TAILORING BIOTECHNOLOGIES
Vol. 1, Issue 2, Nov. 2005, pp: 81-106

A Critical Observation on the Mainstream Discourse of Biotechnology for the Poor

Shuji HISANO

Abstract

Since the late 1990s, when massive backlash against genetically modified organisms emerged worldwide, the mainstream political economic powers, i.e., the US government and transnational biotech companies, have been actively and deliberately engaged in the discourse of biotechnology for the poor to combat world hunger. This line of discourse has been endorsed at several international gatherings as well as in epistemic communities. The objective of this paper is to sort out and critically analyze the discourse put forward by the mainstreamers. Within the hegemonic political, economic, legal, and ideological setting of biotechnology development, we need to look for room for maneuver so that we can carefully make out alternative perspectives and frameworks to reappropriate and redesign biotechnology to fit in the socioeconomic and bioenvironmental context of the resource-poor in the developing world. In order for this analysis to be theoretically reflected, we will refer to Antonio Gramscis concept of hegemony and counter-hegemony, as well as Andrew Feenbergs concept of democratic rationalization.

1. Increasing discourse of biotechnology for the poor

Since the late 1990s, when a massive backlash against genetically modified organisms (GMOs) emerged worldwide, the mainstream political economic powers, i.e., the US government and transnational biotech companies, have been actively and deliberately engaged in the discourse of biotechnology for the poor to combat world hunger. This line of discourse has been endorsed at several international gatherings, including the international conference on biotechnology convened by the Consultative Group on International Agricultural Research (CGIAR) and the US National Academy of Sciences and co-sponsored by UN organizations in October 1999. The proceedings of this conference were published as *Agricultural Biotechnology and the Poor*

(Persley and Lantin, eds., 1999). While heated debate remains on the safety of GMOs, the discourse of biotechnology for the poor has been consistently pushed ahead and has gradually penetrated into the international community:

> The topic of global hunger has become a prominent backdrop for the worldwide debate over genetically modified food crops. The possible use of biotechnology to boost food production and quality in developing countries has become a focal point for biotechnology advocates and critics alike (Pew Initiative, 2004).

It was under such a circumstance that the UN Development Program (UNDP) released the controversial *Human Development Report 2001* (UNDP, 2001). This report, subtitled *Making new technologies work for human development,* is focused on "the way that biotechnology and information and communications technology can transform lives in developing countries". The report clearly says that many developing countries might reap great benefits from GMOs. While it acknowledges that there are environmental and health risks that need to be addressed (Fukuda-Parr, 2001), it stresses the unique potential of the technology, urging far greater public investment in research and development to ensure that biotechnology meets the agricultural needs of the world's poor. As was to be expected under ongoing pro/con conflicts over GM technology, this report generated strong reactions from a number of non-governmental organizations (NGOs) (e.g., PAN-AP, 2001) as well as from prominent critics (e.g., Shiva, 2001). On the other side of the conflicting views, this report was welcomed as a "timely and constructive review of the potential for biotechnology to help some of the world's poorest communities" (Monsanto, 2001).

The discourse of biotechnology for the poor, as well as the resulting pro/con debate about it, was renewed in May 2004 when the UN Food and Agriculture Organization (FAO) launched its annual report *The State of Food and Agriculture 2003/04,* featuring its focus on "the potential for agricultural biotechnology to address the needs of the world's poor and food-insecure" (FAO, 2004). The answer FAO supplies to the question of "whether agricultural biotechnology can meet the needs of the poor" is largely affirmative. Although it also points out that the "gene revolution" is not a panacea and needs to be approached cautiously, the report has received a big welcome from proponents. As shown in an open letter to the Director-General of FAO signed by more than 650 civil society organizations and 800 individuals (ETC Group, 2004), FAO is now strongly criticized for marking a radical departure from its

1 Indeed, FAO has always claimed that we need to pay more attention to diverse forms of biotechnology, such as molecular marker assisted selection, tissue culture technique, and other feasible biotechnologies. This line of discussion is especially espoused by Louise O. Fresco, Deputy Director-General of FAO (Fresco, 2003).

previously cautious approach to technology[1] . It is certain that FAO does not give good definitive answers to the questions of what technologies should or can be developed and in whose hands. Therefore, it is still relevant to ask the same question: Is it possible to develop feasible biotechnologies that address the real problems of the resource-poor?

What we need to do now is not to throw the baby out with the bath water, but to carefully evaluate the discourse of biotechnology for the poor and disentangle and salvage positive messages out of the discourse. This framing of the issue is pressing; otherwise, even concerned scientists and administrators, as well as those who have a more moderate and nuanced stance, would find it difficult to keep their position away from the influence maneuvered by the mainstreamers. The discourse of biotechnology for the poor is somewhat convincing, at least ostensibly, given the fact that an additional 2 billion people will have to be fed over the next 30 years from an increasingly fragile natural resource base and that more than 800 million people are chronically hungry (FAO, 2004).

The objective of this paper is to sort out and critically analyze the discourse put forward, as well as what has been actually pursued, by the mainstreamers. This analysis is meant to understand the ideological background against which we have to carefully make out alternative perspectives and frameworks to reappropriate and redesign biotechnology to fit in the socioeconomic and bioenvironmental context of the resource-poor in the developing world as Tailor-made Made Biotechnologies (TMBT) Network Project is aiming to do (Ruivenkamp, 2003a)[2] . In this regard, we need to look for room for maneuver within the hegemonic political, economic, and legal setting of biotechnology development. Otherwise, ambitious endeavors for alternatives such as the TMBT-network might go down to another fragmented niche project, as ubiquitously seen at the local level. Because of a lack of space, however, this paper won't look at international legal and political frameworks that are considered critical to redirect the path of biotechnology development, such as intellectual property right (IPR) regimes and biosafety regulation. Instead, this paper will focus on the mainstream discourse: how it has been (re)produced and in turn has structured the course of biotechnology development. To do so, I will draw upon Antonio Gramsci's concept of hegemony, since it enables us to grasp the nature of ideology in contemporary capitalist societies in which ideological factors are of great importance in affecting social and political relations by reproducing and legitimizing a particular set of interests as a common

2 The idea and activities of the TMBT project is also outlined in the first issue of this journal (Ruivenkamp, 2005).

view or general interests (Gramsci, 1971). Additionally, out of this concept we can understand the possibilities, or room for maneuver, to challenge the hegemony: counter-hegemony, which is not just meant to work against the dominant cultural assumptions, but rather to work for the creation of new social relations. In addition to Gramsci's concept, by referring to Andrew Feenberg's concept of democratic rationalization (Feenberg, 1999), I'd like to open a theoretical window through which the concept of the TMBT-network can be developed further.

2. The method and context in which mainstreamers put forward the discourse

As mentioned earlier, proponents of GM technology claim that GM crops will feed the world by increasing agricultural yields, and malnutrition will be overcome by developing "functional foods" such as provitamin-A-enhanced rice (Golden Rice). Millions are being spent on advertising and PR campaigns across the world to persuade consumers and policy makers to accept GM crops. The most outstanding example of PR campaigns counting on the discourse of biotechnology for the poor was aggressively but tactically launched by Monsanto Europe in the summer of 1998 in light of rapidly growing criticism and skepticism against GM technology among European citizens. Entitled *Let the Harvest Begin,* it was signed by some 50 prominent scientists and policy makers from developing countries.

> As we stand on the edge of a new millennium, we dream of a tomorrow without hunger. To achieve that dream, we must overcome many hurdles, including poverty, distribution, water supply, soil erosion, and crop disease. Biotechnology alone cannot address all of these hurdles, but it is an important tool in our hands today. We know advances in biotechnology must be tested and safe, but they should not be unduly delayed.

This advertising message was swiftly responded to and criticized by the African delegates to FAO's Commission on Genetic Resources. The counter-statement, entitled *Let Nature's Harvest Continue,* strongly objected that "the image of the poor and hungry from our countries is being used by giant multinational corporations to push a technology that is neither safe, environmentally friendly, nor economically beneficial to us" (cited in Paul and Steinbrecher, 2003).

Nevertheless, similar PR messages have been widely circulated and have appeared repeatedly in mainstream scientific and popular journals, other media, policy documents, and other sources around the world. Seven

Academies of Science, led by the US National Academy of Science, for example, urged action to promote the use of GM technology in alleviating world hunger and poverty (Seven Academies of Science, 2000). These claims made by mainstreamers are so compelling that we are almost led to believe that there is an "ethical obligation" (Nuffield Council on Bioethics, 2003) and only "ideological or pseudo-scientific reasons" can be given for opposing their acceptance and holding up research into "potential solutions", and that we could be blamed of being "irresponsible and immoral" (Prakash, 1999).

But it cannot be presumed if-and how-highly sophisticated, patented, and expensive tools and technologies can be applied to even more diversified, complex, and marginalized conditions of many localities. Also, when we look at a variety of alternative approaches available to address the problems resource-poor farmers in the developing world are facing, we can raise a legitimate question about the potentiality and feasibility of biotechnology to feed the hungry. That's why the discourse, however accompanied by an ethical point of view, should be the subject of inquiry, as this paper is aimed.

Reality of "Molecular Divide"

There exists "a sharp dichotomy between developed and developing countries" in terms of agricultural biotechnology research expenditures (FAO, 2004). It is roughly estimated that the crop biotechnology research and development (R&D) in developed countries, including both public and private sectors, amounts to $1,900-2,500 million a year, while only $165-250 million is spent in developing countries (Byerlee and Fischer, 2002). More noteworthy is the fact that a handful of transnational biotech companies influence agricultural biotechnology R&D. For example, Monsanto invested $527 million in R&D (2002), more than 80 percent of which was directed to the seed business. Syngenta spent $727 million in R&D (2003), out of which $127 million was spent on seed development and $146 million on plant science research. DuPont's total R&D expenditure reached $1,349 million in 2003, 43 percent of which was directed to agricultural science. The magnitude of private-sector investment in agricultural biotechnology R&D is vaster than these amounts would suggest, given that the CGIAR, which is the largest international public-sector supplier of agricultural technologies, has a total annual budget of less than $300 million for plant improvement R&D, including around $25 million for biotechnology R&D, in developing countries (FAO, 2004).

The private-sector biotechnology R&D has been largely dedicated to developing GM crops with traits that are of significance to the commercial

market in agricultural exporting countries, whether developed or developing (i.e., the US, Argentina, Canada, Brazil), with the exception of China. It is estimated that the most widely grown GM crops are soybean (61.2%), maize (22.9%), cotton (10.6%), and canola (5.3%), with the trait of herbicide tolerance (73.4%), insect resistance (18.0%), or both (8.6%) (James, 2004). Almost all of them are developed and distributed directly or indirectly by a handful of biotech companies (i.e., Monsanto, Syngenta, DuPont, Bayer, and Dow AgroSciences).

Furthermore, it is worth noting that the means of biotechnology R&D are also controlled by those same companies. A survey conducted by a team of University of California researchers shows that the private sector holds 74 percent of agricultural biotechnology patents, with 41 percent of them owned by the big five (Graff et al., 2003). It is also mentioned that many of the fundamental methods for transferring genes into plant cells, including the use of *Agrobacterium,* were developed in the public sector, but the rights to those technologies have, to a large extent, been licensed exclusively to private companies, who in turn have concentrated their patenting on application-based technologies for established product lines (Ibid.). This kind of technology transfer between the public and private sectors is increasing, especially in the US and some other developed countries (Fuglie and Schimmelpfenning, 2000).

As has long been acknowledged by the international and academic communities, the private sector's interests are not paid on public-good research (e.g., crop improvements) of relevance to small-scale farmers and to complex tropical and subtropical environments. Given the private sector's lack of interest in the needs of the poor, what is required to legitimize the mainstreamers' discourse is to pay attention to the critical role of "honest brokers" such as FAO, the CGIAR and other multilateral organizations aiming for pro-poor technologies while addressing public concerns about potential risks of GMOs on human health and the environment. For example, Seven Academies of Science (2000, p.24) recommends governments, international organizations, and aid agencies to increase public funding for public-good research in both the CGIAR and national research institutions.

In spite of such recommendations, expectations, and optimistic views on the role of international and national institutions, the reality is that the growth rate of public expenditure on agricultural research slowed dramatically during

3 This situation has been brought about under liberalization, structural adjustment programs, privatization, and economic globalization policies. It is ironic that the same political economic powers who have propelled such policies are now advocating an increase in funding for national and international public research.

the 1990s in many developing countries (Pardey and Beintema, 2001). Also, international donor and aid agencies no longer give agriculture, and with it agricultural R&D, the attention they once did (Ibid.)[3] . As a result, funding for CGIAR centers has stagnated in real terms (World Bank, 2003). This has widened the gap between public and private research, between research priorities and needs, between developing and developed countries, and between poor and rich farmers. It has become a "molecular divide" (Fresco, 2003). Against these trends, it is quite logical that the same line of documents suggests that the challenge is "how to bridge the gap between the interests of the public and private sectors and redefine their roles" (Persley and Lantin, 1999, p.17).

3. Public-private partnerships for technology transfer: beyond the discourse

Public-private collaboration is generally expected to bridge the gap in biotechnology R&D by facilitating the transfer of technology and expertise from developed countries to developing ones (Kameri-Mbote et al., 2001). While relationships between universities and industries and between public research institutions and private companies have existed in developed countries since the 1980s, it is still an untried challenge to bring relevant actors into public-private partnerships for biotechnology in developing countries.

Byerlee and Fischer (2002) analyze the relevance of four broad options for public policy: (1) leave technology transfer entirely in the hands of the private sector, (2) develop a public program independent of the private sector (especially in areas where the private sector is not engaged), (3) negotiate to access relevant proprietary technologies through a range of commercial and non-commercial arrangements such as material transfer, licensing agreements, and market segmentation, and (4) negotiate public-private alliances and joint ventures to develop appropriate technologies. The latter two options fall into the concept of public-private partnerships, and given a lack of resources and capacities on the side of the public sector, are likely to be chosen as effective measures for each sector to contribute to solving problems in developing countries.

Potentially, public-private partnerships represent a more effective means of addressing large and complex research problems in developing country

4 It might be instructive to be reminded here that, under the ever-increasing pressure of neo-liberal globalization, these kinds of institutional arrangements to keep or attract private investments (mainly those of transnational companies) is also expected from governments and the private sector, even in developed countries, as termed "national competitive state" by Hirsch (1995).

agriculture because they combine intellectual resources with human capital, financial resources, institutional support, and complementary, synergetic potential. (Spielman and van Grebmer, 2004, p.36)

To this end, however, governments and public sector organizations in developing countries need to put in place a wide array of institutional arrangements, such as enactment and enforcement of more efficient biosafety regulations and stronger intellectual property rights; provisions of sound infrastructure, services, and tax incentives; and efficient markets for agricultural technologies (e.g., liberalization of government monopolies) (Kameri-Mbote et al., 2001)[4] . This is because existing institutional settings are believed to impede private investments necessary for the international transfer of biotechnology innovations. Kameri-Mbote and her colleagues go on to say that "Developing countries should depart from the tradition of viewing the private sector as being made up of profit propelled establishments. The sector should be viewed and acknowledged as a utility player in biotechnology research and development" (Ibid., p.24). Before giving careful consideration to such a political implication, we consider some examples of public-private partnerships already implemented in developing countries.

CGIAR

In 1995, the CGIAR established and convened a private sector committee (PSC) and a civil society committee (NGOC) as a means of improving the dialogue among stakeholders. This was part of the process toward the Third System Review of the CGIAR. Despite all the efforts of the NGOC to incorporate its alternative viewpoints, the review report largely followed the proposal of the PSC and called for intensified commitment to biotechnology R&D, intellectual property rights (IPR), and greater partnership with the private sector (GRAIN, 1998; German NGO Forum, 1999).

In CGIAR-private sector collaborations, proprietary genes and technologies have usually been provided free of charge. Also, the products, if successfully developed, could be available in segmented markets at a cheap price or free of charge. Theoretically, this kind of technology transfer could allow proprietary technologies to be applied to typical subsistence crops of significance to resource-poor farmers and be made available to them. However, few technologies for these crops have been successfully developed and transferred so far.

Furthermore, the case of the Golden Rice project, in which 71 patented technologies owned by 32 different companies and universities are involved

(Potrykus, 2000), shows the difficulty of dealing with IPR and biosafety issues, as well as the technical difficulty in achieving the level of development needed to put it into practical use. Although the Golden Rice Humanitarian Board, established in 2000, has been working on negotiations to make the rice freely available to national and international agricultural research centers, whether Golden Rice provides either the most effective or the most desirable solution to the vitamin A deficiency (VAD) problem is open to question. For example, this project has been criticized on the grounds that we already know low-risk and low-cost solutions, such as encouraging farmers to go back to growing indigenous, familiar, vitamin A-rich plants among their main crops, a practice wiped out by the "Green Revolution" (MASIPAG, 2000).

Another worry is how genetic and other resources, held and managed by CGIAR centers, will be used and capitalized on through their partnerships with the private sector. A recent case of public-private partnership involving the ICRISAT (International Crops Research Institute for the Semi-Arid Tropics), India, shows that a key motivation for CGIAR centers to move into partnerships with the private sector is their lack of money (GRAIN, 2004). In exchange for providing financial resources and proprietary technologies, private partners have exclusive access to the resources of the centers, namely, the vast genetic resources, researchers, facilities, and test fields.

ISAAA

In order to support the search for collaboration possibilities, several brokering institutions have been established. Since its establishment in 1991, the International Service for the Acquisition of Agri-biotech Applications (ISAAA) has been among them. ISAAA has played a crucial role in "the transfer and delivery of appropriate biotechnology applications to developing countries and the building of partnerships between institutions in the South and the private sector in the North, and by strengthening South-South collaboration" (ISAAA, 2002). ISAAA-brokered projects are well documented in Alvarez (2000).

The case of the CINVESTAV (Centre of Research and Advanced Studies, Mexico) and Monsanto collaboration on the virus-resistant potato project is critically analyzed by Commandeur (1996) and Qaim (1998). Ironically, potatoes are predominantly grown by large- and medium-scale farmers in Mexico. Even for small potato farmers, the technology donated by Monsanto in 1991 didn't make sense because it was developed to cope with two kinds of potato viruses that are not the most pressing problems there. Another transfer was

made in 1997 for a potato-virus-resistant gene that is also of relatively minor importance when compared with leaf blight and other structural problems. Additionally, it is pointed out that there is a lack of a mechanism, such as a formal seed market or public technological assistance programs (i.e., extension services), to reach small-scale farmers with new varieties to ensure regular renewal of certified seed potatoes.

The case of the KARI (Kenyan Agricultural Research Institute) and Monsanto collaboration on the virus-resistant sweet potato project has been held up worldwide as an example of how GM crops will help revolutionize farming in Africa. However, as of 2004, three years of field trials have shown that GM sweet potatoes modified to resist a virus were no less vulnerable than ordinary varieties, and sometimes their yield was lower. The GM project has cost Monsanto, the World Bank, and the US government an estimated $6 million over the past decade. In his research on GM crops in sub-Saharan Africa, DeGrassi (2003) concluded that "Virus-resistant sweet potatoes are not demand driven, site specific, poverty focused, cost effective, and institutionally and environmentally sustainable". Embarrassingly, in Uganda, conventional breeding has produced a new, high-yield, virus-resistant variety of sweet potato in just a few years and at a small cost (Ibid.).

Although the ISAAA describes its activities as "a demand-driven program that responds to the priority needs of target national programs in Africa, Asia, and Latin America", the strategy is rather to focus on the introduction of near-term biotechnology applications that already have been tested in developed countries (ISAAA, 2002). Its programs are also directed at promoting public acceptance of the technology through publications, seminars, workshops, and most importantly, its fellowship programs. According to its critics, the fellowship programs are intended to build up an advocacy elite network "to create the regulatory environment for the successful introduction of corporate biotechnology from the North" (GRAIN, 2000).

USAID

The US Agency for International Development (USAID) is another important broker. In the 1990s, USAID introduced a new program designed to integrate management and technology transfer issues with biotechnology R&D and training (Lewis, 1999). Since then, USAID has directly supported several public-private collaborative research programs, mainly through the Agricultural Biotechnology Support Program (ABSP), which has been largely focused on institutional capacity-building for the use and management of

biotechnology R&D (i.e., intellectual property rights and biosafety regulation). In its collaborative projects, developing awareness and understanding of IPR plays an increasingly important part. "The absence of patent protection does mean that some companies will not transfer certain technologies or certain crop applications" (Ibid., p.198).

During the past few years, African countries have emerged as the frontier for biotechnology transfer in a new sense, especially in light of the political turmoil over the recent food crisis in Southern African countries and their rejection of GM food aid from the US. For example, ABSP launched the Southern Africa Regional Biosafety Program in 2000 to provide technical training in biosafety regulatory implementation. Moreover, a new program called the Program for Biosafety Systems (PBS) was announced in May 2003 to award $14.8 million to assist developing countries, mainly in Africa, in enhancing their biosafety policies, research, and capacities (ISNAR, 2003). However, it is cautiously anticipated that every attempt of this kind will be made to ensure that biosafety regulations are consistent with the US interpretation of the WTO rules rather than the Biosafety Protocol (Masood, 2003).

Another example of USAID brokering activities is the African Agricultural Technology Foundation (AATF), which was established in July 2002 in cooperation with the Rockefeller Foundation, the UK Department for International Development (DfID), and biotech companies (Monsanto, DuPont, Dow AgroSciences, and Syngenta). Although its website states that it will link "the needs of resource-poor farmers with potential technological solutions" (AATF website, accessed in August 2004), another website claims that "the goal of the AATF will be to work…to negotiate the sales rights of genetically modified crops and bring new agricultural technologies to the African market" (Oryza.com, 2004).

Bt cotton as a Trojan Horse?

It is clear from the above examples that the conventional model of public-private partnerships implemented within the CGIAR centers and/or brokered by ISAAA and USAID has prioritized the transfer and dissemination of proprietary biotechnology applications-GM technology and crops-already tested or even commercialized in developed countries. Bt cotton is the only GM crop that is now commercialized in developing countries. Indeed, Bt cotton in South Africa has been heralded as an African success story by the biotech industry. While a well-cited study, focusing on the agricultural economics of Bt cotton based on premature data in 1998-1999, had proclaimed huge yield

increases for Bt cotton farmers in Northern KwaZulu Natal, South Africa (Thirtle et al., 2003), it is now widely recognized that Bt cotton has not proved to be sustainable in reducing pesticide use nor in improving income for farmers (Pschorn-Strauss, 2005).

Furthermore, the hype of Bt cotton in India has also been watered down by a three-year field assessment in the villages of Andhra Pradesh as well as sporadic reports from other states. The study conducted in Andhra Pradesh (Qayum and Sakkhari, 2005) found that Bt cotton has largely failed. Farmers had to spend more (no reduction in pesticide use, three to four times more expensive seeds, 12 percent higher total cultivation costs), yet suffered lower yields (30 percent less than non-Bt cotton). Such outcomes were more or less expected from the outset, since it is quite logical that increasing reliance on a single gene in growing a variety of crops to make them resistant to certain insects could not be sustainable. Also, small, resource-poor farmers have long been squeezed between rising input costs and stagnant or declining producer prices. They are suffering a continued reduction in domestic support under the growing pressure of IMF/World Bank structural adjustment policies as well as multilateral (WTO) and bilateral agreements, while massive subsidies in the US and the EU allow their large-scale producers and agribusinesses to enjoy competitive advantages in the export market (Greenberg, 2004).

Pschorn-Strauss sees Bt cotton introduced in developing countries as a Trojan Horse: "By having one GM crop in place, it is then possible and far easier to grow other GM crops; the necessary legislation is in place, the relevant scientists are trained up, the idea of genetically modified crops is more acceptable, etc.…Bt cotton has been chosen as a Trojan Horse in Africa and India, as it is perceived as being less controversial (it is not a food crop) and it has been easy to convince farmers with little money to start growing it" (Pschorn-Strauss, 2005, pp.14-15).

Problems with the conventional public-private partnership model

Sticking to this kind of technology transfer model is apt to divert our attention from serious and reflexive discussions as to what types of technologies should and can be applied, in what way, and in whose hands.

First, it is sometimes rightly claimed that modern biotechnology is not *the* option, but *an* option to complement conventional and traditional technologies/knowledge as well as socio-economic interventions. However, as far as technology transfer projects promoted by the mainstreamers through public-private partnerships are concerned, the question of what kinds of technologies

are really demanded by resource-poor farmers to solve their problems is tacitly avoided. Technologies are always there to be transferred and disseminated among developing countries from the beginning. Unfortunately, this is also true of the FAO's report, in which political implications are largely colored by the idea that GM technology is *the* option. As Tripp (2002) clearly points out, no matter what its eventual contribution might be, GM technology is not the only thing standing between resource-poor farmers and secure livelihoods. "Not only is there a need for [complementary] technology, there is also a need to strengthen the institutions that support agriculture" (Ibid., p.241).

Second, while the transfer of proprietary technologies and materials on a top-down basis has been prioritized in the name of "humanitarian aids," other approaches and programs on a participatory, bottom-up basis, such as the Interactive Bottom-Up Approach (IBU), that involve local stakeholders in decision-making on the technology (Ulmanen, 2003) have rarely drawn mainstreamers' attention. Attention should have been drawn to other feasible solutions, such as tissue-culture and molecular-marker-assisted technologies, and to emerging approaches to "the innovative and participatory efforts of various civil society organizations to establish new co-creative relations between biotechnological and endogenous developments to reach those people that have been bypassed by the industrialization of agriculture and green revolution" (Ruivenkamp, 2003a).

Third, contents and directions of the capacity-building strategies needed to promote biotechnology for the poor are also open to question. Based on the above two observations, we can justifiably assume that capacities recommended to be built up in developing countries include those to ensure, or at least stimulate, the interactive and participatory processes to reflect local needs and knowledge, aiming eventually to empower these local stakeholders. However, the FAO report, for example, encourages developing countries to build up a certain set of capacities, such as "more efficient biosafety regulations and stronger IPRs", which are seen as indispensable incentives for private companies to transfer their proprietary technologies. It can be easily imagined that this recommendation would only satisfy the mainstreamers, who have always tried to manipulate international regulatory frameworks to this end.

Lastly, it is commonly assumed that if the technology will be put under the

5 From the late 1990s until 2002, the NGOC, as a representative of civil society organizations (CSOs), struggled to create constructive, rather than antagonistic, relations with the CGIAR (Waters-Bayer, 2001) by regarding it as "a good and useful Work Horse - part of a team of horses clearing the way for food security around the world" rather than as "a Trojan Horse for trade representatives" or "a War Horse advocating CSO policies" (RAFI, 2000). All the efforts of the NGOC to make the CGIAR seriously reflect diverse civil-society voices turned out to be in vain, as was the system review process in 1998. The NGOC then has decided to disengage itself from the CGIAR (Kapiriri, 2003).

management of public research institutions such as CGIAR centers, it must be useful and feasible to resource-poor farmers. What comes into question is the degree to which these public institutions can keep their mandate as a generator and protector of public-good science and technology. This question is seldom asked or answered, though most literature concerning public-private partnerships in biotechnology R&D also acknowledge the managerial difficulty and constraints with actual collaboration (Spielman and van Grebmer, 2004; Rausser et al., 2000). There have been many criticisms against the CGIAR for having changed its mandate from being a publicly funded research body working with broad stakeholders to alleviate poverty and hunger to "an agricultural research outsource for the multinational corporations" (Sharma, 2004)[5] . There is also the skeptical observation that even without being approached by industry, the pressure to be associated with particular developments in industrialized agriculture is so strong that public research institutions carry out the same sort of research as private institutions (Ruivenkamp, 2003b).

4. Room for maneuver to counter hegemony

It is argued that technological developments are built in a process of social construction, negotiations, and decisions, rather than driven by any internal technological logic. While Feenberg's (1999) ideas are based on this line of thought, he does not just analyze the socially contingent nature of technological design. He instead focuses on the unequal distribution of influence over technological design. The design of a given technology is not just shaped by social actors enrolled in a socio-technical network, but rather is structured by a certain institutional arrangement in which not all actors have the same amount of influence in the process. Feenberg employs the concept of a "cultural horizon" to describe how technology is designed and accepted in a way that incorporates the beliefs, values, and norms of the dominant group, while appearing natural, general, and unquestioned to those dominated (Ibid.).

Gramsci (1971) argues that hegemony is where a politically dominant class maintains its position not simply by force or the threat of force, but also by an ideology to win a sort of consent among various social groups-not least the subordinate classes-to the social order maintained under the intellectual and moral leadership of the dominant class. Hegemony as such is produced and reproduced through a network of institutions, social relations, and ideas outside the direct political sphere. This nature of hegemony makes the social meaning (cultural horizon) behind a certain technology invisible once it is translated into technical terms. This explains why a recontextualizing critique

of technology is required to uncover that horizon, demystify the illusion of technical necessity, and expose the relativity of the prevailing technical choices. It also explains why this critique has to be carried out in a political economic context in which the development of technology is inextricably linked to the hegemony of the dominant class.

> It is this hegemony that is called to account, not technology per se, when we point out that today technical means form an increasingly threatening life-environment. It is this hegemony, as it has embodied itself in technology, that must be challenged in the struggle for technological reform. (Feenberg, 1995, p.17)

Coming back to the mainstreamers' discourse of biotechnology for the poor, we can identify multilayered hegemonic strategies for legitimizing their interests on certain developments of biotechnology at the cost of alternative perspectives for biotechnology developments.

Hegemonic strategies by political force or threat of force

A typical example of this hegemonic strategy was in May 2003 when the US government and its allies decided to file a case with the WTO against the EU over its so-called "de-facto moratorium" on approving new GMOs, imposed in 1998. Although this WTO case has an aspect of a transatlantic trade war, as has happened with various agricultural products, there are also other important implications about the appropriateness of safety regulations as well as the discourse of biotechnology for the poor. The latter issue erupted when the US president George W. Bush said this:

> For the sake of a continent [Africa] threatened by famine, I urge the European governments to end their opposition to biotechnology. Acting on unfounded, unscientific fears, many European governments have blocked the import of all new biotech crops. Because of these artificial obstacles, many African nations avoid investing in biotechnology, worried that their products will be shut out of important European markets" (cited from news release from the White House, 2003).

This political threat was crucial at that time because some Southern African countries were suffering from food crises since the previous year and were driven to accept emergency food aid. Bush's statement was made when those African countries declared they would not accept food aid from the US for fear of GMO contamination. Under overwhelming pressure to accept GM food aid, only Zambia held out to the end and overcame its food crisis without GM food aid. When Angola and Sudan faced food crises in early 2004 and

requested that food aid be certified GMO-free or at least be milled, they were denounced by the US government, and since then, constant pressure has been applied to both countries (African Center for Biosafety, 2004).

Hegemonic strategies of forming institutional networks and social relations

As already analyzed before, the establishment of public-private partnerships intermediated by ISAAA and USAID fit into this category. Mainstream philanthropic activities such as the Monsanto Pledge and the Syngenta Foundation are also effective in maneuvering for their hidden agenda. In some cases, these institutional networks are also brokered by mainstreamers' regional lobbying groups, such as AfricaBio, to approach scientists and administrators in developing countries.

Hegemonic strategies of using intellectual and educational tools

To effectively implement the above strategies, the mainstreamers have launched massive tactical public-relation campaigns through their lobby groups, which are disguised as neutral third parties, such as the International Life Science Institute (ILSI), the AgBioWorld Foundation, the International Food Information Council (IFIC), the Council for Biotechnology Information (CBI), and the Biotechnology Institute. These campaigns are targeted at epistemic communities, journalists, school teachers, young students, and direct stakeholders like consumers and farmers. Since January 2000, AgBioWorld has collected endorsements from more than 3,400 international scientists who have signed its Declaration of Support for Agricultural Biotechnology "to improve agriculture in the developing world". Its website proudly says that signers include 25 Nobel Prize winners and other prestigious scientists (http://www.agbioworld.org/ declaration, accessed in August 2005). The Biotechnology Institute has made a strong effort to reach schoolteachers through professional development and support materials, linking and supporting local, grassroots teacher programs, and so on. This institute is also organizing activities, meetings, and conferences to educate international audiences. Both the IFIC and the CBI provide their target groups with many publications and information kits. Not surprisingly, these "non-profit" organizations are funded by and work hand-in-hand with agro-food and biotechnology industries.

All of these hegemonic strategies are usually complemented by lobbying

activities organized by the business sector, such as the Biotechnology Industry Organization (BIO), Grocery Manufactures of America (GMA), the European Association for Bioindustries (EuropaBio), the Business and Industry Advisory Committee (BIAC) to the OECD, CropLife International (formerly Global Crop Protection Federation), and the International Chamber of Commerce's (ICC) Commission on Biosociety.

Counter-hegemonic movements intensifying the pro/con debate

Faced with these overwhelming hegemonic strategies implemented by the mainstreamers, many civil society organizations, as well as individual critics, have been waging an attack on the hegemony, creating and intensifying the pro/con debate. We have witnessed the occurrence of massive social changes: solidarized demonstrations against the globalization project (McMichael, 2000) at the WTO Seattle meeting in 1999, as well as at subsequent meetings in Genoa, Doha, and Cancun; and the networking of international civil society movements such as the World Social Forum in Porto Alegre and Mumbai. Biotechnology issues are considered a core part of these counter-movements against the globalization project (Buttel, 2003). Also, there have been many "voices from the South" raised to counter mainstreamers' public relations campaigns and reveal the falseness of their discourse of "biotechnology for the poor" (Hickey and Mittal, ed., 2003). Finally, we cannot disregard the escalation of biotechnology politics into the international political arena, as in the passage of the Cartagena Protocol on Biosafety in 2000 (which comes into effect in 2003) despite the tremendous influence of the Miami Group and the biotech industry. As long as these struggles can stimulate our concerns about GM technology and our awareness of the falseness of the discourse, we still need such counter-hegemony movements.

However, the more skeptical and critical public opinions about GM technology become, the more deliberate the strategies the mainstreamers work out to countervail skepticism and criticism. It is also probable that as the pro/con debate over GM technology becomes more intense and antagonistic, even those researchers and administrators who rightly gain insight into the social significance of their work through the politicization of biotechnology will find fewer and fewer opportunities to set their reflections into action. If this is the case, they will likely take the side of the mainstreamers who advocate the rationality and soundness of modern science and technology. Or they may be inspired to follow the opposite course and deconstruct agricultural research by challenging "positivist and realist epistemologies" of scientific knowledge

with the intent to reconstruct it elsewhere "along different lines for genuine approaches" towards sustainable agriculture (Kloppenburg, 1991), rather than maneuvering towards democratizing scientific knowledge and technology design processes from within. Although it is correct that farmers' local knowledge should be taken into serious account as an alternative source of knowledge of agriculture production, we should not discount the possibility that scientific knowledge and technologies can be tailored and used to facilitate sustainable and endogenous development of agriculture.

Counter-hegemonic tactics from within to democratize technology

As Feenberg (1999) proposed, we need to conceptualize technology as an ambivalent process, and consequently, as a site of political struggle. Ambivalence means the availability of technology for alternative development in different social contexts with different social consequences, but not in a sense of contingency. Schurman shares this positive perspective of technology development based on her insight into the ambivalence:

> Many of the technological, social, and institutional developments are fundamentally ambiguous. Technologies embody emancipatory as well as oppressive potential, depending on how that technology is deployed, by whom, and for what purposes and on the meanings it is given by those who use it. It is not hard to imagine liberatory and positive possibilities, as well as the more negative scenarios (2003, p.19).

At stake, therefore, is how to democratize the technology and bring out its emancipatory and positive possibilities, not just through its applications but through its very design, to meet the social demands of disadvantaged majorities. As already experienced in the slow but steady progress of international regulatory frameworks, we still need political struggles over institutional reform, since the very process of political struggles can "create opportunities for altering power dynamics and relations in the future through the re-evaluation of existing patterns and the establishment of new norms, regulatory frameworks, and institutional relationships" (Ibid., pp.18-19).

At the same time, the nature of hegemonic strategy should be taken into account to come up with a proper perspective for democratization of technology. According to Gramsci, hegemonic influence is exercised effectively through ideological social institutions (i.e., intellectual and moral leadership). Under such hegemony, the process of social transformation must entail wide-ranging counter-hegemonic cultural activity, rather than (or at least before) confronting head-on the hegemonic social structure. The former strategy is

referred to as a "war of position", in which we need to engage with the logic of the system, or to be "tactically inside and strategically outside the system" (Paulo Freire, cited in Mayo 1999, p.6). This is mainly because it would be effective, however long it takes, to gain influence in the cultural institutions of "civil society", to develop organizational capacity, and to win new allies to transform the system in the end. Certain ideas or ideological statements are turned into facts not only by the power of discourse, but also by gaining control over the social support networks and the material resources of organizations and networks (Bieler, 2001). As long as the social support networks and material resources are under hegemonic control of the mainstreamers, we have to engage in a "war of position" to regain control over the social support networks and material resources in a tactical way.

This idea is compatible with Feenberg's concept of "democratic rationalizations". He took hints from De Certeau's discussion of strategies (institutionalized means of control embodied in social and technological systems) and tactics (responses of the dominated to the dominant codes from within) (Feenberg, 1999). When the dominated cannot escape strategies, only by tactically reacting to the strategies can the dominated find room for maneuver to misappropriate resources, manipulate rules, weaken the control of the dominant, and ultimately alter the framework. Such tactics are possible because what we call the system, or hegemonic social structure, is actually complex and divergent sets of social relations and therefore is fragile and vulnerable to tactical subversion. The concept of "democratic rationalization" is derived from Feenberg's conviction that new technology can also be used to undermine the existing social hierarchy or to force it to meet needs it has ignored. In this relation, he sheds light on user interventions to challenge undemocratic power structures around technology and its design. Such interventions are carried out in different ways, such as (1) public controversies and other challenges mounted by lay actors to force design changes; (2) "innovative dialogue" and "participatory design" through which expert and lay actors may collaborate in creating a technology; (3) the process of "creative appropriation" in which users innovate new functionalities for already existing technologies, as seen in the Internet (Ibid.). All of these must be incorporated in the idea of TMBT-like counter-hegemonic projects, while the last one is supposedly relevant to a possibility to re-appropriate elements of biotechnologies and redesign them to serve resource-poor farmers.

Transformative education to counter hegemony

We need to focus on the role of professionals, scientists, intellectuals, or whatever we call them, in the process of social transformation to challenge the technological hegemony. Gramsci defines "organic intellectuals" as a thinking section of the particular social class to direct and organize its elements (Gramsci, 1971). Aiming for hegemony, those organic intellectuals need to convince "traditional intellectuals", whose role is to produce consensus in civil society.

This focus on the role of intellectuals doesn't mean that the role of lay actors is disregarded in the process. According to Gramsci, hegemony necessarily always involves an educational relationship whereby institutions operating within "civil society" and those agents (traditional intellectuals) associated with them tend to endorse the ideology of the dominant. Gramsci states that adult education (distinguished from formal education) has an important role to play in a "war of position", implying the dual process of education, self-education and social education, in the course of counter-hegemonic projects (Suzuki, 1999). The attention to self-education is based on his understanding of the process of empowerment, in which an individual becomes a transformative actor by embodying critical reflection and self-awareness in the social, political, and economic context of a capitalist society. This insight into the "substance" concept of human nature characterized by conscious and cooperative activity is derived from Marx's theory of alienation, whereby an individual faces a constant contradiction between hegemonic ideology and his/her social experience (or practice) as the subordinate that in turn makes this interface into an inevitable site of ideological struggle. A well-referred concept of human "essence" as the ensemble of social relations should be regarded as the second layer, which can only be attached to the fundamental substance of human nature as a conscious being; otherwise, we cannot understand how individuals are empowered and identified as transformative beings through consciously changing themselves and their social relations. This dialectical synthesis of "substance" and "essence" of human nature into a transformative actor with critical self-reflection is what can be described as the process of empowerment.

What social education and those agents (organic intellectuals) associated with it can do for this process is to intermediate and help this self-education proceed effectively. Because those subordinated find it difficult to develop

6 Their role is especially important when the tactical efforts of counter-hegemonic projects are made to influence global law and policy, about which social scientists and lawyers can play a significant role (Rajagopal, 2003).

views that challenge hegemonic ideas and practices and to unveil the underlying contradictions within the dominant ideology, the role of organic intellectuals is essential. However, this process of self- and social education must be reciprocal, since organic intellectuals and social educators also need their own self-reflection in social, political, and economic contexts. What is more important is the dialectical relation between intellectuals who "know" and the "people-nation" that "feels" (Gramsci, 1971). The former may know but do not always understand or feel, while the latter may feel but does not always know. Intellectuals, in order to know something socially and politically-not merely abstractly or philosophically-must understand it with feeling and passion.

> One cannot make politics-history without this passion, without this sentimental connection between intellectuals and people-nation. In absence of such a nexus the relations between the intellectual and the people-nation are, or are reduced to, relationships of a purely bureaucratic and formal order; the intellectuals become a caste, or a priesthood (Gramsci, 1971, p.418).

In my view, such a nexus is one of those provided in the TMBT-like counter-hegemonic projects. If demands and alternative knowledge of the lay public need to be translated and incorporated into technical codes to gain a broader consensus, it is only by interacting with this dispossessed public that scientific researchers as "organic intellectuals" are expected to contribute. It is therefore crucial to ask whether and how reflexive activities of scientific researchers, whose contributions are also expected in the regulatory and administrative processes[6] , can be stimulated through involvement in counter-hegemonic projects.

5. Conclusion

The aim of such counter-hegemonic projects is not just to criticize and reveal the falseness of the discourse, though such a social critique to expose the contradictions that lie behind the dominant hegemonic discourse remains crucial. What we need further is to develop a discursive as well as institutional setting for reflexive researchers to gain moral and intellectual control over the social support networks and material resources for the alternative purposes, while effectively and persuasively politicizing the hegemonic model of biotechnology development described in the mainstream discourse. This is by no means an easy task. However, it should be remembered that the mainstreamer's ethical discourse of "for the poor" and/or "for the environment"

(albeit for their own interests) cannot help but open up room for critical reflections among those involved. By demonstrating affluent possibilities of alternative biotechnologies to meet the needs of the resource poor, and by connecting organic intellectuals (transformative scientists and administrators) to the dispossessed, or, in other words, by playing a nexus, TMBT-like counter-hegemonic projects are expected to give room for critical reflection among those intellectuals.

> They [researchers] can attempt to grasp again the social significance of their scientific sub-sector. Or the social contrast in the research can eventually stimulate the researchers to 'sub-politicization' of the research to an attempt to actually get insight into the social significance to their work (Ruivenkamp, 2003b, p.36).

References

African Center for Biosafety (2004), GM Food Aid: Africa Denied Choice Once Again? Johannesburg: African Center for Biosafety.

Alvarez, D. (2000), 'Connecting People to the Promise of Biotech: Update ofthe ISAAA Fellowship Program in Africa and Southeast Asia', ISAAABrief, No.14, Ithaca: ISAAA.

Bieler, A. (2001), 'Questioning Cognitivism and Constructivism in IR Theory: Reflections on the Material Structure of Ideas', Politics, Vol.21 (2), pp.93-100.

Buttel, F. (2003), 'The Global Politics of GEOs', in Schurman, R.A. and Takahashi-Kelso, D.D. (eds.), Engineering Trouble: Biotechnology and Its Discontents, Berkeley: University of California Press.

Byerlee, S. and Fischer, K. (2002), 'Accessing Modern Science: Policy and Institutional Options for Agricultural Biotechnology in Developing Countries', World Development, Vol.30 (6), pp.931-948.

Commandeur, P. (1996), 'Private-Public Cooperation in Transgenic Virus-Resistant Potatoes', Biotechnology and Development Monitor, No.28, pp.14-17.

DeGrassi, A. (2003), Genetically Modified Crops and Sustainable Poverty Alleviation in Sub-Saharan Africa: An Assessment of Current Evidence, Accra: Third World Network Africa.

ETC Group (2004), 'Message to FAO: "Fight Hunger - Not Farmers"', News Release from ETC Group, June 16.

FAO (2004), The State of Food and Agriculture 2003/2004 - Agricultural Biotechnology: Meeting the needs of the poor? Rome: FAO.

Feenberg, A. (1995), 'Subversive Rationalization: Technology, Power, and Democracy', in Feenberg, A. and Hannay, A. (eds.), Technology and the Politics of Knowledge, Bloomington: Indiana University Press.

Feenberg, A. (1999), Questioning Technology, London: Routledge.

Fresco, L. O. (2003), 'Which Road Do We Take? Harnessing Genetic Resources and making Use of Life Sciences: A New Contract for Sustainable Agriculture,' an address to the European Forum on "Sustainable Agriculture for Developing Countries: Options from life sciences and biotechnologies", Brussels, January 30-31.

Fuglie, K. O. and Schimmelpfenning, D. E. (2000), Public-Private Collaboration in Agricultural Research: New Institutional Arrangements and Economic Implications, Ames: Iowa State University Press.

Fukuda-Parr, S. (2001), 'UNDP Responds to Critics of HDR 2001 Report', an open letter on Human Development Report 2001, August 7.

German NGO Forum (1999), Public-Private Partnership for Global Food Security? The Cooperation between the CGIAR and the "Life Sciences" Industry, Bonn: German NGO Forum Environment & Development.

Graff, G. D., Cullen, S. E., Bradford, K. J., Zilberman, D. and Bennett A. B. (2003), 'The public-private structure of intellectual property ownership in agricultural biotechnology', Nature Biotechnology, Vol.21 (9), pp.989-995.

GRAIN (1998), 'The CGIAR's System-wide Review', Seedling, Vol.15 (4), pp.2-7.

GRAIN (2000), ISAAA in Asia: Promoting corporate profits in the name of the poor, a paper pre pared by Kuyek, D., available on the website: http://www.grain.org.

Gramsci, A. (1971), Selections from the Prison Notebooks, edited and translated by Q.Hoare and G.N.Smith, New York: International Publishers.

Greenberg, S. (2004), Global Agriculture and Genetically Modified Cotton in Africa, a report for the African Centre for Biosafety, October.

Hickey, E. and Mittal, A. eds. (2003), Voices from the South: The Third World Debunks Corporate Myths on Genetically Engineered Crops, a joint project of Food First, Institute for Food and Development Policy, and Pesticide Action Network North America.

Hirsch, J. (1995), The National Competitive State: State, Democracy and Politics in Global Capitalism, Berlin: Edition ID-Archiv, originally published in German.

ISAAA (2002), ISAAA Brochure, Manila: ISAAA SEAsia Center.

ISNAR (2003), 'Consortium to Support Biosafety in Developing Countries', News Release, June 9.

James, C. (2004), 'Preview: Global Status of Commercialized Biotech/GM Crops: 2004', ISAAA Briefs, No.32, Ithaca: ISAAA.

Kameri-Mbote, P., Wafula, D. and Clark, N. (2001), Public/Private Partnerships for Biotechnology in Africa: The Future Agenda, Nairobi: African Centre for Technology Studies.

Kapiriri, M. (2003), 'The NGO Committee of the CGIAR', a report presented at the Civil Society Workshop on Agricultural Research for Development, Dakar, Senegal, May 20-21.

Kloppenburg, J., Jr. (1991), 'Social Theory and the De/Reconstruction of Agricultural Science: Local Knowledge for an Alternative Agriculture', Rural Sociology, Vol.56 (4), pp.519-548.

Lewis, J. (1999), 'Leveraging Partnerships between the Public and Private Sector: Experience of USAID's Agricultural Biotechnology Program', in Persley and Lantin (1999).

MASIPAG (2000), Grains of Delusion: Golden Rice Seen from the Ground, a joint paper with BIOTHAI, CEDAC, DRCSC, GRAIN, PAN-Indonesia and UBINIG, Los Banos: MASIPAG.

Masood, E. (2003), 'A Continent Divided', Nature, Vol.426, November 20, pp.224-226.

Mayo, P. (1999), Gramsci, Freire and Adult Education: Possibilities for Transformative Action, London: Zed Books.

McMichael, P. (2000), Development and Social Change: A Global Perspective, 2nd ed., Thousand Oaks: Pine Forge Press.

Monsanto (2001), 'Monsanto Welcomes UN Report on Biotech's Benefits for Developing World', Press Release, July 9.

Nuffield Council on Bioethics (2003), The Use of Genetically Modified Crops in Developing Countries: A follow-up Discussion Paper to the 1999 Report, London: The Nuffield Council on Bioethics.

PAN-AP (2001), 'The UNDP Exploits the Poor and Hungry to Push Genetic Engineering', a statement distributed through CropChoice.com, July 26.

Pardey, P. G. and Beintema, N. M. (2001), Slow Magic: Agricultural R&D a Century After Mendel, Washington DC: IFPRI.

Paul, H. and Steinbrecher, R. (2003), Hungry Corporations: Transnational Biotech Companies

Colonise the Food Chain, London: Zed Books.
Persley, G. J. and Lantin, M. M. eds. (1999), Agricultural Biotechnology and the Poor: Proceedings of the International Conference on Biotechnology, Washington DC: CGIAR.
Pew Initiative (2004), Feeding the World: A Look at Biotechnology and World Hunger, Washington DC: The Pew Initiative on Food and Biotechnology.
Potrykus, I. (2000), 'The "Golden Rice" Tale', an article posted on the listserve of AgBioView, October 23.
Prakash, C. S. (1999), 'Feeding a World of Six Billion', AgBioForum, Vol.2 (3&4), pp.223-225.
Pschorn-Strauss, E. (2005), 'Bt cotton in South Africa: the case of the Makhathini farmers', Seedling, April, pp.13-24.
Qaim, M. (1998), 'Transgenic Virus Resistant Potatoes in Mexico: Potential Socioeconomic Implications of North-South Biotechnology Transfer', ISAAA Briefs, No.7, Ithaca: ISAAA.
RAFI (2000), 'In Search of Higher Ground: The intellectual property challenge to public agricultural research and human right and 28 alternative initiatives', RAFI Occasional Paper Series, Vol.6 (1), September.
Rajagopal, B. (2003), International Law from Below: Development, Social Movements and Third World Resistance, Cambridge University Press.
Rausser, G., Simon, L. and Ameden, H. (2000), 'Public-Private Alliances in Biotechnology: Can they narrow the knowledge gaps between rich and poor?' Food Policy, Vol.25 (4), pp.499-513.
Ruivenkamp, G. (2003a), 'Tailor-Made Biotechnologies for Endogenous Developments and the Creation of New Networks and Knowledge Means', Biotechnology and Development Monitor, No.50, pp.14-16.
Ruivenkamp, G. (2003b), 'Genomics and Food Production: The social choices', in van Est, R., Hanssen, L. and Crapels, O. (eds.), Genes for Your Food - Food for Your Genes: Social issues and dilemmas in food genomics, The Hague: Rathenau Institute.
Ruivenkamp, G. (2005), 'Tailor-made biotechnologies: Between Bio-Power and Sub-Politics', Tailoring Biotechnologies, Vol.1 (1), pp.11-33.
Schurman, R. A. (2003), 'Biotechnology in the New Millennium: Technological Change, Institutional Change, and Political Struggle', in Schurman, R. A. and Takahashi-Kelso, D. D. (eds.), Engineering Trouble: Biotechnology and Its Discontents, Berkeley: University of California Press.
Seven Academies of Science (2000), Transgenic Plants and World Agriculture, Washington DC: National Academy Press.
Sharma, D. (2004), 'Agricultural Research: CGIAR turns to outsourcing', an article distributed through GMWatch.org, April 26.
Shiva, V. (2001), 'The Seed and the Spinning Wheel: The UNDP as Biotech Salesman', a statement distributed through biotech-info.net, July 25.
Spielman, D. and von Grebmer, K. (2004), 'Public-Private Partnerships in Agricultural Research: An Analysis of Challenges Facing Industry and the Consultative Group on International Agricultural Research', EPTD Discussion Paper, No.113, Washington DC: IFPRI.
Suzuki, T. (1999), Pedagogy of Empowerment: UNESCO, Gramsci, and Post-postmodern, Tokyo: Hokuju Shuppan (in Japanese).
Thirtle, C. Beyers, L. Ismael, Y and Piesse, J. (2003), 'Can GM-Technologies Help the Poor? The Impact of Bt Cotton in Makhathini Flats, KwaZulu-Natal', World Development, Vol.31 (4), pp.717-732.
Tripp, R. (2002), 'Can Biotechnology Reach the Poor? The adequacy of information and seed delivery', Food Policy, Vol.26 (3), pp.249-264.
Ulmanen, J. (2003), 'Monitoring Biotechnology for Development: Lessons Learnt', Biotechnology and Development Monitor, No.50, pp.17-23.

UNDP (2001), Human Development Report 2001: Making New Technologies Work for Human Development, New York: UNDP.
Waters-Bayer, A. (2001), 'The Process of Change in International Agricultural Research and Development and the Role of NGOs', in Food without Farmers? Agricultural research needs profoundly changed CGIAR, Bonn: German NGO Forum Environment and Development.
World Bank (2003), The CGIAR at 31: An Independent Meta-Evaluation of the Consultative Group on International Agricultural Research, Operation Evaluation Department, Washington DC: World Bank.