GM maize in México: An irreversible path away from agricultural biodiversity, farmer livelihoods and the right to food within the center of origin of maize

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The Mexican government stands on verge of approving the large-scale release of genetically modified maize for commercial production. The continued government policy promoting genetic modification in maize, despite earlier warnings from the Mexican scientific community, stands in contrast to a chorus of legitimate concerns stemming from unanswered scientific, legal, social and economic questions over the implications for food security and the right to food concerning the adoption of agriculture using genetically modified crops at centers of their origin and diversity. This is a decision whose importance and impacts are difficult to understate: A potentially irreversible impact on Mexican maize, that is at the heart of the Mesoamerican culture, that is also the staple food of Mexicans and millions more; a threat to our food and health, as well as to the indispensable communal way to create and maintain maize diversity in front of the interest of large corporations to privatize and control the maize seed market, that would make maize producers depend on such corporations, would threaten the right to save seed, and would diminish agricultural biodiversity and destroy the millenarian culture associated to maize and its diversity; finally all this would negatively affect maize consumers all around the world and global food security hindering the possibility of facing the challenges posed by a changing climate.

Recommendations and requests – a call to action

A *pro-forma* public consultation period in México of requests for commercial-scale planting of GM maize has just finished as the last procedural hurdle on the path to approval, despite all previous efforts to convey. We conclude that the potential impacts threaten the right to maize as a vital food. Furthermore, given the biological irreversibility at hand, we therefore strongly insist and urge the Mexican authorities to implement the activities specified below, in order to create necessary broader dialogue and a collective re-think of the wisdom of large-scale release of genetically modified (GM) maize into the epicenter of maize agricultural biodiversity.

We urge the Mexican government to:

- Take into consideration the work of 235 experts from 70 institutions coordinated by the Mexican biodiversity commission (CONABIO) that designates Mexico as the center of maize diversity containing the centers of origin and domestication (http://www.biodiversidad.gob.mx/genes/proyectoMaices.html; Kato-Yamakake et al., 2009).
- Amend the Regulations of the Mexican Biosafety Law, so that the Special Protection Regime for centers of crop origin and diversity, particularly for maize, is enforced.
- Stop the processing of any application for open-field release of GM corn in México.
- Reject permits for commercial planting of transgenic maize and cancel all existing permits for “pilot scale” and “experimental scale” releases of GM maize into the environment on the basis of the scientific evidence documenting the extent of transgene flow and the center of origin and diversity of maize in the entirety of the Mexican territory.
- Begin an immediate transparent and open peer-review of the environmental and social aspects of GM maize cultivation in México, based on thorough scientific criteria and public engagement, utilizing a set of criteria and standards that are scientifically, socially and environmentally acceptable. Such a process should consider the alternative options to address issues of food production in México and include representatives of peasant and indigenous maize production of communities throughout México, whose livelihoods may be impacted by the introduction of GM maize in the country.
- Conduct a thorough and transparent review and public consultation of the acceptability of the existing policies surrounding GM maize agriculture in Mexico.

Introduction and background

In 1999, after an experience of 11 years on biosafety, the Mexican government following the scientific advice of a panel of experts, placed a *de facto* moratorium on the cultivation of genetically modified (GM) maize to safeguard México's *cultural and natural heritage (patrimonio cultural y natural)* (Serratos-Hernández 2009) –*the* rich maize agricultural biodiversity at its center of origin and diversity of maize. Mexico, as the global steward of this vital resource, has a unique and important responsibility to preserve this genetic diversity for the breeders and farmers around the world to respond to the challenges of food security, including those posed by climate change, as well as to guarantee a diverse and healthy offer of maize products, but also to guarantee Mexico´s food sovereignty, being maize the staple food of this country.

In 2005, the Mexican Biosafety Law (LBOGM 2005) was enacted that in effect removed the moratorium –despite the situation that motivated it in the first place remained unchanged— and instead formalized a path for the approval of large-scale commercial cultivation of GM crops within its borders. Since 2009, the Mexican biosafety commission (CIBIOGEM) has given approval for 177 small GM maize field trials to four transnational companies (Dow AgroSciences, DuPont, Monsanto and Syngenta). These trials were nothing but reiterations of previously evaluated trials on which the *de facto* 1999 moratorium was based. Hence, results from such trials, if anything, should have confirmed the reasons to establish such a moratorium. In contrast, and without making a formal and public presentation of such trials´ results, at the moment, three multinational corporations are in the final stages of seeking approval for the wide-scale release of patent-protected transgenic maize varieties in México – a decision with potentially irreversible implications for the heart of Mesoamerican culture, agricultural biodiversity, farmers' livelihoods and the right to food.

Throughout the history of this process, scientists, NGOs and the general public, for more than 15 years have raised these issues in various fora[1] with variable responses from the Mexican government (Peralta and Marielle 2010). A decision of this magnitude must be carefully considered. This requires a deliberative, inclusive and transparent risk appraisal process involving a wide group of actors. Unfortunately, the process of "public consultation"[2] (mandated by the aforementioned Biosafety Law) put forth by the Mexican government to date has been anything but these procedures. Not only is the length of public consultation allowed exceedingly short (20 days once the announcement has been made), but the lack of transparency of the process, given that the detailed outcome from the performed "experimental" and "pilot" GM maize releases have not been made public, has preempted any scientific scrutiny. This not only undermines the principles of independent scientific critique and verification that are at the core of sound science practice, but is also a missed opportunity to address biosafety issues more broadly that ensures the safety of any approved

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1 See http://www.unionccs.net

2 See the "Formato de Consulta Pública", accessed November 20, 2012

http://www.senasica.gob.mx/includes/asp/download.asp?IdDocumento=14667&IdUrl=20755

environmental release of a genetically modified organism into centers of origin and genetic diversity. Furthermore, the Mexican government has decided on a public consultation process that limits the scope of comments on approval to those that can be "scientifically and technically substantiated"[3], thereby restricting those who can "legitimately" provide feedback and artificially framing the issue of approval or non-approval as if there were only scientific and technical concerns. This completely ignores equally valid and reasonable considerations of the social, economic, legal and ethical impacts of such a decision.

In this brief, we analyze the key environmental, health, legal, socioeconomic and agronomic/food security issues and their implications in the event that large-scale release of GM maize in México, its center of origin and diversity, is undertaken. We find that scientific justification and evidence of social, environmental or agricultural utility is lacking after over 16 years of planting GM crops in the United States and a few other countries (Gurian-Sherman 2009, 2012; Gurian-Sherman and Gurwick 2009; Benbrook 2012). But on the other hand, there is irrefutable scientific, social, environmental and cultural reasons to stop GM release at its center of origin and diversity (see also Commission for Environmental Cooperation 2004).

Our conclusion is that the most prudent action calls for greater foresight, by implementing a precautionary policy that ensures the conservation and sustainable use of México's maize agricultural biodiversity. This requires establishing an official and effective moratorium on the cultivation of GM maize varieties, and embarking in a long-term research on the benefits, risks and opportunities provided by a range of agronomic practices for enhancing Mexican agriculture and improving the livelihoods of the Mexican rural communities. The latter should be evaluated in terms of their effectiveness to achieve a sufficient and sustainable maize production in México and deliberated inclusively by broader society. Such precautionary action has been taken recently in other countries harboring important agricultural biodiversity, specifically India for Bt eggplants, Peru for cultivation of GM crops and Bolivia for the dissemination of GM seeds.

Key issues and implications for food security and the right to food

The focal issue for the right to food and food security is making decisions today that will preserve this right for present and future generations. This means that agricultural policies must capacitate and not threaten the ability of farmers of today to provide a diversity of agricultural options for the farmers of tomorrow (Alvarez-Buylla et al., 2011). Central to this aim is agricultural biodiversity and México's role in safeguarding maize agricultural biodiversity. Below we briefly analyze the potential implications of GM maize in México from the perspective of five issues: Environmental/biodiversity conservation, human and animal health, legal, socioeconomic and agronomic/food security. Many of these issues are intertwined, particularly in the instance of hybridization of GM maize varieties with non-GM varieties, a biological reality documented in México and observed even during the time the moratorium was in place and to this day (see references below). A number of complexities and

[3] Ibid. "Dicha opinión deberá estar sustentada **TÉCNICA y CIENTIFICAMENTE** [their emphasis]"

uncertainties are discussed that merit further investigation and clarity concerning GM maize release in México, but enough evidence and data is at hand to justify precautionary action.

ENVIRONMENTAL/BIODIVERSITY CONSERVATION IMPLICATIONS

• ENVIRONMENTAL RELEASE OF GM MAIZE IN MÉXICO MAY HAVE ADVERSE EFFECTS ON THE CONSERVATION OF AGRICULTURAL BIODIVERSITY OF MAIZE AND ITS WILD RELATIVES

México, as the recognized center of origin and diversity of maize (Kato et al., 2009) maintains this agricultural biodiversity through seed exchange and selection by farmers, a vital activity for generating and maintaining the germplasm for maize breeders around the world in order to respond to a changing climate, new pest pressures, or consumer preferences (Alvarez-Buylla et al., 2011; Ureta et al. 2011). Evidence suggests that communities that maintain high levels of maize agricultural biodiversity are the best positioned for resilience against climatic changes (Bellon et al. 2011). The commercialization of GM maize in México is set to deeply disrupt the processes that underlie germplasm diversification and the livelihoods of peasants that produce over 70% of the maize used for human consumption in México.

The Mexican Biosafety Law contains a Special Protection Regime that was meant to safeguard the genetic diversity of local, wild and/or cultivated varieties of crop plants that have their center origin or diversity in México (LBOGM 2005). However, amendments to the biosafety regulations of this same law contradict it (LBOGM-Reglamento 2009) and did away with this provision, on the assumption that there were areas of México that did not require this special protection regime. However, in order to provide an apparently legal framework to be able to release GM maize varieties, the Mexican government has published, as mandated by the Biosafety Law, an agreement to establish the center of origin and diversity outside of which the GM plants could be planted. However, a scientific analysis undertaken by the leading biodiversity agency in México, CONABIO, found native corn diversity throughout the Mexican territory (Acevedo et al. 2011; CONABIO Official Report at: http://www.biodiversidad.gob.mx/genes/proyectoMaices.html), and together with the transgene flow data (Piñeyro et al., 2008), leads to the irrefutable conclusion that the entirety of the Mexican territory should be considered as the center of maize origin and diversity (Kato et al., 2009).

• GENE FLOW STUDIES CONFIRM THE BIOLOGICAL AND POLICY IMPLAUSIBILITY OF COEXISTENCE BETWEEN GM AND NON-GM MAIZE

The agencies that oversee the implementation of the Mexican Biosafety Law maintain that GM maize production areas (primarily in the North of México) can be segregated from other areas of open-pollinated maize cultivation of “criollo” native varieties. However, a wealth of scientific evidence of gene flow in maize (Quist and Chapela 2001; Serratos et al., 2004; Serratos et al., 2007; Piñeyro et al. 2009a, b; Dyer et al. 2008, 2009; van Heerwaarden et al. 2012) and cotton (Wegier et al. 2011) in México demonstrates that on the contrary, coexistence is not possible. The incidence of “contamination” of the maize food supply in the USA with a variety of GM maize not approved for human consumption (know as “Starlink”) led to millions of dollars in losses for farmers, where a low level presence of the transgenes could still be detected in the food supply years after measures were taken to remove them (Marvier and Van Acker 2005). As Mexican maize production and consumption is much more extensive than in the USA, such gene flow would be much harder or even impossible to manage and revert. Given the persistence and uncertainties of the impact of transgene flow, this issue has further relevance to conservation, socioeconomic and legal implications, as discussed below.

• *THE LARGE-SCALE PRESENCE AND USE OF GM TRAITS AND THEIR CO-PRODUCTS CURRENTLY APPLIED FOR RELEASE LEADS TO THE DEVELOPMENT OF RESISTANCE IN PEST AND WEEDS*

The global experience with the two predominant GM traits; one conferring resistance to specific insect pests and the other providing tolerance to herbicide applications, are leading to the generation of resistant pests and weeds. This has the secondary environmental effect of the need to spray other herbicides and pesticides to face the problem, leading to the same cycle of resistance experienced with antibiotics in the medical field (Benbrook 2012).

• *THE LARGE-SCALE PRESENCE AND USE OF GM PEST RESISTANCE GENES MAY HAVE IMPACTS ON NON-TARGET ORGANISMS*

Several studies have documented unexpected negative effects on non-target organisms as reviewed by Alvarez-Buylla (2004). Such effects are likely to multiply in megadiverse regions as México.

IMPLICATIONS FOR HUMAN AND ANIMAL HEALTH

In contrast to many industrialized countries where maize is used mainly for animal feed and for industrial processes, in México, maize is consumed with very little processing in large quantities (240-300 g daily) and is the staple food (Ackerman et al. 2003). Great uncertainties concerning the possible long-term animal and human health effects of consuming GM crops and being exposed to associated agrochemicals become very relevant (Domingo 2007), specially because a growing number of scientific studies are suggesting harm in test animals (Mathews et al. 2005; López et al. 2012; Malatesta et al. 2002a, b; 2003; Seralini et al. 2012). These findings have recently set off a global public debate on the need for long-term, standardized testing to fully address the veracity of these findings.

In addition, many studies (Classen et al., 1990; Arnason et al., 1994; Serratos et al., 1993; Vázquez-Carrillo et al., 2011) showed that the nutritional quality and secondary metabolism products of genetically diverse germplasm and native maize varieties (i.e. protein, free sugars, oil and phenolic content) was higher and more diverse in comparison to the uniform genetic pedigrees of GM hybrids, and would thus likely provide for a healthier diet for the Mexican population and sources of natural defense products.

• RISK OF CONTAMINATION OF MAIZE FOOD CHAIN WITH BIOFUEL AND OTHER GM MAIZE LINES THAT PRODUCE PHARMACEUTICAL OR INDUSTRIAL PRODUCTS (BIO-REACTOR LINES)

There are several lines of bio-reactor GM maize being produced and tested; ranging from ones intended for biofuels, to those used to derive pharmaceuticals or experimental chemicals (Ellstrand 2003). A large-scale commercial planting of GM lines increases the probabilities that such bio-reactor seeds escape to the Mexican maize production regions and food chains; this would deeply threaten food security in Mexico and elsewhere, as Mexican germplasm would be required.

LEGAL, SOCIO-ECONOMIC AND CULTURAL IMPLICATIONS

Socioeconomic, legal and biodiversity issues interrelate at the nexus of intellectual property rights (IPRs) via patents on transgenes and plant variety protection (PVP) on the hybridized varieties.

• IPRs WILL SEVERELY RESTRICT TRADITIONAL PRACTICES OF SEED EXCHANGE AND AGRICULTURAL BIODIVERSITY AND THE RIGHT TO FOOD

IPRs on GM varieties have the potential to deeply affect the communal management of seed stocks and thus threaten the reproduction of open seed systems indispensable for the longterm survival of landrace diversity (Alvarez-Buylla et al., 2011). We have not yet examined the implications of Mexican patent and plant variety protection laws, but *this is certainly an area that requires more investigation*.

• IPRs INSTALL A REGIME OF OWNERSHIP THREATENING FOOD SOVEREIGNTY

In our research, we attempted to trace family pedigrees of the varieties used by the applicants and adapted for the Mexican environment, through the Mexican government Registro de Variadades Vegetales[4]. We found that the information is not available to the public through online sources. In our view, there is still the open question on whether these GM varieties for which patents and PVP are being sought by these private companies utilize Mexican maize germplasm that was developed by Mexican farmers or research institutions in their local adaptation breeding programs from which the commerical seed is then produced. The implications of the privatization issue for food security should be investigated further.

•IPRs CONTRIBUTE TO SEED MARKET CONSOLIDATION MAY AFFECT SEED PRICING

As México seems to be replicating policies and market strategies towards GM crops already enacted in places like the United States, the experience from this and other countries adopting agricultural biotechnology is valuable for forecasting similar outcomes there. The global experience with strong

[4] http://snics.sagarpa.gob.mx/dov/Paginas/default.aspx

IPRs on germplasm has facilitated the concentration of seed supplies and the best lands under a very small number of multinational corporations (Adi 2006; Sagar 2000; Howard 2009) resulted in lower competitiveness (Pinstrup-Andersen 1999) and may contribute to changes in seed pricing (Shi et al. 2009). México's seed sector is already heavily dominated by some of these same companies seeking to introduce IPR-protected maize in México (Luna et al. 2012) and commericialization will likely intensify their market power. Similar narrowing of the maize seed market, particularly if modifications to existing IPR regimes take place, could be expected to occur in México.

• *IMPACTS FOR SUSTAINABLE LIVELIHOODS FOR SMALL-HOLDER PRODUCERS*

The livelihoods of Mexican peasants, as well as the agroecologically and locally adapted alternatives for sustainable maize production in México would be deeply threatened by a massive commercial release of GM maize (Nadal 2003; Alvarez-Buylla et al, 2011). Furthermore, the GM varieties do not yield more than the non-GM hybrids already used in the North of México, where the GM varieties may be released, so dependencies on the large maize producers will not likely solve the deficit in maize production. The latter could be actually solved with non-GM technology (Turrent et al. 2012).

Conclusions

Based on our analysis above, we conclude that the large-scale release of GM maize in México that will follow commerical approval will deeply threaten the core of Mesoamerican culture, Mexican food sovereignity and overall social well being, as well as global food security. The release of GM maize varieties is likely to further exacerbate existing inequalities, externalize risks and adverse effects and endanger all-important seed exchange practices that maintain and augment agricultural biodiversity since millenia and pose a potential threat to maize genetic diversity through transgene accumulation in open-pollinated varieties maintained by peasants throughout México. The only prudent decision at this time is to reestablish the moratorium on the releases of GM maize varieties in all of México, since further evidence has confirmed that the decision taken by the Mexican government in 1999 was based on scientifically sound arguments and experiences were rightly established. Furthermore, measures should be put in place, as recommended by the Commission for Environmental Cooperation (2004) to avoid the entrance into the Mexican territory of viable GM maize seeds.

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