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Agricultural Biotechnology in Southeast Asia. Patterns of Inclusion and Exclusion

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Agricultural Biotechnology in Southeast Asia. Patterns of Inclusion and Exclusion

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Executive summary

This paper discusses the dynamics of inclusion and inclusion of Southeast Asian farmers into global flows of information and knowledge associated with the "gene revolution," embodied in genetically-engineered seeds of agricultural crops. It highlights how the global policy divide over GMOs is mirrored within Southeast Asia – with the Philippines and Thailand representing opposite ends of the spectrum. While the former has adopted a positive attitude towards these fruits of modern agricultural biotechnology, the latter has – officially at least – struck a more sceptical pose. As in the European Union, the divergent approaches towards GM crops that currently prevail in Southeast Asian therefore pose a challenge to the process of regional economic and regulatory integration. It is also emphasized that while the existing regulatory framework rests on the assumption that Southeast Asian states have the institutional capacity to effectively regulate the flow of GM seeds, keeping "unauthorized" seeds out of the hands of farmers, this capacity may in practice be weak, as is evidence by the spread of illicit cultivation of GM crops in Thailand. As an increasing number of farmers in Southeast Asia – and its larger neighbours – gain access to GM seeds, licit or illicit, Southeast Asian governments are likely to find the task of controlling the transboundary flows of these contentious seeds evermore challenging.

Environmental and developmental models: Integration or fragmentation?

Recombinant DNA technology — genetic engineering — is a recent scientific advance that has been intensely contested, particularly with regards to its agricultural applications. So also in Southeast Asia, where some since the early 1990s have sought to ensure that genetic engineering is harnessed for socially beneficial purposes — such as the feeding of an ever-increasing population – and made available to farmers and consumers. Government agencies, corporations, and philanthropic organisations have supported the work of the scientific community to use modern biotechnology to increase the productivity of Southeast Asian farmers, to reduce the need for them to apply chemical herbicides and insecticides to their crops, and also to improve the quality, including the nutritional characteristics, of their produce. This biotech "push" in Southeast Asia has also been opposed by many, not least because it is feared that the cultivation of genetically modified crops represent a step towards a dystopian future characterized by domination by multinational corporations, catastrophic environmental ruination, and "Frankenfood"-triggered public health disasters.

Social mobilization and political contestation over agricultural biotechnology is, of course, far from unique to Southeast Asia. They are reflections of the planetary-scale "cognitive divide" around agricultural crops classed as "Genetically Modified Organisms" (Herring 2008), which emerged mainly due to differences in political dynamics on both sides of the Atlantic. While the Americans embraced the new technology and the seeds that it produces, the Europeans have largely rejected it, at least for human consumption.[i] There has thus

emerged a geopolitically distinct divide with regards to agricultural biotechnology, with the United States being an enthusiastic adopter, and leading European countries such as France and eventually also the European Union as a whole adopting a more precautionary approach.[ii] Southeast Asian struggles over agricultural biotechnology have thus taken place in a geopolitical context, where local contestation mirrors and in many ways is fuelled by battles originating elsewhere. In that regard Southeast Asia, like much of the developing world, has become territory on which a low-intensity transatlantic "proxy war" has been fought – as political, economic, and social agencies and actors from the US and EU have sought to promote rival versions of "modern" agriculture.

What have been the outcomes of these struggles over GM agriculture in Southeast Asia? How has agricultural biotechnology fared in Southeast Asia? What do the future prospects look like? And how does this relate to questions of inclusion and exclusion? These are the questions that I will seek to address in this essay. I will begin by briefly taking stock of the diffusion of GM crops in Southeast Asia. I will then highlight some of the implications of the patterns that we can now observe in terms of inclusion and exclusion. In doing so I will mainly discuss examples from the Philippines and Thailand, two countries that have ended up on opposite side of the global cognitive divide, with the Philippines opting for the "American" model, and Thailand officially opting for the more risk-averse "European" approach.

GM agriculture in Southeast Asia today

Research, development, and adoption of GM crops proceeds – or should, according to government regulation, proceed – in distinct stages. In short, the process begins in laboratories and subsequently moves to greenhouses and then field trials (first confined, then open), to end with widespread commercial planting.[iii]

In Southeast Asia, the Philippines and Myanmar are the only two countries that, to date, have adopted GM crops on any larger scale, with the Philippines having an estimated 800,000 hectares of GM corn (maize) under cultivation, and Myanmar growing an estimated 300,000 hectares of GM cotton. This is sufficient to earn these countries designation as "biotech mega-countries" by the leading pro-GM organization International Service for the Acquisition of Agri-Biotech Applications (ISAAA). In Indonesia, GM sugarcane has recently been approved for commercial cultivation, with the first such plantations expected to be established in the course of 2014. One can thus expect that Indonesia, in the not too distant future, will join the ranks of "biotech mega-countries" (which would simply mean that they have more than 50,000 hectares under commercial cultivation). While neither Malaysia nor Vietnam has yet to commercialize GM crops, both countries are conducting field trials (on papaya and corn, respectively) and are thus in a position, should they so decide, to take the final step towards commercialization within the next few years.[iv] In contrast, Thailand is some considerable distance away from commercialization of GM crops, as a de facto moratorium on field trials is in effect.

In a wider Asian perspective, the area under GM crop cultivation in Southeast Asia pales in comparison with the leading Asian adopters: India (11 million hectares of cotton), China (4.2 million hectares, mainly cotton), and Pakistan (2.8 million hectares of cotton) (James 2013).

The biotech crops being cultivated in Asia are mainly of the non-food variety. Corn is used as feed, and cotton supplies the textile industry. However, in January 2014 Bangladesh began commercial cultivation of a GM food crop, namely *brinjal*, which is a kind of eggplant – and a staple crop across the Indian subcontinent as well as in parts of Southeast Asia (*The Daily Star*, 22 January 2014).

Asian countries thus vary greatly in terms of the extent to which they have embraced the "gene revolution." In Southeast Asia, by most measures, the Philippines is the clear ag-biotech leader, followed by Myanmar, Indonesia, Vietnam, and Malaysia. While Thailand boasts an impressive, by regional standards, human-resource base in terms of scientific capacity, the momentum behind its biotechnology drive has been weaker than in many of its regional peers. Indeed, compared to its neighbours, Thailand stands out as something of a biotech Luddite. This impression, reflecting official policies and practices is, however, only a partially correct one – as will become clear below.

The main conclusion we can draw based on this brief survey is that the transatlantic divide in political attitudes to agricultural biotechnology is mirrored in a similar divergence *within* Southeast Asia.

Dynamics of inclusion and exclusion

Policies and developments in the field of agricultural biotechnology are of relevance to questions of inclusion/exclusion at multiple levels and a variety of different domains. Here I will consider them as a matter of inclusion into and exclusion from global flows of knowledge and information. GM agriculture is concerned with exchange of knowledge and information at the most fundamental level — the basic building blocks of life. Recombinant DNA technology is a way of exchanging information between different living things, thereby creating organisms with new traits. It follows that the planting of a GM seed can be viewed, simply, as the introduction of novel information into the Southeast Asian environment. At another level, GM agriculture in Southeast Asia rests on the transfer of relevant scientific knowledge, technology, and technique to Southeast Asian scientists — predominantly from North American and Western European universities and corporations — allowing them the opportunity to genetically engineer organisms that may be suitable for local conditions, issues, and concerns. In addition, GM agriculture rests on the diffusion of GM seeds from laboratories to farmers, who must also learn how to use them appropriately. State agencies as well as private sector actors can and do play important roles in this diffusion process. I will not be able in this brief essay to elaborate on all these aspects, but I wish to highlight what I believe are some of the most politically salient issues of inclusion/exclusion that Southeast Asia is currently facing with regards to agricultural biotechnology.

Regulatory disharmony

At the global level, the transboundary exchange of organisms whose genetic makeup has been modified using a particular set of technologies (but not others)[v] is regulated through the Cartagena Protocol on Biosafety. With the exception of Brunei and Singapore, two countries with minimal agricultural sectors, the ASEAN states are full members of this

international regulatory regime.[vi] As a consequence of their international commitments, Southeast Asian governments have formed state agencies with biosafety as their remit, who have been empowered to make decisions on how GM crops should be handled, in the laboratory and outside it. The development and importation of agricultural biotechnology is therefore the subject of extensive regulation and monitoring. Southeast Asian states, like states elsewhere in the world, have in effect been empowered to act as scientific and technological gatekeepers; they define who should have access to agricultural biotechnology, and its fruits, and who should not. Governments have the power to exclude, and there are therefore important spatial and territorial dimensions to governance of agricultural biotechnology. Firstly, states guard against unauthorized GM information flows from overseas. Secondly, they must guard against GM technology escaping from tightly regulated domestic spaces – most notably specially designated laboratories and trial sites – into unregulated spaces (such as farmers' fields).

In theory at least, it would be possible for the countries of Southeast Asia to adopt similar regulatory positions with regards to agricultural biotechnology – thus effectively governing the region as a single integrated territory. Indeed, the Association of Southeast Asian Nations (ASEAN) has the ambition to "harmonize" the policies of member countries towards agricultural biotechnology, but as yet this ambition remains unfulfilled. The divergent attitudes to GM crops within Southeast Asia thus represent one area where progress towards the creation of a meaningful ASEAN Economic Community, set to launch in 2015, may prove difficult. At the very least, deeper integration of agricultural commodity chains will be somewhat constrained if, as is now the case, some seed and plant varieties can be grown in some Southeast Asian countries, but not, for regulatory reasons, in others.

Challenges to state capacity

The existing regulatory framework rests on the assumption that Southeast Asian states not only have the power to exclude GM seeds and plants by invoking biosafety concerns, but also that they have the institutional capacity to enforce such exclusions. This capacity to exclude may in practice be weak or nonexistent. Southeast Asian governments are likely to find the task of policing borders and monitoring and "disciplining" Southeast Asian farmers exceedingly difficult. As noted above, Thailand is – officially – a biotech laggard. In reality, however, Thai farmers are known to have adopted GM crops surreptitiously. Some of the clearest evidence for this comes, strangely enough, from the EU. European authorities inspect food imports in order to make sure that GM crops that have not received EU authorization do not make it into the European food supply. When unauthorized GM products are found, this is reported to the EU's Rapid Alert System for Food and Feed (RASFF). The RASFF database contains a total of 119 notifications of unauthorised genetically modified food or feed in imports (from all countries) into the EU in the period 1 January 2012 to 6 February 2014. Of these, Thailand alone accounts for 36, or more than 30 percent of the total. In all instances the culprit was GM papaya. In the Thai case, then, a very serious tension between official policy and the "everyday" political economy of GM crops has become manifest, as farmers seek prosperity in what Ronald Herring with reference to India and Brazil has described as "an anarchic agrarian capitalism that defies surveillance and control of firms and states"(Herring 2007, 130). There are no available estimates of the number of farmers planting GM crops in Thailand. However, recent surveys for the presence

of GM crops on Thai farms performed by Chulalongkorn University botanist Piyasak Chaumpruk have found evidence of GM papaya and GM corn (Sarnsamak 2012).

GM papaya may have entered the Thai farming sector through a number of different avenues. Historically, the US-backed Papaya Biotechnology Network of Southeast Asia took the lead in adapting a technology developed for papaya in Hawaii for Southeast Asian papaya varieties, in order to make them resistant to the devastating papaya ringspot virus (PRSV), as well as to develop varieties of the fruit that ripen less quickly thus lengthening their shelf life. This network brought together academics and researchers from Indonesia, Malaysia, the Philippines, Thailand, and Vietnam with experts from the United States. The GM papaya grown in Thailand today is likely to trace their origins to this research effort, which in Thailand was curtailed after it was revealed that the Ministry of Agriculture had distributed GM papaya seeds from one of its research stations to several hundred papaya farmers. It is also possible that GM seeds subsequent to that episode have been brought in from Hawaii, which is a leading producer of GM papaya. Whatever the case may be, it seems clear that GM seeds are being propagated by Thai "bootleggers" – and that the Thai state in this sense has failed in its role as biotech gatekeeper. However, unlike many other states – India and Brazil come to mind – the illicit expansion of GM farming has not yet prompted the government to legalise these crop choices.

The challenge of ensuring that GM crops are limited to authorized areas is mirrored at the national level in the Philippines. While anti-GM activists were unsuccessful in their efforts to block adoption of GM crops in the Philippines a little more than 10 years ago, their lobbying efforts paid off in the form of *local* government decrees declaring sub-national areas "GMO free." A prominent example is the 2003 ordinance issued by the Bohol provincial government, prohibiting "the entry, use, and propagation of GMOs in the province to safeguard the health of Boholanos and protect the environment" (Pamugas 2011, 443). Similar "GMO-free zones" were subsequently established in Negros Occidental, Oriental Mindoro, and several other parts of the archipelago. While at the very least symbolically significant, monitoring and policing the supposedly GMO-free zones in the Philippines is in reality rather problematic, as farmers can and do plant GM corn also in areas where local ordinances banning them are in force. The number of farmers growing GM corn in the Philippines had reached more than 300,000 by 2011. Given the power of the demonstration effect provided by farmers successfully adopting GM crops, it is unlikely that GM corn can be easily stopped at provincial borders.

Seeds of contention

In the coming years, we are likely to see continued contestation over the authorization and spread of new GM crops in Southeast Asia. Both the Philippines and Thailand are likely to remain in the regional spotlight in this regard. For the Philippines, a recent court decision has thrown the country's biotech trajectory into some doubt. Greenpeace Southeast Asia and MASIPAG (among others) appealed to the Court of Appeals to stop field trials of GM eggplant – known as Bt *talong* – conducted by UP-Los Baños. In May 2013, the Court of Appeals decided that the field trials had to stop. The decision was in effect moot, as the trials had already been completed. The decision therefore did not impact any ongoing field trials of GM crops. However, the decision has raised the spectre of further court cases that

might stop ongoing and future field trials, as well as threaten existing commercial cultivation of GM corn and the future adoption of "Golden Rice." Unsurprisingly, therefore, the court decision was greeted with "elation" by anti-GMO activists (Estremera 2013). The respondents in the case have appealed the case to the Supreme Court. Meanwhile, pro-biotech farmers have mobilized, demanding that the court does not deny them access to the new GM variety of eggplant.

In another recent incident, in August 2013, anti-GMO activists attacked and destroyed field trials of so-called Golden Rice — designed to eliminate Vitamin A deficiency among those who eat it — at a governmental agricultural research station in Bicol province. The attack on Golden Rice was widely condemned by not only the Filipino scientific community, but also by many foreign scientists. Also highlighted were the financial links between anti-GMO groups in Asia and sponsoring European governments. Most notably, prominent plant scientists pointedly asked why the Swedish government's international development cooperation agency, SIDA, was funding one of the NGOs allegedly vandalising the experimental fields.[vii] If the remaining undamaged field trials can be completed successfully, there would be no remaining obstacles – except possibly political ones – for the Philippines to give the green light to commercial cultivation of Golden Rice.

In Thailand, there is little political impetus or pressure for providing Thai farmers with access to GM crops. This is at least in part related to official state ideology. Thai advocates of agricultural biotechnology have found it difficult to frame the adoption of GM crops in relation to the "sufficiency economics" paradigm of development that has been formulated by the Buddhism-inspired Thai king. However, in practice most Thai farmers appear to reject what the Thai state and many social activists depict as morally and ideologically superior agricultural methods such as organic farming.[viii] It is also, and perhaps even more importantly, related to the fact that Thailand, unlike the Philippines, is a major food exporter. Thailand's reluctance to embrace GM technology has in no small part been motivated by fears that Thai agricultural exports would be denied access to major markets in Europe and in Japan. The GM question has recently been re-framed in relation to Thailand's status as a regional "seed hub." Thailand is already a major supplier of seeds for field crops and vegetables to the neighbouring countries. But the Thai seed industry with Monsanto in the lead has been arguing that Thailand's central role in the regional seed economy is threatened by the country's refusal to allow production of GM crops. Monsanto in particular has lobbied hard for a change in policy such that it can expand its existing facilities in Phitsanulok and turn it into a centre of production of GM seeds — which would then be exported not only within Southeast Asia but further afield as well. Monsanto believes that the thousands of Thai contract farmers, on whom the company rely for production of hybrid seeds, are exceptionally skilled and internationally competitive. However, as more and more countries turn to GM corn (and other GM crops) in Southeast Asia and beyond, the non-GM niche that Thailand currently inhabits will shrink. For Thailand's seed industry to remain viable in the long term, the argument goes, limited planting of GM seeds will have to be accepted. However, it is noteworthy that the "seed hub" concept rests, again, on an assumption that GM seeds can be kept out of the hands of ordinary Thai farmers. While GM policies remain unchanged for the time being, the "seed hub" strategy has recently been endorsed by the Thai ministries of Agriculture and Science and Technology.

Another interesting – but so far unsuccessful – effort to re-frame GM seeds in Thailand can be found in a papaya farmer's challenge of the state's ban on GM papaya on the ground that it represented an infringement of his human right to access technology. The National Human Rights Commission considered the appeal but ruled in August 2013 that the ban did not breach his human rights, since, according to the Commission, it is unclear whether modern agricultural biotechnology has good or bad effects and what impact it has on the rights of the general public.

Concluding thoughts

The politics of GM crops is structured such that farmers have little effective say in whether or not they are given access to and able to adopt new technologies that are emerging as a result of the gene revolution. Although there are exceptions in the Philippines (corn), Myanmar (cotton), and Indonesia (sugarcane), for the majority of Southeast Asian farmers cropping choices — GM or non-GM — have officially been removed from the menu of available options by governmental fiat. At the same time, Southeast Asian governments have limited capacity and one may suspect that they will have increasingly limited enthusiasm for enforcement of regulations that deny Southeast Asian farmers access to what, to many of them, appear to be superior seeds and crop varieties. The biotech revolution has been slow in coming to Southeast Asia. But as more and more GM crops are gradually adopted in pioneering Southeast Asian countries such as the Philippines and Indonesia, as well as in the region's giant neighbours, it is likely to prove increasingly challenging and costly for the remaining adherents of a more "European" approach, such as Thailand, to maintain their GM exclusion zones.

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[i] This applies to agricultural biotechnology. Curiously enough, pharmaceuticals produced using GMOs — such as insulin — are universally accepted.

[ii] This transatlantic rift is not a reflection of any coherent philosophical or ideological position with regards to modern biotechnology, but rather politically contingent. This becomes clear if we compare and contrast US and EU attitudes towards two areas of modern biotechnology: GMOs and stem cell research. Thus, neither the US nor the EU is consistently precautionary.

[iii] I ignore what is, for food crops, logically the next step, namely commercialization of food products containing GMOs. I do so because many countries, including Thailand and the Philippines, have allowed *imported* but not locally produced GM foods to be sold commercially.

[iv] Although unrelated to agriculture, I may mention that the Malaysian government has released genetically engineered mosquitos in order to evaluate their potential as a means by which to combat dengue fever, a deadly mosquito-borne disease.

[v] The products of so called "mutation enhanced technologies" (such as radiation) are not considered GM. Thailand has registered 20 "mutant varieties" of rice, bananas, beans, and other agricultural crops that were developed using such "enhanced" but non-GM genetic modification. The Philippines has registered 15 mutant varieties (mainly rice). The register of such mutant varieties is hosted by FAO and IAEA, and can be accessed at mvgs.iaea.or.

[vi] Year of accession to the Cartagena Protocol on Biosafety: Cambodia (2003); Indonesia (2004); Laos (2004); Malaysia (2003); Myanmar (2008); Philippines (2006); Thailand (2005); Vietnam (2004).

[vii] http://www.marklynas.org/2013/10/scientists-challenge-swedish-government-over-funding-of-golden-rice-trial-vandalism/

[viii] After many years of consistent efforts to promote it, organic farming accounts no more than 0.17 percent of all agricultural land in Thailand and 0.67 percent in the Philippines.

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A response to 'Agricultural Biotechnology in Southeast Asia. Patterns of Inclusion and Exclusion'

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The question posed by Tomas Larsson points to the asymmetry that characterises flows of knowledge related to agro-biotechnology in the context of Southeast Asian integration. These asymmetries, as remarked in the paper, are generated by the ambiguous role of governments, who as promoters of development and guardians of the environmental and health security of their citizens, tend to exercise (in some case contradictory) mechanisms of inclusion and exclusion within the complex system of know-how involved in the genetic revolution in agriculture. Depending on the capacity of states to negotiate common solutions with regard to the introduction, production and marketing of GMO, it will be possible to the nascent economic union of the states of the SEA "harmonise" their agricultural and trade policies and define the horizons of common action.

Indeed, there is a spectrum of different attitudes on the thorny issue of genetically modified organisms and the asymmetries of knowledge are due to the emergence of two opposing trends in ASEAN. As pointed out by Larsson, the two poles of the spectrum are represented by the Philippines and Thailand, reflecting, respectively, the pro-GMO orientation of the United States and, by contrast, the anti-GMO trend embraced by the European Union. In the Philippine case the flow of knowledge and technology around GMO is legitimised and propelled by government policy, while in the case of Thailand, this flow is not officially licensed, but flows informally and illegally in the folds of the local agricultural system.

As shown by several sources, and as pointed out by Larsson, the ideological closure of Thailand is motivated by the top-down publicising of a development model based on the link between sustainability and eco-Buddhist teachings, namely the one inaugurated by the economic philosophy of the king (*setakit popiang*, or sufficiency economy) at the end of the 1990s. This only superficially represents a limit to the introduction of genetically modified crops in Thailand. Farmers in Thailand have been deeply involved in their introduction for at least two decades through relations of contract farming for the production of hybrid seeds with the same multinational corporations that seek today to introduce GM seeds legally. Farmers in Thailand are already using genetically modified seeds and it is therefore necessary to inquire into the reasons that led them to adopt GMOs illegally. In essence one has to wonder if it is not appropriate to include the farmers themselves in the flow of legitimate knowledge, and help them to formulate conscious and free choices with regard to modified organisms.

In fact, in the case of Thailand, farmers use their agency to circumvent and evade government regulations to an extent that all but ignores official calls for the use of organic agriculture. The latter, which is not extensive nor intensive nor market-oriented, is in fact alive and well in rural areas in Thailand, but does not apply to

commercial crops but to family horticulture. This attitude itself masks the ambivalent attitude of farmers, as exemplified by a common practice of exclusion of modified seeds from the diet of farmers themselves and of domestic animals. Corn famers I met on fieldwork, for instance, do not trust in the seeds they cultivate for agro-business corporations and feed their domestic animals as chicken and pork with organic corn. This trend shows a lack of confidence in the product of multinational corporations, but also the profound alienation of the peasantry.

The choice of the farmers in Thailand currently carries no weight on the policy-making of governments: but has it ever had any weight from the days of the Green Revolution until today? And what of the opinion of Philippine farmers and civil society about the choices made by their governments?

To look to harmonise policies across ASEAN, at the legislative level societies should aim to democratise access to information and knowledge flows for and against GMOs. These flows of information, however, are likely to be distorted by the fundamental condition of many farmers. In Thailand, for instance, they act as cheap labour in the open-air factories of transnational industrial agriculture. The agency of Thai farmers is very different from that of their European counterparts: there are different systems of access to and property of the land, other regimes of access to information and different systems of incentives for agricultural production. It is therefore necessary to ask whether the behind peasants' illegal behaviour there does not operate any abuse or pressure from the multinational companies themselves. It is necessary to ask whether some government policies are inclined to camouflage, designed to show an anti-GMO image (and therefore morally *upright* and *uncompromised*), whilst at the same time these policies are not enough to provide official controls and incentives for GMO-free agriculture.

Some general thoughts, with a view to finding openings to favour harmonisation between the policies of different ASEAN governments, could in some way inspire future phases of research and documentation:

1. The formula of contract-farming implies a lack of responsibility of the farmers regarding the destination of the product, and in many cases. These rural worker have no incentive to cure the health and environmental outcomes of production. This is already the farmers' attitude with regard to hybrid crops, and is likely to take repeat itself with regard to the cultivation of GMO. The opening of flows of knowledge around bio-technology must therefore be accompanied - in the case of the introduction of GMO - by monitoring the negative effects inherent in the Green Revolution and in the regime of contract farming in countries like the Philippines and Thailand. Among the most serious economic externalities there is the possibility that the introduction of GMO, a competitive sector *par excellence*, could also impact the food price mechanism and the dynamics of land grabbing (even in the form of encroaching on illegal forest soils by contract farmers) in different states.

2. The intentions and actions of anti-GMO social movements must be taken seriously also in order to prevent the multiplication of fractal conflicts between civil society

and economic institutions and governments around the issue. Memoranda of Understanding drawn up around bioethical parameters suggested by civil society should guide the process of GMO research and implementation in the states who intend to open up these possibilities: the European strategy of flexible mechanisms proves to be appropriate in this case to ensure that the different states deliberate on the ways and timing of the introduction of GMO, opting for solutions adapted to their own specific environmental conditions and agricultural vocations.

3. The above considerations also suggest that the environmental and health problems inevitably become two axes around which the next wave of debate and research is propelled. The sceptical countries in this sense may represent a constructive and dialectic in the process of harmonization of policies. As part of the prevention of prudence, the GM crops (in unwilling countries) could be used for non-food crops (the new market for bio-fuels, for instance, is a possible fall back). The harmonization of policies must look at the economic and social benefits of GMO without neglecting the fact that the unconditional opening of financial, technological and genetic flows may represent a negative externality in many respects, and that the unknown nature of possible damage to local socio-environmental balances should encourage caution even in the most optimistic scenario.