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GMOs and the Developing World: A Precautionary Interpretation of Biotechnology

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The subject of genetically modified (GM) products has raised considerable controversy in recent years, especially in developed countries, where it has led to tension over regulatory differences between the United States (US) and the European Union (EU). One aspect of this tension is its impact on developing countries, especially in Africa. The aim of this article is to explore this impact, paying particular attention to GM food aid policy and GM crop growing promotion. We use the theoretical framework of the precautionary principle (PP) to evaluate the issues involved. Our conclusion is that the EU's strong interpretation of the PP in relation to GMOs ('potential difference') currently prevails over the US's weak interpretation of the PP in relation to GMOs ('substantial equivalence') in developing countries, but that this could change as a result of non-GM crop failure and improved performance of GM crops.

Keywords: regulation; biotechnology; precautionary principle; development

1. Introduction

On paper, advances in agricultural biotechnology have great potential for the development of the world's poorest countries. Drought-resistant crops, salinity-resistant crops and crops resistant to specific pests that have blighted the developing world for centuries are all promised outcomes of the agri-biotech revolution. However many countries, developed and developing, have remained unconvinced by the arguments promoting GM technology. Opposition scientists have voiced doubts about the safety of agricultural biotechnology, both in terms of human health and environmental safety; consumers in Europe and Japan are unwilling to purchase GM products; and many governments around the globe remain sceptical about the usefulness, safety and need for GM crops and foods. As a result, very few countries have adopted the technology. The US produces by far the lion's share of GM crops, followed by Canada and Argentina—its co-complainants in the *biotech products* World Trade Organisation (WTO) case against the EU moratorium on GM products. China is the largest market for US GM crops (GAIN 2005a, 3), and has an expanding biotech acreage due to the popularity of Bt cotton, though it lies behind Brazil in terms of GM crop acreage, where an estimated 40–45 per cent of its soybean harvest this year is biotech. However, GM cotton is not yet grown in Brazil, and currently all its GM cotton imports have been suspended, significantly, 'to avoid problems with their exports to the European Union' (GAIN 2005b, 6). In Europe, agri-biotechnology has not been enthusiastically adopted, most GM harvests being

for experimental purposes only, while in Africa, only South Africa commercially cultivates any GM crops.

In 2002, the strength of feeling in developing countries against genetic modification took a serious turn when, in an effort to avoid contact with GM foods and seeds, six African nations refused shipments of food aid containing GMOs (genetically modified organisms). In 2004, two further countries refused GM food aid. This has brought the issue of biotechnology to the forefront of public and governmental attention and renewed the international debate. Opinion regarding the use of GMOs in the developing world is divided, and the divergence revolves around the tension between the US's and the EU's regulatory positions. The question arises of whether, through a weak precautionary interpretation resulting in GM permissive regulation, the US is dumping the unwanted surplus products of agricultural biotechnology on Africa in the guise of food aid; or, whether the EU's stringent application of precaution, manifested in its moratorium on GM products, has forced famine-struck African countries to refuse both agricultural biotechnology and food aid containing its derived produce. On the continuum that is the 'precautionary principle', many African countries appear closer to the EU position in terms of the GMO regulatory system, some rejecting GM food in aid form, and many choosing not to introduce agricultural biotechnology into their farming system.

In section 2, we explain our theoretical framework in terms of the divergent regulatory systems in the US and the EU, focusing on their different interpretations of the precautionary principle (PP): the US's weak interpretation, based on the notion of 'substantial equivalence' between non-GM and GM products vs. the EU's strong interpretation, based on the notion of what we have termed 'potential difference' between non-GM and GM products. In sections 3 and 4, we examine GM food aid policy from the perspectives of the donor and recipient countries, respectively. In section 5, we discuss the impact on developing countries of agricultural technology promotion, and in section 6, we conclude that although the EU's interpretation of the PP is currently dominant in developing countries, that dominance could be undermined by widespread non-GM crop failure (e.g. due to prolonged droughts) and significant improvements in GM crop technology (e.g. in drought-resistant capacity).

2. Two Interpretations of Precautionary Regulation: 'Substantial Equivalence' and 'Potential Difference'

At the heart of the dispute between the EU and the US lie opposing views regarding the nature of genetically modified organisms and the appropriate regulatory regime for them. In the US, the products of agricultural biotechnology are viewed as equivalent to the products of conventional farming. This means that from the outset, GM products have been regulated by existing governmental bodies; no new form of oversight has been developed for the use of GMOs in farming or the marketing of GM foods. By contrast, in the EU, stringent specific legislation has been developed specifically to deal with the new technology, both its 'deliberate release', i.e. use in farming, and its 'food and feed' use.

This divergence over GMO regulation is often characterised as a split between the precautionary principle, employed by the EU, and the sound science principle of risk assessment employed by the US. However, this distinction is misleading, because the US employs precautionary measures in its risk assessments, while the EU has a tradition of scientific robustness as well as a historical use of substantial equivalence for regulation of GMOs. Until 1986, both the US and the EU employed a precautionary approach,[1] but this 'hinge year' (Cantley 1995, 550) saw the US adopt the Co-ordinated Framework for the Regulation of Biotechnology, which acknowledged that 'guidelines have been modified many times with gradual relaxation of ... requirements' (Office of Science and Technology Policy 1995). According to Mark Cantley (2005), 1986 also saw the EU abandon the precautionary principle in favour of a policy of prevention. The truth of the matter is that today both blocs endorse precautionary measures: the US a weak risk assessment-based form of precautionary regulation; the EU a strong set of precautionary legislation.

In the US, since 1986, GMOs have been regulated by a trio of governmental bodies—the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA)—through the Co-ordinated Framework, which links the bodies charged with the regulation of GMOs. The FDA is responsible for food safety; the EPA is responsible for crops that contain, or are used in conjunction with, a pesticide; and the USDA is responsible for agricultural and environmental factors, including field trial administration and confinement of experimental releases. The USDA is also responsible for the deregulation of GM products, a process that involves the submission of information by the biotech company proving the plant is not a 'pest'. If this information is accepted, the GM product is henceforth considered as safe as the equivalent conventional product (Hoffman 2005).

This principle of 'substantial equivalence' first emerged in the early 1990s in response to the need for regulatory oversight of biotechnology, and it is used by the Organisation for Economic Co-operation and Development/Food and Agriculture Organisation (OECD/FAO) as a benchmark for the assessment of GM food safety; the 1996 FAO/WHO joint report states that:

> The OECD has ... advocated that the concept of substantial equivalence is the most practical approach to address the safety evaluation of food or food components derived by modern biotechnology. Substantial equivalence embodies the concept that if a new food, or food component is found to be substantially equivalent to an existing food or food component, it can be treated in the same manner with respect to safety (FAO 1996, 5).

However, it is a difficult criterion to operationalise; as Erik Millstone et al. (1999, 1) note, 'The concept of substantial equivalence has never been properly defined; the degree of difference between a natural food and its GM alternative before its "substance" ceases to be acceptably "equivalent" is not defined anywhere, nor has an exact definition been agreed by legislators'.

Following the 1986 'hinge year' (Cantley 1995, 550), the EU developed its GM legislative framework and was initially happy to adhere to the US principle of

substantial equivalence. Both blocs adopted agricultural biotechnology within the existing structure of intensive farming and viewed GM products as 'like' conventional products (Levidow and Murphy 2003, 51). In the EU, Directive 90/220 EEC regulated the 'Deliberate Release into the Environment' of GMOs, while Regulation EC 258/97 'Concerning Novel Foods and Novel Food Ingredients' was used to authorise foods derived from biotechnology. Both 90/220 EEC and EC 258/97 contained provisions for the authorisation of GM products through a 'simplified procedure', using the principle of substantial equivalence (EU 1990; EC 1997).

But since October 2002, authorisation for the 'Deliberate Release of GMOs into the Environment' has been regulated under Directive 2001/18, revising Directive 90/220, which had been in place since 1990. 'Deliberate release' applies to crops and plants, and the authorisation procedure is divided into two categories: Part B, *experimental release*; and Part C, *commercial release*, including cultivation, importation or transformation of GMOs. For *experimental releases*, the authorisation process is purely national; the request is submitted in the member state where the field trial will take place, and the authorisation applies only in that member state (Europa 2004, 6). The *commercial release* of GMOs is an elaborate process, legislated by Part C of the Directive. When the regulatory framework was strengthened in 2002, Directive 2001/18 introduced Community-level principles for environmental risk assessment; mandatory post-market monitoring of GM products; obligatory provision of information to the public; and requirements for labelling and traceability at all stages of the marketing process (EU 2001). In terms of regulation, the revised Directive brought to an end the use of 'substantial equivalence'-based simplified authorisation procedures outlined in Directive 90/220, article 6 (5), which allowed authorisation 'if the competent authority considers that sufficient experience has been obtained of releases of certain GMOs' (EU 1990). 'Approval for Food Use' has also been revised; it now comes under Regulation 1829/2003 on 'Genetically Modified Food and Feed', which repealed the 'Novel Foods and Novel Food Ingredients' Regulation on 18 April 2004 (EU 2003). This revision ended another simplified authorisation procedure whereby food products or ingredients deemed substantially equivalent could enter the food chain on the opinion of one member state authority.

As this stricter precautionary attitude towards GMOs began to prevail in the EU, approvals slowed, and the idea of introducing a temporary moratorium until changes could be made to the authorisation legislation was bandied about the corridors of decision-making. We can trace the idea of the moratorium to the 1996 decision to revise Directive 90/220, although the actual decision to introduce a de facto moratorium was not taken until June 1999. The moratorium can thus be seen as emerging in a period of uncertainty between the use of legislation based on 'substantial equivalence' and its revision to a regulatory system based on what we have termed a notion of 'potential difference'.

The question arises: why do the US and the EU currently differ over their interpretation of the precautionary principle (PP) in relation to GMOs? As Jonathon Wiener and Michael Rogers (2002, 317) note, the conventional answer to this question is that the EU endorses the PP and 'proactively regulates uncertain risks', while the US 'opposes the PP and waits for evidence of harm before regulating'. But

Wiener and Rogers (2002, 322) rightly reject this answer as too simplistic: although on some issues, such as GMOs, hormones in beef and toxic substances, the EU is more precautionary than the US, on other issues, such as new drug approvals, lead in gasoline and mad cow disease in blood donations, the US is more precautionary than the EU. The fact is that 'neither the US nor the EU is a more precautionary actor across the board' (Wiener and Rogers 2002, 323). What factors, then, make GMOs one of the issues over which the EU is now more precautionary than the US? Wiener and Rogers list a large number of possible factors, three of which we think are telling. First, European consumers are now more susceptible than American consumers to negative perceptions about GMOs, because they have stricter values about what is 'natural', greater fear of the unknown, more recent experience of food scares and deeper distrust of government. Second, the power of green non-governmental organisations (NGOs) and political parties is now greater in the EU than in the US. Third, the EU is using its strong interpretation of the PP as a means of economic protectionism. On this last factor, equally, the US is using its weak interpretation of the PP to promote its own economic interests. More to the point for this article, the EU and the US accuse each other of foisting their respective GMO interpretations on the developing world, with potentially tragic consequences for some developing countries.

In what follows, we will apply these two opposed interpretations of the PP, first, to the issue of GM food aid, from the perspectives of both food aid donor countries (mainly the US) and the recipient countries (mainly in Southern Africa); and second, to the issue of GM crop growing. We conclude that the EU's strong interpretation of the PP presently holds sway in the developing world, though this may change in the future because of environmental and technological developments.

3. GM Food Aid from the Perspective of Donor Countries

Because few developing countries cultivate GM crops, contact with GMOs is, for many of their peoples, currently limited to that contained in shipments of food aid, coming mainly from the US. The US interpretation of GM (that products resulting from agri-biotechnology are substantially equivalent to the products of conventional agriculture) means that GM and non-GM foods are treated by it as the same in terms of donated food aid. Let us look at the practice of US food aid in general, before focusing on its GM dimension.

3.1. The US's Food Aid Policy

Since the mid-1950s, the US has been the 'world's largest provider of food-aid, accounting for some two thirds of the total and amounting to an average of $2bn a year (1992–2002)' (Oxfam 2004). However, the US's food aid programme has been widely criticised. It differs significantly from that of other donor countries in two respects: first, the US is the only country to donate the majority of its food aid 'in kind', rather than in cash; and second, it is 'the only major donor to sell food aid to developing countries, rather than providing it exclusively in grant form' (Oxfam 2005).

Jennifer Clapp (2005, 468) tells us that the 'modern era of food aid was instituted in the US in 1954, with the passage of US Public Law (PL) 480'. Under this law, food aid falls into three categories:

> Title I is government to government aid in the form of concessional sales with the express aim of opening new markets for US grain. Title II is grant food aid distributed in emergencies. Such aid can be distributed via NGOs and the World Food Program (WFP). Title III is government to government grants of food aid for development activities (Clapp 2005, 468).

Clapp (2005, 468, 469) refers to the US food aid policy as a 'multi-purpose tool', for although it is true to its aim of providing 'food deficit countries with food', it is 'also clearly a mechanism for surplus disposal and export promotion', creating a market for surplus agricultural production and thus raising US cereal prices. Indeed, Oxfam (2005, 22) suggests that 'the commercial motive undermines the humanitarian purpose of food aid', pointing out that 'Supporters of US food aid loudly advertise its commercial benefits, as an opportunity to enter new markets, create new tastes for US products, and utilize preferential financing and valuable distribution networks' (Oxfam 2005, 21). USAID (2003) itself openly acknowledges this:

> The principal beneficiary of America's foreign assistance programs has always been the United States. Close to 80 percent of the US Agency for International Development's [USAID's] contracts and grants go directly to American firms. Foreign assistance programs have helped create major markets for agricultural goods, created new markets for American industrial exports and meant hundreds of thousands of jobs for Americans.

However, following the establishment of the WFP in 1963, Clapp (2005, 470) argues that food aid 'by the late 1980s and early 1990s had become largely a development tool, with motivations for donating food governed more by the existence of an international regime (and desire to co-operate) than by donor economic and political considerations'. Although the FAO (2002) disagrees with this time frame, suggesting that 'food aid continued to be associated with the disposal of surpluses throughout the 1980s and 1990s', it agrees that a new trend emerged, as 'countries became much more responsive to the recipients' needs'. Thus, from the late 1990s onward, international food aid provision began to fulfil a humanitarian, developmental role, rather than a self-interested economic role. However, the advent of GM technology in agriculture appears to have reversed this trend. Clapp (2005, 470) states that 'In view of the development of agricultural biotechnology in recent years ... [e]conomic factors may once again be key motivating factors for food aid policy'.

Critics of USAID policy argue, first, that the US should provide cash assistance rather than in-kind food assistance; and second, that the US should provide GM-free food aid for countries that have import restrictions on agri-biotech products. Let us consider these two arguments in turn.

3.1.1. Cash Rather Than In-Kind Food Aid

The argument that the US should give cash aid rather than in-kind food aid is behind the charge that its food assistance is a form of export subsidy. For example,

Peter Mandelson, at a December 2005 trade summit, referred to US food aid policy as '"fake" aid designed to help US farmers rather than the world's poor' (Thornton 2005). He made clear that 'Food aid for poor countries and for emergency relief can be a tool to advance development and for humanitarian relief' (Europa 2005), but he criticised the US's aid policy, stating that 'the large structured US programme of "in kind" food aid is designed in reality to give support to US agricultural producers. It distorts trade and depresses local production. Statistics show that this aid is directly related to the price shifts for the commodities concerned on the US market' (Europa 2005).

US agricultural subsidies allow commodity production to exceed domestic market requirements: 'the US Farm Act of 2002 allows for up to $19bn to be given to national farmers' (BBC News 2004), and USDA figures show that between 1998 and 2004 'soya farming received $13bn in subsidies from the American taxpayer' (Lawrence 2006). Under this subsidised farming system, the US produces agricultural surpluses, and the EU claims that the US now uses export credits and food aid to dispose of these surpluses profitably. The insistence of US government and growers' associations that only 'in-kind' food aid is provided maintains this domestically profitable system.

Critics have argued that such food aid violates WTO rules against export subsidisation (Oxfam 2005, 19), and distorts traditional trade patterns in local food markets of the recipient countries. Concessionally sold food aid, which amounts to 'around 20 per cent of all food aid' (Clapp 2004, 1442), is not targeted at those most in need, and, therefore, finds itself on the local market where it displaces local foods and reduces domestic production, thereby depressing local economies, severing local trade relationships and hampering the ability of current populations and future generations to produce their own food. As a result, export credits and Title I food aid can, if not properly administered, add to debt rather than fulfil development goals.

3.1.2. GM Food Aid

The second argument criticising US food aid policy is that it uses food aid as a 'Trojan horse' to introduce GM crops and foods into developing countries. Greenpeace (2002) argues that USAID is 'at the forefront of a US marketing campaign designed to introduce GM food into the developing world'. Although export subsidy questions have dominated the Doha round of WTO talks regarding food aid, the main reason for the re-politicisation of food aid is the presence of GM varieties of grain in US donations to developing countries. Given that over 60 per cent of food aid donations come from the US, and that from the mid-1990s, US farmers have produced an ever-increasing percentage of GM crops, it is unsurprising that since the late 1990s, the US's food aid donations have contained GMOs. During 2000, for instance, the US donated to relief programmes 500,000 tonnes of maize, of which, USAID claims, it is 'safe to assume 30 per cent was GM' (Walsh 2000).

Once GMOs have made an appearance on the market, and (mostly illegally) in the field, USAID's Program for Biosafety Systems (PBS) can offer assistance to developing countries in the establishment of relevant mechanisms for import and use

of agricultural biotechnology. According to Grain (2005a, 11), this corresponds to the US administration's agenda to help 'steer countries towards the US model' of substantial equivalence, away from the potential difference principle, and 'help policy makers make regulatory "trade-offs" sacrificing comprehensive risk assessments in order to access the "benefits of introducing GM crops into their countries" '.

However, despite the economic advantages that the introduction of GM food to Africa would bring to the US, many still believe the US has truly humanitarian and altruistic aims at heart. One US Department of State official commented:

> There is really no reason to believe that it was part of a US policy to deliver biotech food aid: the US has been delivering maize to the same countries for the last 20 years. The food was non-biotech until recently and then it became biotech; our policy about delivering food aid to countries has not changed (Bobo 2005).

US trade official Robert Zoellick asserts that Americans have been consuming GM produce for nearly a decade and 'no adverse consequences have ever been reported' (Farish 2003). Because the UN WFP stipulates only that food aid meets standards required in the *exporting* country, and because no concerns have been voiced in the US, GM foods are internationally deemed to be suitable for famine aid. And, as the *Economist* (2002, 76) comments, 'compared with the clear and immediate danger posed by malnutrition, the possibility of being poisoned by Frankencorn seems rather remote'.

Moreover, biotech proponents claim that 'the negative perception of agricultural biotechnology in Southern Africa' (Bodulovich 2005, 1074) is due to the strong precautionary position of the EU. Greg Bodulovich (2005, 1074) suggests:

> the European Union's unwillingness to accept GM crops, even in the light of favourable scientific evidence, is having an impact on African development. It is impacting on the improvement of farming practices and restricting the availability of food aid to those suffering food shortages. This is unlikely to change until the EU fully accepts GM crops and an import market for GM produce is established.

The EU's moratorium on the authorisation of new GM crops and foods is thus blamed for Africa's rejection of agri-biotechnology. In 2002–03, US ambassador to the UK, William Farish, blamed Southern African refusal of food aid on 'the EU's unilateral, illegal and unjustified actions, taken without any scientific, health or environmental basis, which constrain choice and opportunity worldwide' (Farish 2003). US critics of EU policy maintained that 'there is no scientific evidence that the GM food is harmful' (Doyle 2002) and that 'the EU moratorium has ramifications far beyond Europe' (Farish 2003). Zoellick accused 'European countries [of] press[ing] Africa to reject the US aid' and called for Europeans to pay attention to 'morals and ethics' (*Ecologist* 2003, 46). In short, the US is accusing the EU of allowing populations in Southern Africa to starve by maintaining an overly strict interpretation of the precautionary principle, which has resulted in a de facto ban on GM products and imports.

This accusation is on two counts, as the *Economist* (2002, 76) explains:

> Africans have two reasons for being wary of GM food aid: one silly, one slightly less so. The silly reason is the suggestion that GM foods are a danger to human health. Americans have been chomping GM maize and soyabeans for seven years, without detectable harm ... The more sensible reason for being wary of GM foods is that there are people who, not being in any danger of starvation, are precious about what they eat. They are called Europeans. And their tastes matter enormously in Africa because countries such as Zambia earn much of their hard currency from agricultural exports to rich countries.

The fear of Southern African governments is that if GM seed imported as food aid is planted, it 'will contaminate their own crops and harm their export potential' (Doyle 2002). For,

> in developing countries, where labelling capacity is weak and where it will cost too much in any case to try to segregate farm products into separate GM vs. non-GM marketing channels, the cheapest way to compete for the business of anti-GM food and feed customers in Europe and Japan is to remain entirely 'GM-free' (Paarlberg 2002, 249).

This leads us to view GM food from the perspective of the recipient countries.

4. GM Food Aid from the Perspective of Recipient Countries

Although it is likely that there has been a GM presence in food aid shipments to developing countries since the widespread adoption of agri-biotechnology in the mid-1990s, the issue did not gain political prominence until several famine-struck countries refused cereal-based aid containing GM grain in 2002. In early 2002, it became clear that the 'the worst food crisis since the 1992 drought' (Zerbe 2004, 594) was about to hit Southern Africa. An estimated 15 million people faced food shortages and famine. Responding to the UN World Food Programme's call for support for the region, the US 'sent some 500,000 tons of whole kernel corn as food aid to the region' (Clapp 2004, 1446) of which it is estimated that 75 per cent contained GMOs. Because, according to USAID, GM and non-GM grain is non-separable, no shipments of food aid could be classed as GM-free, as requested by several drought-struck nations. During the famine of 2002–03, six Southern African countries refused GM food aid: Malawi, Mozambique, Zambia, Zimbabwe, Lesotho and Swaziland all turned back shipments of food aid destined for their starving populations. After consideration, Swazi officials decided to accept the GM food, while 'Lesotho, Malawi, Mozambique and Zimbabwe all asked that GM seeds be milled before distribution to prevent their cross-breeding with local flora' (Michael 2002).

Zambian President Mwanawasa, who had particularly strong views on the issue, referred to GM food as 'poison' (BBC News 2002) and refused such aid, despite 3 million of his people starving (Plaut 2003). Following the refusal of food aid, the US

invited 30 Zambian officials to the US to learn about biotechnology and inspect grain-handling facilities. However, as Jack Bobo (2005) explains,

> they were still unclear about the safety of the food and they felt it could cause long term economic problems for the country i.e. they might not be able to export in the future. Obviously, you could mill it and address that if you were concerned primarily with the export issue, but they decided not to. Ultimately they would not mill the grain, but did not explain to us why that was not an option.

President Mwanawasa stood by his decision, which the US Department of State soon realised was 'a policy position, rather than an information question' (Bobo 2005). Justifying this decision, Mwanawasa is reported to have said that 'the rejection is not intended to demean those who had donated it, rather it was done to protect the long-term interest of the Zambian people and the environment' (Michael 2002). Despite the pressure of famine, Mwanawasa thus persuaded the US that his refusal of GMOs was due not to a misunderstanding of the science behind the 'substantial equivalence' interpretation of agri-biotechnology, but a policy decision to adopt the 'potential difference' interpretation favoured by the EU.

In 2004, a similar situation occurred. Despite food shortages, Sudan requested that food aid be certified 'GM-free'. In December 2004, Angola passed a law banning GMO imports and allowing only milled GM food aid to enter the country. The UN World Food Programme warned Angola that its request for milled donations 'could adversely affect food contributions from donors', stating that 'Some donors have already expressed their intention to reduce donations because of the extra costs the milling would imply' (Reuters 2005). Earthlife (2004) suggests:

> The WFP obviously has learnt very little from the Southern African food crisis [of 2002–03] when several Southern African countries imposed restrictions on GM food aid ... [for] the scenario presented by the WFP and USAID to these African countries, is either they accept GM food or face dire consequences.

What the WFP and USAID failed to acknowledge is that 'Zambia, which imposed an outright ban on the acceptance of GM food aid, not only managed to cope with its crisis, but is now even able to export non-GM food to its neighbours' (*Mail and Guardian* 2004). Greenpeace (2002) revealed that in 2002, non-GM maize was available to Zambia from a variety of local sources: Kenya was able to provide 10,000 metric tonnes, Tanzania 50,000, South Africa 1,020,000 and Uganda 80,000. Evidently, then, the alternative to US-grown GM varieties of corn and soy was not starvation and death.

Defenders of African countries that reject GM grain argue that 'Food security will not be achieved by technical fixes, like genetic engineering. People who need to eat need access to land on which to grow food or money with which to buy food' (Greenpeace 2006). They argue that the US is taking advantage of famine in Southern Africa to open up a market for GMOs in the developing world. For as Declan Walsh (2000) suggests, 'Aid is the last unregulated export market open to US farmers'. In 2002–03, developing countries, including Kenya, Tanzania, South

Africa, Uganda and India could have provided the necessary quantities of non-GM grain to meet the WFP aid target. However, by contrast to its pledge of $50 million credit to Zambia to commence the purchase of GM commodities (*Ecologist* 2003, 46), the US refused to make monetary donations for the purchase of non-GM grain from the above countries. Again, when famine struck Angola and Sudan in 2004, non-GM food aid was requested, and Zambia, having itself vehemently refused GM food aid in 2002, could have provided non-GM food commodities, but the necessary monetary aid was not made available by the US.

Moreover, although not specified by either industry or USAID, it is likely that any aid grain planted and grown in developing countries, once introduced, will subsequently have to be paid for and repurchased at the start of each season. Additionally, to make the most of increased yield potential, farmers need to purchase pesticides and herbicides, developed and controlled by the corporation supplying the GM seeds, to suit the particular crop. This ensures that developing countries are dependent not only on the developed one third of the world (Shiva 2001, 283), but upon a handful of large companies for their future nourishment.

However, Bobo (2005) claims that many African nations are mistaken in believing that the EU is totally opposed to GM products:

> the EU is not totally opposed to biotechnology ... a number of products have been approved in the EU and the EU is one of the main importers of US biotech soybeans, $250 million of corn gluten feed goes into Europe, so it is one of the biggest consumers of biotech products.

The use of biotechnology would not, therefore, close the entire EU market to African countries. Regarding plant biology, a USDA scientist points to further misunderstandings:

> Zambia exports a lot of green beans. They are concerned that if they import GM maize for feed purposes and some people start to grow it, maybe that will affect their exports to the EU. But if you actually stop and think about it, corn is never going to cross with green beans, and corn is not an export commodity for Zambia, whereas green beans are (USDA 2005).

5. The Promotion of the Growing of GM Crops in Developing Countries

5.1. GM Crop Promotion

Having completed our analysis of GM food aid, we turn to an equally controversial GM issue for developing countries—the aggressive promotion of GM crops by developed countries that produce and export agricultural biotechnology. South Africa for years was the one country in Southern Africa to have accepted and authorised agri-biotech technology, and it was upheld as a great GMO success story. However, although certain GM crops are currently under commercial cultivation in South Africa, including 'glyphosate-resistant cotton, soybean and corn varieties' (Bodulovich 2005, 1070), in November 2005, the government announced a mora-

torium on the import of GMO crops, pending the results of an inquiry into 'their potential impact on South African trade' (GENET 2005). Furthermore, a recent study, conducted in May 2005, showed that Bt cotton, the most widely grown GM crop, has not been successful in South Africa. Chee Yoke Heong (2005) tells us that 'the use of Bt cotton was supposed to help reduce dependence on pesticide use on bollworm, thus saving on insecticides and increasing yields. However, this was not the case in Makhathini. Instead, new secondary pests emerged that required the use of more pesticides'. Moreover, she adds that 'Since Bt cotton seeds are double the price of non-GM cotton, farmers increased their debt to be able to plant it, thereby increasing their risk. In the final income analysis, only four farmers of the total sample of 36 farmers made a profit' (Heong 2005). In a five-year South African study, GM cotton profit margins were analysed by Biowatch, and the conclusion was reached that 'the majority of Bt small-scale cotton farmers on the Makhathini Flats in South Africa have stopped planting Bt cotton because they cannot repay their debts' (Grain 2005b). The study showed that:

> small-scale cotton farmers in Northern Kwa-Zulu Natal have not benefited from Bt Cotton and that the hype surrounding this case is just that—a media hype created by American biotechnology companies to try and convince the rest of Africa why they should approve genetically modified crops (Grain 2005b).

An additional three-year study of small-scale farmers, carried out in Andra Pradesh in India, echoed these findings; Grain (2005b) tells us that in this region also 'farmers are in debt as a result of increased cost and lower yields (12 per cent lower than non Bt Cotton)'.

Given that GM Bt cotton seeds cost more than non-GM cotton seeds, that they have failed to demonstrate high 'yieldiness' and that they cannot be saved from year to year, it appears that this technology has not been as successful in developing countries, in both financial and yield terms, as was hoped. Moreover, Bt cotton is not the only GM crop to have failed in the developing world. Other crops, many of which were the products of public sector/corporate partnerships, have not lived up to the hype surrounding their development, even failing to progress past the trial stage. In Kenya, for example, *The Nation* reported that Monsanto had 'developed a coat protein responsible for virus resistance ... donated to Kari [the national Biotechnology Centre] royalty free, to use in its sweet potato improvement programme' (Gathura 2004). However, the GM sweet potato failed, or rather failed to 'improve' on conventional varieties. The trial report indicated that 'during the trials non-transgenic crops used as control yielded much more tuber compared to the transgenics'. The lower yield capacity and insufficient virus resistance of the GM sweet potato has encouraged Kenya, and Kari, to investigate the potential of conventionally bred improved tubers, which Gatonye Gathura (2004) suggests 'questions the suitability of wholesale importation of foreign technologies'.

The failure of these products did not come as a great surprise to those who did not have high expectations. Dave Toke (2004, 7) found that 'throughout [his] examination of the various detailed regulatory arguments about GM food and crops on both sides of the Atlantic [he has] rarely seen any references as to whether or not

GM crops can (or cannot) help solve world hunger'. But explanations for the failures differ widely. Grain (2005a, 1) suggests that:

> getting the sweet potato out to farmers was not the real intention anyway. The overriding goal was to open doors to GM, and in this it was a great success. [T]he project served as a vehicle for driving forward a regulatory framework conducive to GM crops ... to set up the regulatory frameworks and the technical capacity that US corporations require to build-up global markets for their GM crops.

For this reason, anti-GM groups refer to nation-specific utility crops, which rarely see the light of day, as 'Trojan horse projects'. The benefits of this tactic include: the opening of collaboration between private GM companies and southern research centres; good public relations for biotech corporations; and the implementation of permissive GM regulations (reflecting the 'substantial equivalence' rather than the 'potential difference' interpretation of GMOs) which facilitate commercialisation and field testing. Grain (2005a, 4) asks:

> Who cared if the GM sweet potato actually worked; what mattered was that Kenya and other countries became places where Monsanto can sell its GM seeds and have its patents enforced. Whatever the fate of the GM sweet potato, what is certain is that Monsanto now has the green light to start field trials of its Bt cotton in Kenya.

5.2. The Green Revolution

The debates surrounding GM technology mirror very closely those of the Green Revolution. In the same way that the products of the Green Revolution were hailed as 'saviour of the developing world' in the 1960s and 1970s, so the products of agricultural biotechnology are portrayed in the 1990s and 2000s. Insect and herbicide-resistant crops are hailed as less input intensive than other forms of modern agriculture, high yields are promised and high nutritional content is advertised. However, in light of experience of the Green Revolution, Southern African countries may be fully justified in their wariness of GM crops and biotech promises, for environmental, social and economic reasons.

First, although Asia and Latin America saw 'substantial yield increases' (Holmen 2003, 2), it is widely noted that the Green Revolution did not deliver in Africa. Grain (2005b, 28) claims that the Green Revolution project was not a resounding success because 'the seeds that these programmes produced have been largely rejected by farmers because they don't correspond to their needs'. Indeed, it is estimated that currently only 5–10 per cent of seeds sown in Africa are the product of the formal seed sector and unless GM technology produces locally useful products, this is unlikely to change. The technology that has been so commercially successful in the US—herbicide-tolerant and insect-resistant maize and soya, appear irrelevant in developing countries, while GM cotton, which could be of use, appears not to have been adapted to southern climates or ecological systems. Moreover, mirroring the profit-driven strategy of the Green Revolution, several proposed GM crops of social use for the developing world, such as insect-resistant cassava and sweet potato, have been abandoned before completion.

Second, concern regarding environmental degradation caused by the industrialisation of agriculture, first raised in the 1960s and 70s, has re-emerged with the biotech revolution. The Green Revolution brought environmental damage as agriculture became 'petro-dependent [and] ... farmers need ever more fertilisers and pesticides just to achieve the same results' (Rosset 2000); further degradation is feared with GM technology. Third, issues of social desirability have been re-ignited; those who can afford increased inputs will benefit from any increased productivity it brings; those who cannot, the poorest in developing societies, will not; GM may further exacerbate this social divide.

However, a more positive interpretation of the failure of GM varieties in Africa is voiced by those involved in their development. One US agency employee commented:

> these products do not just fall out of the sky, it takes years to develop them, you can spend 10–15 years on development. But there has been a problem of rhetoric; early on it was suggested that we could solve all these problems with biotech, feed people etc. and that caused a misperception; it does take a very long time and require many early field tests. A lot of experiments fail, but that is part of the learning process ... for products such as disease resistance, you need to do a lot of the experiments in the target country (interview, USDA employee, 10 November 2005).

Another reason is that overly stringent biotech guidelines in these countries can prevent the development of specific disease-resistant GM products. A US agency employee suggested that the EU's moratorium has negatively affected regulation development, in that many developing countries have 'taken a very extreme approach', adopting rules 'that are really very much more stringent than the regulations the EU has put into place' (USDA 2005), and have prevented local trials taking place.

In summary, there is a deep divergence of opinion. On the one hand, US agencies are accused of promoting GM crop production in developing countries with the promise of nationally useful crops, so that USAID and US corporations can develop a minimalist regulatory framework conducive to the reception of GM products, less useful for the recipient country, but more profitable for the donor country. On the other hand, the EU is accused of encouraging developing countries to adopt overly stringent regulations which prevent scientists working on nation-specific, socially useful products.

6. Conclusion

In this article, we have examined the implications of the GM issue for developing countries, focusing particularly on the respective impacts of conflicting US and EU GM regulatory approaches. We evaluated GM food aid policy and GM crop growing policy, and showed how they revealed two different interpretations of the precautionary principle: the US's weaker interpretation of substantial equivalence; and the EU's stronger interpretation of potential difference. We conclude that the EU's interpretation is currently more influential in the developing world, due to past

experience of agricultural 'revolution' and precautionary policy-making. However, we note that this could change if environmental forces such as global warming exacerbate the impact of drought on crops, and if technological breakthroughs are achieved in the drought-resistant capacities of GM crops. In such circumstances, the US's more relaxed attitude to the precautionary principle may become irresistible to developing countries.

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Note

1. According to Mark Cantley (2005), 'whether or not the Americans called it that, in the original debate from 1973 to 1986, there was very much a precautionary approach'.

Interviews

Bobo, J. (2005) Interview with Jack Bobo, Deputy Chief of the State Department's Biotechnology and Textile Trade Division, US State Department, 15 November 2005, Washington DC.

Cantley, M. (2005) Interview with Mark Cantley, senior official in the European Commission, 22 March 2005 (Mr Cantley wishes to make clear that the views he expressed in the interview are his own, not those of the European Commission).

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