.sciencedirect.com/science/article/B6T3Y-3Y21TSP-1/2/e131160b5393220337c67a712a0b813b

Jansson Stefan, Catherine Bellini, Christiane Funk, Per Gardeström, Markus Grebe, Vaughan, H., Pär Ingvarsson, Edouard Pesquet, Göran Samuelsson, Wolfgang Schröder, Åsa Strand, Hannele Tuominen, Johan Trygg, Xiao-Ru Wang, Inger Andersson, Rishikesh Bhalerao, Peter Bozhkov, Christina Dixelius, Åsa Lankinen, Karin Ljung, Ewa Mellerowicz, Ove Nilsson, Jan Stenlid, Sten Stymne, Björn Sundberg, Eva Sundberg, Sara von Arnold, Gunnar Wingsle, Urban Johanson, Henrik Jönsson, Per Kjellbom, Christer Larsson, Carl Troein, Adrian Clarke, Magnus Holm, Bengt Oxelman, Cornelia Spetea Wiklund, Annelie Carlsbecker, Stenbjörn Styring, Harry Brumer, & Glaser, E. (20111006)
Quasi-science prevents an environmentally friendly agriculture and forestry. In Petition, pp. 2, Umea University
http://www.plantsci.org.uk/sites/default/files/Debate%20article.pdf AND http://www.ask-force.org/web/Fundamentalists/Jansson-Swedish-Scientists-Petition-2011.pdf AND British Support: http://www.ipetitions.com/petition/changeeugmlegislation/

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
<Go to ISI>://WOS:000246369400013 AND http://www.ask-force.org/web/Organic/Kalaitzandonakes-Compliance-Costs-Regulation-2007.pdf

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
<Go to ISI>://WOS:000252663200013 AND http://www.botanischergarten.ch/Sustainability/Kesavan-Strategies-Models-Sust-2008.pdf

Kirchmann, H., Nyamangara, J., & Cohen, Y. (2005)
Recycling municipal wastes in the future: from organic to inorganic forms? Soil Use and Management, 21, pp 152-159
<Go to ISI>://000229679600010

Korn, M. (1996)
The dike pond concept: Sustainable agriculture and nutrient recycling in China. Ambio, 25, 1, pp 6-13
<Go to ISI>://A1996TX84000003

Kuiper, J. (2000)
A checklist approach to evaluate the contribution of organic farms to landscape quality. Agriculture, Ecosystems & Environment, 77, 1-2, pp 143-156
http://www.sciencedirect.com/science/article/B6T3Y-3Y21TSP-D/2/600a32f07a0ebf302ec171de342cd5ef
http://www.botanischergarten.ch/Organic/Kuiper-Checklist-Landscape-2000.pdf

Kuntz, M. & Ricroch, A. (2012)
Is it Time to Adjust the Current Regulatory Risk Assessment for GM Food and Feed? ISB News Report, Agricultural and Environment Biotechnology, February 2012, pp 1-4
http://www.isb.vt.edu/news/2012/Feb12.pdf AND http://www.ask-force.org/web/Regulation/Kuntz-Ricroch-ISB-Time-Adjust-2012.pdf

MacNaeidhe, F.S. & Culleton, N. (2000)
The application of parameters designed to measure nature conservation and landscape development on Irish farms. Agriculture, Ecosystems & Environment, 77, 1-2, pp 65-78
http://www.sciencedirect.com/science/article/B6T3Y-3Y21TSP-6/2/74711f07b233ef47d8c2cd32fbcc4c45 AND http://www.botanischergarten.ch/Organic/MacNaeidhe-Parameter-Nature-2000.pdf

Mader, P., Fliessbach, A., Dubois, D., Gunst, L., Fried, P., & Niggli, U. (2002)
Soil fertility and biodiversity in organic farming. Science, 296, 5573, pp 1694-1697
<Go to ISI>://000175976200061 AND http://www.botanischergarten.ch/Organic/Maeder-Science-2002-p1694.pdf

Mäder, P., Fliessbach, A., Dubois, D., Gunst, L., Fried, P., & Niggli, U. (2002)
Soil Fertility and Biodiversity in Organic Farming. Science, 296, 5573, pp 1694-1697
http://www.botanischergarten.ch/Organic/Maeder-Science-2002-p1694.pdf

Marsden, T. (2012)
Towards a Real Sustainable Agri-food Security and Food Policy: Beyond the Ecological Fallacies? The Political Quarterly, 83, 1, pp 139-145
<Go to ISI>://WOS:000299947800019 AND http://www.ask-force.org/web/BioEconomy/Marsden-Towards-Real-Sustainble-Agrifood-Security-2012.pdf

McHughen, A. & Smyth, S. (2008)
US regulatory system for genetically modified [genetically modified organism (GMO), rDNA or transgenic] crop cultivars. Plant Biotechnology Journal, 6, 1, pp 2-12
<Go to ISI>://WOS:000251505400002 AND http://www.ask-force.org/web/Regulation/McHughen-US-Regulatory-System-2008.pdf

Miller-Wallstreet (20120518)
Monsanto Announces $50 Million Commitment to African Agricultural Development at Symposium on Global Agriculture and Food Security Wallstreet Journal pp (Wallstreet Journal Article)
http://online.wsj.com/article/PR-CO-20120518-904063.html AND http://www.ask-force.org/web/Developing/Miller-Monsanto-Anouncing-Millions-Africa-20120518.pdf

Miller, H., Morandini, P., & Ammann, K. (2008)
Is biotechnology a victim of anti-science bias in scientific journals? Trends in Biotechnology, 26, 3, pp 122-125
doi:10.1016/j.tibtech.2007.11.011 AND http://www.botanischergarten.ch/Peer-Review/Miller-Morandini-Ammann-Peer-Review-2008.pdf

Miller, H.I. (1994a)
OVERREGULATED BIOTECHNOLOGY. Nature, 371, 6499, pp 646-646
<Go to ISI>://WOS:A1994PM77300018 AND http://www.botanischergarten.ch/Regulation/Miller-Overregulated-Bioitechnology-1994.pdf

Miller, H.I. (1994b)
REGULATORY DISINCENTIVES. Nature, 370, 6487, pp 244-244
<Go to ISI>://WOS:A1994NZ22900021 AND http://www.botanischergarten.ch/Regulation/Miller-Regulatory-Disincentives-1994.pdf

Miller, H.I. (2009)
The Human Cost of Anti-Science Activism. Policy Review, 154, pp 65-78
<Go to ISI>://WOS:000264930700005 AND http://www.ask-force.org/web/Regulation/Miller-Human-Costs-Anti-Science-1-2009.pdf

Morris, E.J. (2011)
Modern Biotechnology - Potential Contribution and Challenges for Sustainable Food Production in Sub-Saharan Africa. Sustainability, 3, 6, pp 809-822
http://www.mdpi.com/2071-1050/3/6/809/ AND http://www.ask-force.org/web/Sustainability/Morris-Modern-Biotechnology-Potential-2011.pdf

Morris, S. & Spillane, C. (2010)

EU GM Crop Regulation: A Road to Resolution or a Regulatory Roundabout? European Journal of Risk Regulation, 4, pp 359-369
http://www.ask-force.org/web/Regulation/Morris-Spillane-EU-GM-Crop-Regulation-final-2010..pdf

Mueller-Jung, J. (2007)
Wie verpackt man eine Kulturrevolution in Watte? How to wrap up a cultural revolution in cotton wool ?, Frankfurter Allgemeine Zeitung 259 7. Nov. 2007 Indiens Bauern, die bereits von der "gruenen Revolution" enorm profitiert haben, erleben einen beispiellosen Boom der Gentechnik.Der naechste grosse Umbruch ist maechtig in Fahrt. English: Indian farmers have profited greatly from the Green Revolution, now they encounter an unprecedented breakthrough of genetical engineering. pp N1 (Frankfurter Allgemeine Zeitung Article)
http://www.botanischergarten.ch/Bt/Mueller-Jung-FAZ-Indian-cotton-2007.pdf AND english translation by K.Ammann: http://www.botanischergarten.ch/Cotton/Mueller-FAZ-Cotton-2007-eng-1.pdf

Norton, L., Johnson, P., Joys, A., Stuart, R., Chamberlain, D., Feber, R., Firbank, L., Manley, W., Wolfe, M., Hart, B., Mathews, F., MacDonald, D., & Fuller, R.J. (2009)
Consequences of organic and non-organic farming practices for field, farm and landscape complexity. Agriculture Ecosystems & Environment, 129, 1-3, pp 221-227
<Go to ISI>://000261964100028 AND http://www.botanischergarten.ch/Integrated/Norton-Consequences-Organic-Non-Organic-2009.pdf

Ongeng, D., Muyanja, C., Geeraerd, A.H., Springael, D., & Ryckeboer, J. (2011a)
Survival of Escherichia coli O157:H7 and Salmonella enterica serovar Typhimurium in manure and manure-amended soil under tropical climatic conditions in Sub-Saharan Africa. Journal of Applied Microbiology, 110, 4, pp 1007-1022
<Go to ISI>://WOS:000288169600016 AND http://www.ask-force.org/web/Escherichia/Ongeng-Survival-E-coli-O157-H7-Manure-2011.pdf

Ongeng, D., Muyanja, C., Ryckeboer, J., Springael, D., & Geeraerd, A.H. (2011b)
Kinetic model-based prediction of the persistence of Salmonella enterica serovar Typhimurium under tropical agricultural field conditions. Journal of Applied Microbiology, 110, 4, pp 995-1006
<Go to ISI>://WOS:000288169600015

Ongeng, D., Vasquez, G.A., Muyanja, C., Ryckeboer, J., Geeraerd, A.H., & Springael, D. (2011c)
Transfer and internalisation of Escherichia coli O157:H7 and Salmonella enterica serovar Typhimurium in cabbage cultivated on contaminated manure-amended soil under tropical field conditions in Sub-Saharan Africa. International Journal of Food Microbiology, 145, 1, pp 301-310
<Go to ISI>://BIOSIS:PREV201100248113 AND http://www.ask-force.org/web/Escherichia/Ongeng-Transfer-Internalization-Ec-Cabbage-2011.pdf

Paarlberg, R. (2000)
Genetically modified crops in developing countries - Promise or peril? Environment, 42, 1, pp 19-27
<Go to ISI>://WOS:000084733000004 AND http://www.botanischergarten.ch/Developing/Paarlberg-GM-crops-Developing-2000.pdf

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
<Go to ISI>://INSPEC:8907610 AND http://www.botanischergarten.ch/Developing/Paarlberg-GM-commercial-Risk-Africa-2006.pdf

Paarlberg, R. (2008) Starved for science: how biotechnology is being kept out of Africa Harvard University Press, Cambridge MA and London, IS: 13: 9780674033474, paperback pp 235
http://ejsd.org/docs/The_Population_Bomb_Four_Decades_On.pdf#page=137

Paarlberg, R. (2009a)
The Ethics of Modern Agriculture. Society, 46, 1, pp 4-8
http://dx.doi.org/10.1007/s12115-008-9168-3 AND http://www.botanischergarten.ch/Developing/Paarlberg-Ethics-Modern-Agriculture-2008.pdf

Paarlberg, R. (2009b) Starved for Science, How Biotechnology is kept out of Africa Harvard University Press; 1 edition (August 5, 2009) Cambridge, USA, IS: ISBN-10: 0674033477 ISBN-13: 978-0674033474 pp 256
http://www.amazon.com/Starved-Science-Biotechnology-Being-Africa/dp/0674033477/ref=sr_1_1?s=books&ie=UTF8&qid=1331185222&sr=1-1#_

Paarlberg, R. (2010) Food Politics: What Everyone Needs to Know Oxford University Press, USA (April 7, 2010) Oxford and New York, IS: ISBN-10: 019538959X ISBN-13: 978-0195389593 pp 240
http://ejsd.org/docs/The_Population_Bomb_Four_Decades_On.pdf#page=137

Peterson E. Wesley F. Author & Brink L. Reviewer (2010) A Billion Dollars a Day: The Economics and Politics of Agricultural Subsidies 37 BBC Audiobooks (4. Mai 2009) IS: 0165-1587 AND ISBN-10: 1405185872 ISBN-13: 978-1405185875 pp 119-121
<Go to ISI>://WOS:000275251100006 Amazon: http://www.amazon.de/dp/1405185872/ref=rdr_ext_tmb#_

Phalan, B., Rodrigues, A.S.L., Balmford, A., Green, R.E., & Ewers, R.M. (2006)

Comment on "Resource-Conserving Agriculture Increases Yields in Developing Countries". Environmental Science & Technology, 41, 3, pp 1054-1055
http://dx.doi.org/10.1021/es062097g AND http://www.ask-force.org/web/Yield/Phalan-Comment-Resource-Conserving-2006.pdf

Phillis, Y.A. & Andriantiatsaholiniaina, L.A. (2001)
Sustainability: an ill-defined concept and its assessment using fuzzy logic. Ecological Economics, 37, 3, pp 435-456
http://www.sciencedirect.com/science/article/B6VDY-433NRMK-8/2/9ca4e16bcd27fc79fc96ba0809584ff6 AND http://www.ask-force.org/web/Sustainability/Phyllis-Sustainability-Ill-defined-concept-2001.pdf

Phillis, Y.A., Kouikoglou, V.S., & Manousiouthakis, V. (2010)
A Review of Sustainability Assessment Models as System of Systems. Ieee Systems Journal, 4, 1, pp 15-25
<Go to ISI>://000276535900003 AND http://www.ask-force.org/web/Sustainability/Phillis-Review-Sustaninability-Assessment-2010.pdf

Potrykus, I. (2010)
Regulation must be revolutionized. Nature, 466, 7306, pp 561-561
http://dx.doi.org/10.1038/466561a AND http://www.ask-force.org/web/Regulation/Potrykus-Regulation-Revolutionized-2010.pdf

Potts, S.G., Willmer, P., Dafni, A., & Ne'eman, G. (2001)
The utility of fundamental ecological research of plant-pollinator interactions as the basis for landscape management practices. Proceedings of the Eight International Pollination Symposium Pollination: Integrator of Crops and Native Plant Systems, 561, pp 141-152
<Go to ISI>://WOS:000173805800019

Pretty, J., Hine, R.E., Morison, J.I.L., Noble, A.D., Bossio, D., Dixon, J., & de Vries, F.W.T.P. (2006)
Response to Comment on "Resource-Conserving Agriculture Increases Yields in Developing Countries". Environmental Science & Technology, 41, 3, pp 1056-1057
http://dx.doi.org/10.1021/es062733a AND http://www.ask-force.org/web/Yield/Pretty-Response-Phalan-2006.pdf

Pretty, J., Toulmin, C., & Williams, S. (2011)
Sustainable intensification in African agriculture. International Journal of Agricultural Sustainability, 9, 1, pp 5-24
<Go to ISI>://WOS:000288300500002 AND http://www.ask-force.org/web/Sustainability/Pretty-Sustainble-Intensification-Africa-2011.pdf

Pretty, J.N., Noble, A.D., Bossio, D., Dixon, J., Hine, R.E., Penning de Vries, F.W.T., & Morison, J.I.L. (2005)
Resource-Conserving Agriculture Increases Yields in Developing Countries. Environmental Science & Technology, 40, 4, pp 1114-1119
http://dx.doi.org/10.1021/es051670d AND http://www.ask-force.org/web/Yield/Pretty-Resouce-Conserving-Agriculture-2005.pdf

PRRI (20120516)
Electronic Source: PRRI submission - information on identification of LMOs that are not likely to have adverse effects, published by: PRRI Public Research and Regulation Initiative
http://www.pubresreg.org/index.php?option=com_docman&task=doc_download&gid=611 AND http://www.ask-force.org/web/Regulation/PRRI-submission-LMOs-Unlikely-20120516.pdf

Qaim, M. & Stein, A.J. (2009a)
Biofortification of Staple Crops How well does it work and what does it cost? Ernahrungs-Umschau, 56, 5, pp 274-280
<Go to ISI>://WOS:000266331900004 AND http://www.botanischergarten.ch/Developing/Qaim-Biologische-Anreicherung-2009.pdf AND http://www.botanischergarten.ch/Developing/Qaim-Biologische-Anreicherung-2009-alpha.pdf AND http://www.botanischergarten.ch/Developing/Qaim-Biolog-Anreicherung-Zusammenfassung-Ernaer-Umschau-2009.pdf

Qaim, M. & Stein, A.J. (2009b)
Biologische Anreicherung von Grundnahrungspflanzen: Wirksamkeit und Wirtschaftlichkeit (Biofortification of Staple Crops How well does it work and what does it cost?). Ernahrungs-Umschau, 56, 5, pp 274-280
<Go to ISI>://WOS:000266331900004 AND http://www.botanischergarten.ch/Developing/Qaim-Biologische-Anreicherung-2009.pdf http://www.botanischergarten.ch/Developing/Qaim-Biologische-Anreicherung-2009-alpha.pdf http://www.botanischergarten.ch/Developing/Qaim-Biolog-Anreicherung-Zusammenfassung-Ernaer-Umschau-2009.pdf

Qaim, M., Stein, A.J., & Meenakshi, J.V. (2007)
Economics of biofortification. Contributions of Agricultural Economics to Critical Policy Issues, 37, pp 119-133
<Go to ISI>://WOS:000252133200010 AND http://www.botanischergarten.ch/Biofortification/Qaim-Economics-Biofortification.pdf

Reed, M.S., Fraser, E.D.G., & Dougill, A.J. (2006)
An adaptive learning process for developing and applying sustainability indicators with local communities. Ecological Economics, 59, 4, pp 406-418
http://www.sciencedirect.com/science/article/B6VDY-4J2TVR9-1/2/2af4d30aa3a92565d6dff10db25e87a3 AND http://www.ask-force.org/web/Sustainability/Reed-Adaptive-Learning-Process-2006.pdf

Risgaard, M.L., Frederiksen, P., & Kaltoft, P. (2007)
Socio-cultural processes behind the differential distribution of organic farming in Denmark: a case study. Agriculture and Human Values, 24, pp 445-459
<Go to ISI>://WOS:000250625500004 AND http://www.botanischergarten.ch/Organic/Risgaard-Socio-cultural-Processes-2007.pdf

Ronald, P.C. & Adamchak, R.W. (2008) Tomorrow's Table: Organic Farming, Genetics, and the Future of Food Oxford University Press, USA (April 18, 2008) IS: ISBN-10: 0195301757 ISBN-13: 978-0195301755 pp 232
Book review by J. Gressel 2009 http://www.botanischergarten.ch/Gressel-Book-Ronald-2009.pdf AND Tony Trewawas http://www.botanischergarten.ch/Organic/Trevawas-Redefining-Natural-2008.pdf

Rossi, R. & Nota, D. (2000)
Nature and landscape production potentials of organic types of agriculture: a check of evaluation criteria and parameters in two Tuscan farm-landscapes. Agriculture, Ecosystems & Environment, 77, 1-2, pp 53-64
http://www.sciencedirect.com/science/article/B6T3Y-3Y21TSP-5/2/0117ef4fafec0b9550bbc55e09639ab5

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 AND http://www.ask-force.org/web/Benefits/RS-Reaping-the-Benefits-200910.pdf

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 http://www.agbioforum.org/v12n2/v12n2a03-sadashivappa.htm AND http://www.botanischergarten.ch/Cotton/Sadashivappa-BtCotton_AgBioForum-2009.pdf

Schellhorn, N.A., Macfadyen, S., Bianchi, F., Williams, D.G., & Zalucki, M.P. (2008)
Managing ecosystem services in broadacre landscapes: what are the appropriate spatial scales? Australian Journal of Experimental Agriculture, 48, 12, pp 1549-1559
<Go to ISI>://WOS:000260640500009 AND http://www.botanischergarten.ch/Organic/Schellhorn-Managing-Ecosystem-Services-2008.pdf

Schubert, D. (2005)
Regulatory regimes for transgenic crops. Nature Biotechnology, 23, 7, pp 785-787
<Go to ISI>://WOS:000230427700012 AND http://www.botanischergarten.ch/Regulation/Schubert-Regulatory-NB-2005.pdf

Seufert, V., Ramankutty, N., & Foley, J.A. (2012)
Comparing the yields of organic and conventional agriculture. Nature, advance online publication, pp
http://dx.doi.org/10.1038/nature11069 AND
http://www.nature.com/nature/journal/vaop/ncurrent/abs/nature11069.html#supplementary-information AND
http://www.ask-force.org/web/Organic/Seufert-Comparing-Yields-2012.pdf AND http://www.ask-force.org/web/Organic/Seufert-Supplement-Excluded-2012.xlsb AND http://www.ask-force.org/web/Organic/Seufert-Supplementary-PDF.pdf AND http://www.ask-force.org/web/Organic/Seufert-Excell-Adressen-2012.xlsb

Skar, M., Swensen, G., Dervo, B.K., & Stabbetorp, O. (2008)
Diversity in a Norwegian agrarian landscape: Integrating biodiversity, cultural and social perspectives into landscape management. International Journal of Biodiversity Science & Management, 4, 1, pp 15-31
<Go to ISI>://BIOSIS:PREV200800439468

Slavo Mac (20110824)
Complexity Theorists Predict Food Crisis, Riots and Civil Unrest By April 2013. In SHTFplan.com.
http://www.shtfplan.com/contact-us ftp://server18.hostpoint.ch/www/ask-force.org/web/Developing/Slavo-Complexity-Theorists-Riots-20110424.pdf AND http://www.shtfplan.com/forecasting/complexity-theorists-predict-food-crisis-riots-and-civil-unrest-by-april-2013_08242011

Slingerland, M.A., Klijn, J.A.E., Jongman, R.H.G., & van der Schans, J.W. (2003)
The unifying power of sustainable development. Towards balanced choices between People, Planet and Profit in agricultural production chains and rural land use: the role of science., Wageningen University pp 1-94 WUR-report Sustainable Development Wageningen (Report)
http://www.botanischergarten.ch/Discourse/Slingerland-Unifying-Power-2003.pdf

Slingerland, M.A., Traore, K., Kayode, A.P.P., & Mitchikpe, C.E.S. (2006)
Fighting Fe deficiency malnutrition in West Africa: an interdisciplinary programme on a food chain approach. Njas-Wageningen Journal of Life Sciences, 53, 3-4, pp 253-279
<Go to ISI>://000238275500002 http://www.botanischergarten.ch/Africa-Harvest-Sorghum-Lit-1/Slingerland-Deficiency-Sorghum-2006.pdf AND http://www.botanischergarten.ch/Facultyof1000/Slingerland-F1000-2006.pdf

Smyth, S. & McHughen, A. (2008)

Regulating innovative crop technologies in Canada: the case of regulating genetically modified crops. Plant Biotechnology Journal, 6, 3, pp 213-225
<Go to ISI>://WOS:000253760500001 AND http://www.ask-force.org/web/Regulation/Smyth-McHughen-Regulating-Innovative-Crop-Technologies-Canada-2008.pdf

Srivastava, R.C., Singhandhupe, R.B., & Mohanty, R.K. (2004)
Integrated farming approach for runoff recycling systems in humid plateau areas of eastern India. Agricultural Water Management, 64, 3, pp 197-212
<Go to ISI>://000188209800002 AND http://www.botanischergarten.ch/Integrated/Srivastava-Integrated-Farming-Approach-2003.pdf

Stobbelaar, D.J., Kuiper, J., van Mansvelt, J.D., & Kabourakis, E. (2000)
Landscape quality on organic farms in the Messara valley, Crete: Organic farms as components in the landscape. Agriculture, Ecosystems & Environment, 77, 1-2, pp 79-93
http://www.sciencedirect.com/science/article/B6T3Y-3Y21TSP-7/2/2dc1680ee31269f18c5f7b854bd6a06e AND http://www.botanischergarten.ch/Organic/Stobbelaar-Landscape-Evaluation-2000.pdf

Sunilkumar, G., Campbell, L.M., Puckhaber, L., Stipanovic, R.D., & Rathore, K.S. (2006)
From the Cover: Engineering cottonseed for use in human nutrition by tissue-specific reduction of toxic gossypol. PNAS %R 10.1073/pnas.0605389103, 103, 48, pp 18054-18059
http://www.pnas.org/cgi/content/abstract/103/48/18054 AND http://www.botanischergarten.ch/Cotton/Sunilcumar-Cottonseed-PNAS-2006.pdf

Swaminathan, M.S. (1968)
The age of algeny, genetic destruction of yield barriers and agricultural transformation.Presidential Address, Agricultural Science Section, Varanasi, India. Proc. Indian Science Congr.,, 55th Indian Science Congr.Jan. 1968., Ed. pp

Swaminathan, M.S. (2001)
Biotechnology, genetic modification, organic farming and nutrition security. Phytomorphology, Golden Jubilee Issue 2001, pp 19-30
<Go to ISI>://BIOSIS:PREV200200297086 AND http://www.ask-force.org/web/Swaminathan/Swaminathan-Biotech-Organic-2001.pdf

Swaminathan, M.S. (2006)
An Evergreen Revolution. Crop Sci, 46, 5, pp 2293-2303
http://crop.scijournals.org/cgi/content/abstract/cropsci;46/5/2293 AND http://www.botanischergarten.ch/Swaminathan/Swaminathan-Evergreen-2006.pdf

Tait, J. & Barker, G. (2011)
Global food security and the governance of modern biotechnologies. EMBO Rep, 12, 8, pp 763-768
http://dx.doi.org/10.1038/embor.2011.135 AND http://www.ask-force.org/web/Regulation/Tate-Global-Food-Security-Europe-2011.pdf

Terrance Hurley M., Paul D. Mitchell, & George B. Frisvold (2009)
Characteristics of Herbicides and Weed-Management Programs Most Important to Corn, Cotton, and Soybean Growers. AgBioForum, 12, 384, pp 269-280
http://agbioforum.org/v12n34/v12n34a03-mitchell.pdf AND http://www.ask-force.org/web/BioEconomy/Hurley-Characteristics-Herbicides-Weed-Management-2009.pdf

Traynor, P.L., Adonis, M., & Gil, L. (2007)
Strategic approaches to informing the public about biotechnology in Latin America. Electronic Journal of Biotechnology, 10, 2, April 15, pp 1-9
DOI: 10.2225/vol10-issue2-fulltext-12 AND http://www.ask-force.org/web/Brazil/Traynor-Strategic-Approaches-Public-2007.pdf

Trewavas, A. (2008)
The cult of the amateur in agriculture threatens food security. Trends in Biotechnology, 26, 9, pp 475-478
http://www.sciencedirect.com/science/article/B6TCW-4T44GKV-1/2/892978a0be860356838a6234bc155d3e AND http://www.botanischergarten.ch/Food/Trewavas-Cult-Amateur-2008.pdf

Twardowski, T. & Malyska, A. (2012)
Social and legal determinants for the marketing of GM products in Poland. New Biotechnology, 29, 3, pp 249-254
http://www.sciencedirect.com/science/article/pii/S1871678411002822 AND http://www.ask-force.org/web/Regulation/Twardowski-Social-Legal-Marketing-Poland-2012.pdf

UN-Report-Common-Future (1987)
Our Common Future, Chapter 2: Towards Sustainable Development, United Nations pp 21 From A/42/427. Our Common Future: Report of the World Commission on Environment and Development Geneva (Report)
http://www.un-documents.net/ocf-02.htm#I AND http://www.botanischergarten.ch/Sustainability/UN-Our-Common-Future.PDF

Weed Science (2012)

Electronic Source: International Survey of Herbicide Resistant Weeds, published by: Funded and Supported by the Herbicide Resistance Action Committee (HRAC), the North American Herbicide Resistance Action Committee (NAHRAC), and the Weed Science Society of America (WSSA),
http://www.weedscience.org/In.asp

Williams Amy Lavin, Watson Rebecca E., & DeSesso John M. (2012)
Developmental and Reproductive Outcomes in Humans and Animals After Glyphosate Exposure: A Critical Analysis. Journal of Toxicology and Environmental Health, Part B, 15, 1, pp 39-96
http://dx.doi.org/10.1080/10937404.2012.632361 AND http://www.ask-force.org/web/HerbizideTol/Williams-DeSesso-Developmental-Glyphosate-2011.pdf AND Correspondence: http://www.ask-force.org/web/HerbizideTol/Williams-Belle-Correspondence-Toxicology-2012.pdf

Yokoi, Y. (2000)
Effects of Agricultural Activities on the Ecosystem, OECD pp 7 Agriculture and the Ecosystem, Chapter 11 Paris (Report)
http://www.ask-force.org/web/Sustainability/OECD-Effects-Agri-on-Ecosyst.pdf