GM crops vs. Apiculture. An ecological distribution conflict in the Mayan region of Mexico

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A B S T R A C T

Genetically modified (GM) crops have increasingly transformed socio-ecological landscapes around the world. Their impacts on apiculture (beekeeping) when sharing the same landscape reflect these transformations in a variety of dimensions. As a consequence of such impacts these two sectors have already clashed in several regions. This paper studies a case of such a conflict in a biodiversity and cultural hotspot located in the Yucatan Peninsula, the southeastern part of Mexico. In doing so, it explores the visions of Mayan beekeepers and other local and international actors supporting their stand in this conflict. Analysis shows how this heterogeneous group of actors discursively positions its interests and values on this landscape. This study describes the dynamics of production, markets, and access to natural resources and services at stake, while interpreting the languages of valuation held by key actors through official publications and key respondent interviews. Consequently, this analysis suggests that the variety of interests and values in defence of apiculture point out to (existing and potential) transformations produced by GM crops in the economic, ecological, and cultural dimensions of this landscape. In being the first multidimensional approach to a specific conflict between these two sectors, this study introduces apiculture as a key indicator of the transformations that GM crops produce in socio-ecological landscapes.

Keywords: apiculture, ecological distribution conflict, genetically modified crops, languages of valuation

1. Introduction

A series of airplane photographs capturing eight different Mayan archaeological sites were published in newspapers around the world the 14th of May 2012, all of them showing the same message: "MA OGM". In their respective languages these newspapers explained that MA means 'NO' in Mayan, and OGM is the acronym in Spanish for genetically modified organisms (*organismos genéticamente modificados*). Around two thousand Mayan beekeepers as well as representatives of 25 honey companies and civil society organizations (CSO) held hands to form these letters for the camera crossing the sky (Greenpeace, 2012). They simultaneously gathered in ancient temples that used to be the religious and political centres of Mayan societies, some of them around fifteen centuries old. Standing next to these massive stoned pyramids, which emerge in the midst of the second biggest tropical forest of the Americas, they aimed specifically against Monsanto Co.'s genetically modified (GM) soybean plantations in the Yucatan Peninsula (YP), a region they inhabit in the southeastern part of Mexico. Apiculture (beekeeping) and GM crops, they claimed, cannot coexist.

Such claim has been constantly expressed ever since the European Union (EU), the world's biggest honey market, some months earlier decided to restrict the importation of honey produced in landscapes shared with GM crops. In fact, the Court of Justice of the EU pronounced a Sentence on September 2011 to tag honey as a "GM product" when it contains more than 0.9% traces of GM pollen (Court of Justice EU, 2011). This restriction reduces the price of honey. It also increases production costs because it forces exporters to invest on laboratory analyses to prove their honey has no GM traces exceeding the 0.9% limit. Apiculture has existed in this Mayan region since pre-Columbian times; it became a large-scale industry in the second half of the twentieth century and currently it demonstrates a significant regional economic activity with 90% of its honey being exported to Europe (Financiera Rural, 2011). From the moment this Sentence was pronounced, all members of the apiculture (from production to trade) chain in the YP have organized the opposition to GM crops, along with local and international organizations from the environmental, human rights, and peasant rights fields. Some of them have now formed an activist collective called MA OGM, after the highly voiced slogan in Mayan. While coming from different perspectives and according to their institutional identities, these groups found a common ground in the defence of apiculture.

I consider this as an 'ecological distribution conflict' as understood by Joan Martinez-Alier (2009). Ecological distribution conflicts refer to "struggles over the burdens of pollution or over the sacrifices made to extract resources, and they arise from inequalities of income and power" (Martinez-Alier *et al*., 2010: 154). In this case, by far the most important GM crop corporation worldwide, Monsanto Co., introduced its Roundup Ready© (RR) soybean in Mexico in year 2000. Since then these plantations have progressively expanded, authorised by the Mexican government. Most recently, in summer of 2012, Monsanto Co. was given a permit to cover 253 thousand hectares (ha), a quarter of which are located in the YP (Monsanto, 2012), a region that has been acclaimed as a world biodiversity and cultural hotspot (CONABIO, 2008). The coalition opposing this expansion claims GM crops have a negative impact on the natural resources that apiculture depends on to survive, through deforestation, monoculture, and the use of pesticides. Furthermore, apiculture's main by-product, as I already mentioned, is also being polluted by GM pollen in the eyes of EU authorities.

With these considerations in mind, this paper seeks to explain how the actors involved in this resistance position their interests and values over the landscape of the YP. In section 2, I describe GM crops and apiculture, their global expansion and how they have clashed in several landscapes. Section 3 addresses the case study in the YP. It kicks off by mapping the conflict chronologically, geographically and institutionally. Later on, this section presents an analysis on the different perspectives about the effects GM crops have on this landscape, and on apiculture in particular. Such languages of valuation are expressed in official publications and key respondent interviews. Section 4 shows my findings on these languages of valuation. I conclude with some reflections on apiculture as a key indicator of the transformations GM crops have on socio-ecological landscapes.

2. GM crops and Apiculture: global expansion and conflict

2.1 GM crops

2.1.1 The transgenic revolution

GM crops are the latest technological phase of industrial agriculture. The GM industry has followed almost the same patterns of production and market as its preceding non-transgenic version. It followed the same production patterns, on the one hand, since GM crops are also based on monoculture and its implications, that is to say, land use change in large areas and increased use of chemical pesticides and fertilizers (Engdahl, 2007). On the other hand, the GM industry has followed the same market patterns since both GM and non-GM crops are, to a great extent, controlled by a few transnational corporations (which I will describe bellow). These corporations have historically had the exclusive financial and technological ability to produce (seed and agrochemicals) in such a large-scale basis, and to transport and distribute the harvest for processing or directly to international food and feed markets (Hasecki, 2013).

GM crops are thus in debt with this transnational industrialization of agriculture that preceded them, all of which began after the Second World War –a phenomenon usually known as the 'green revolution'. We may consider GM crops a combination of the 'green' and the 'genetic' revolutions if we acknowledge that the technological novelty introduced by GM crops is in debt, additionally, with the discoveries in genetics that came to light also in the second half of the 20^{th} century (Pingale and Raney, 2005). In a timespan of less than forty years, the fact that bacteria can exchange genes through plasmids was discovered (1946), the double-helical structure of DNA was described (1953), individual genes were isolated, cut out, and recombined to move genes between bacteria (1970s), and genes were introduced to plant cells (1983). This last achievement, by Monsanto Co. and Washington University, made GM crops possible (Halford, 2011).

2.1.2 Global expansion of GM crops

The extent of GM crop cultivation has increased every year, consecutively since commercial cultivation began. A single tobacco farm in China launched a virus-resistant commercial crop in 1988, only to be followed by a farm in California, in 1994, growing rotting-delayed tomato (Stone, 2010). Later on, in 1996, 1.7 million ha were approved for GM cultivation, mainly in the United States. By 2012 (only 17 years later) this number skyrocketed to 170 million ha. There has been a steady increase of around 10 million ha per year. In this 17-year period GM crops have been cultivated in 36 countries from all around the globe. In total 59 countries have granted regulatory approvals for GM crops for import, food and feed use and for release into the environment since 1996 (James, 2012). In 2012 their cultivation was approved by the governments of 28 countries, 6 of which made up for more than 90% of the total area: the United States (40.8%), Brazil (21.5%), Argentina (14.0%), Canada (6.8%), India (6.3%) and China (2.3%) (Nature, 2013).

2.1.3 Transgenes and pesticides

Agricultural plants have been genetically modified to tolerate pesticides and to resist droughts, insects and viruses. By far the most common GM crop is herbicide tolerant (HT) soybean, followed by HT and insecticide resistant maize (James, 2012). GM soybean, maize, cotton and canola account for almost the total of GM crops in the world, and have been designed with one or both herbicide tolerant and insect resistant traits. Each one of these crops has gained ground over its conventional (non-transgenic) counterpart in the last decade. Around 81% of world soybean is now GM; the same percentage stands for cotton; 35% and 30% are now GM maize and canola, respectively (James, 2012).

Herbicide tolerance is obtained by a gene for immunity to the most widely used herbicide in the world, Glyphosate. This is a broad-spectrum herbicide, effective to any kind of plant and used to kill weeds competing with crops (Duke and Powles, 2008). It was discovered in 1970 in Monsanto's laboratories and a year later introduced to the market under the name of Roundup. Its mode of action is to inhibit an enzyme involved in the synthesis of the amino acids that plants depend on to grow. It is absorbed through foliage and transported to growing points (Nandula et al., 2005). Insect resistance, on the other hand, was achieved by a gene from a bacterium called *Bacillus thuringiensis* (Bt) –hence the name Bt crops. This gene produces a protein that affects a great variety of insect species (bees among them) –by liberating a lethal toxin in the insect's gut– and which is expressed in all Bt plant cells, including pollen and nectar (Sandford, 2003).

2.1.4 Exclusive access to genetic resources

Six corporations own almost the entire GM industry: Monsanto Co., DuPont, Syngenta, Dow Chemical, BASF and Bayer. All six of them are among the world's 400 biggest corporations (Forbes, 2013). They started producing commercial chemical substances and are still in this business partly for the pesticides and fertilizers they produce. Monsanto Co. was the first to apply biotechnology to industrial agriculture and since then has been in the forefront of this hexagonal oligopoly in both seed and pesticide production and trade. Originally from Missouri, the U.S.A., this corporation is not only in the GM but also in the conventional (non-GM) agribusiness. In 2012, Monsanto Co. made 14 billion dollars in sales; a 2.3 billion dollar profit; assets for 22.5 billion dollars; and a 55.9 billion dollar market value (ibid.).

GM agribusiness has been benefited by the international homologation of property rights. The World Trade Organization (WTO) became the forum of governmental negotiation and agreement, including GM organisms. WTO's "Agreement on Trade-Related Aspects of Intellectual Property Rights" (TRIPS), adopted in 1995 by all member states, considers the "protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof", a statement that, in its vagueness, opens the possibility of patenting GM organisms in international law (WTO, 1995).

Patenting GM organisms or, more specifically, the genetic information of engineered organisms, and thus their offspring has been a topic of debate and concern in other, non-commercial international forums.

For instance, while the WTO regulated the parameters for private entities to benefit from "inventions" such as GMOs, the United Nations (UN), through its Convention on Biological Diversity, framed the "handling, transport and use of living modified organisms" (Cartagena Protocol, 2003) and the "access to genetic resources" for a "fair and equitable sharing of benefits arising from" their utilisation (Nagoya Protocol, 2010).

2.2 Apiculture

2.2.1 Bees and genes

Apiculture has also manipulated genetic resources, although not through biotechnology, not yet. Beekeepers have crossed honeybee species for generations to increase productivity. Cross-breeding has been traditionally achieved by replacing bee queens, which are commercialized for their genetic advantages in terms of immunological conditions and honey production efficiency. Another cross-breeding technique, recently developed, is known as 'instrumental insemination', which offers beekeepers a better control over genetic flow and has enabled the study of bee genetics (Harbo, 1986). Microbiologists are starting to identify specific bee gene functions and learning to manipulate them to control diseases and parasites (Elsik, et al., 2007).

Currently, there are 20 thousand species of bees in the world, but only 7 of them (divided into 40 subspecies) produce honey. The most commonly used by apiculture worldwide are hybrid varieties of the Western species (*Apis mellifera*), originally produced by the cross-breeding of the African (*A. m. scutellata*) with European subspecies, such as the Italian (*A. m. lingustica*) and the Iberian (*A. m. iberiensis*) (Franck, 1998).

2.2.2 Apiculture as an environmental indicator

Honeybees' genetic information and the landscape they inhabit are both expressed in the type of honey they produce. The amount of honey, as well as its colour, density and taste depend on honeybee and foraged-floral genes. The study of the pollen contained in honey (melissopalynology) shows not only the flowers' DNA but also other conditions of their landscape. There is a correlation between every type of honey and the predominating temperature, humidity, vegetation and soil of the landscape in which it its produced (CONABIO, 2009). The presence of pesticides to which bees, beehives and foraged flowers are in contact with can also be traced (Debayle, D., et al., 2008). Analysing the evolution of pollen traces through time can thus show the characteristics and changes of landscape elements, which makes honey a potential environmental indicator.

The environmental seal found in pollen traces shows the co-dependence between bees and the different flora species that they pollinate. Bees are actually the most important pollinators in the world (FAO, 2008). They have morphologically coevolved with flowers. The structure of their proboscis (tongue) enables efficient nectar gathering. Also, the electrostatic charge produced by the abundant hairiness of their bodies attracts pollen grains even when there is no contact with the flower. Pollen is then scattered into the air and deposited in the flowers´ feminine receptacle. This co-dependence is reflected in food production, since one-third of the human diet depends on insect-pollinated plants (FAO, 2009). Bees are the most important pollinators of global agricultural crops. They pollinate over 70 out of 100 crops that in turn provide 90% of the world's food (FAO, 2009; Klein, 2006). There is even a commercial market for honeybee pollination, whereby beekeepers offer farmers this service by transporting their hives to plantation areas. With the decline of insect pollinators in the world –a phenomenon I will address below– honeybee assisted pollination services for crops has increased annually (Garibaldi et al., 2013).

2.2.3 Honey production and markets

Several human populations have gathered and produced honey and its derivatives for thousands of years. Honey was already represented as a resource in cave paintings from the Paleolithic and Mesolithic periods. It became a sacred good in ancient Egypt, Mesopotamia, Persia and China (sought-after by the ruling classes) and was traded among precious goods throughout the European Middle Ages (Crane, 1999). A combination of technological improvements increased production efficiency in the last 200 years. For example, assisted pollination has been possible since the advent of moveable-frame hives in 1851. The 'smoker' (used to calm bees while honey is extracted) and the 'extractor' also date from the 19th century. In the 20th century, the instrumental insemination of honeybee queens was developed, and antibiotics started to be used to control bacterial diseases (Crane, 1999).

Apiculture became a large-scale activity in the mid 20th century thanks to these technological improvements to a great extent. Today 135 countries produce a total amount of approximately 1 million 600 thousand tonnes per year; 45% of which is produced in Asia, 23% in Europe (including Russia), 19% in the Americas, 11% in Africa and 2% in Oceania (FAOSTAT, 2011). The biggest producers of honey are China (27%), Turkey (5.7%), Ukraine (4.3%), the United States (4.0%), Russia (3.6%), India (3.6%), Argentina (3.6%) and Mexico (3.5%). The biggest exporters are China (19.8%), Argentina (15.3%), Mexico (6.6%), Germany (6.1%) and Uruguay (5.4%). Some 30% of honey is exported, half of which is imported by the EU (ibid.). Between the years 2001-2010, honey international trade represented an annual average of around $940 million dollars (ibid.). The price of honey varies according to its conventional, organic and/or fair-trade status. Organic honey is produced without flour or syrup feed, in free-pesticide landscapes. Another element defining honey price is the diversity of foraged flowers, poly-floral honey having the highest value in the markets.

2.3 Conflict between GM crops and apiculture

2.3.1 A controversial biotechnology

Conflicts have arisen around the world as a response to the socio-ecological transformations produced by GM crops (Scoones, 2008). Some of these transformations have been studied empirically in laboratory experiments or fieldwork. For instance, shocking pictures have spread in the world media showing GM maize-fed rats infested with cancer tumors (Seralini et al., 2012). Other experiments have linked Glyphosate-based herbicides (GBH) to allergic reactions, congenital malformations, miscarriages, endocrine disruption, cancer and other toxic and lethal effects (Dallegrave et al., 2003; Dallegrave et al., 2007; Benítez et al., 2009; Séralini et al., 2009; Carrasco et al., 2010).

Loss of biodiversity, pests and soil and water degradation, as well as an increase of pesticide use and energy consumption, on the other hand, have been claimed to be the consequence of GBH and other pesticides used in GM crops (Hawes et al., 2003; Brooks et al., 2003; Meadows, 2005; Benbrook, 2009; Bindraban et al., 2009). Impacts of GM crops on peasant's socioeconomic condition have also been studied (Isaac, 2002; Altieri and Pengue 2006; Clapp, 2006; Altieri, 2007), as well as the implications of corporate global food commodification (Kloppenburg, 2004; Prudham, 2007; Bello, 2009) and of agricultural genetic enclosure as a biopolitical expression (André, 2002; Herring, 2007; Braun, 2011).

National and regional food-safety agencies –such as the US Food and Drug Administration, or the European Food Safety Authority– have published their own assessments on the consequences of GMO production and consumption, usually with contradicting findings. In fact, the last decade has witnessed a heated debate on whether the accusations against GM crops are scientifically robust, or rather ideologically or politically biased (Stone, 2010). Scientific uncertainty has prevailed. However, it is undisputed that GM crops have caused a worldwide concern that in many cases has been materialized via conflicts in different landscapes.

2.3.2 Colony Collapse Disorder

Almost all the countries growing GM crops were at the same time producing honey during the period 1996-2012. As a consequence of sharing the same landscape (an important topic to which I will return bellow) conflicts have arisen between GM crops and apiculture. Since 2010, such conflicts were reported from Germany, Spain, Poland, Canada, the United States, Peru, Chile, Uruguay and Mexico. The main cause for these conflicts is GM pesticide's toxicity for bees. Beekeepers, scientists and activists have blamed the use of a particular type of insecticide for what has been called the Colony Collapse Disorder (CCD). CCD is the name of a syndrome that has been affecting honey bee colonies since 2006 in the Northern hemisphere, which is characterized by a sudden disappearance of honey bees from the hive (Henry et al., 2012). A great deal of literature exists on CCD, published both in popular press and in scientific journals (Nguyen and Saegerman, 2009; Kaplan 2010, 2010b, 2010c; Creswell, 2011; Gill et al., 2012).

Neonicotinoids are the world's most widely used insecticides, both in GM and non-GM crops. They are based on nicotine, which is a neurotoxin for most insects. Bees that come into contact with neonicotinoids are thought to lose their sense of direction, which disables their ability to fly back to their hive. As any other systemic pesticide, neonicotinoids break down in all the plant's cells, including its flowers, pollen and nectar, affecting insects' nervous system. Among the multiple causes of CCD that have been proposed –which include pathogens, parasites and natural habitat degradation (Cox-Foster et al., 2007; Mullin et al., 2010; Naug, 2009; Bromenshenk et al, 2010)– pesticides and especially neonicotinoids have gained notoriety, alone or in combination with other stressors (Alauz et al., 2010; Vidau et al., 2011; Gill et al., 2012).

Some protests against neonicotinoids due to their effects on bees have reached success. The Polish Ministry of Agriculture, for instance, banned Monsanto's Bt corn (MON810) after the demonstrations led by 1,500 beekeepers and allied civil society organizations in 2012 (Causes, 2012). More recently, a broader mobilization arose in different parts of Europe. International pressure group Avaaz organized a "Save the bees" campaign with massive phone calls and emails, press conferences, opinion polls, demonstrations in London, Brussels and Cologne, as well as a written petition with 2.6 million signatures in the first months of 2013 (Avaaz, 2013). Meanwhile, EU authorities discussed the approval of three types of neonicotinoids (clothianidin, thiamethoxam, and imidacloprid) mainly manufactured by pharmaceutical giants Bayer and Syngenta. Given "new scientific information on the sub-lethal effects of neonicotinoids on bees", the European Commission (EC) asked the European Food Safety Authority (EFSA) for "scientific and technical assistance to assess this new information and to review the risk assessment of neonicotinoids as regards to their impact on bees" (European Commission, 2013: 1-2). In its assessment, EFSA concluded "unacceptable risks" for bees were in fact caused by these three neonicotinoids (EFSA, 2013) and as a response the EC voted in April 2013 to suspend their use within the EU for two years (European Commission, 2013).

2.3.3 Transgenic honey

Traces of GM pollen found in honey have been another source of conflict between these two sectors. Concern on the human health risks of ingesting GM products is very well known and has spread worldwide. Public opinion and legislation in the EU have expressed this concern particularly. As regards to honey, restrictions have been established recently in the EU for the importation of honey suspected of having pollen from GM crops. A conflict between a single beekeeper from Bavaria, Germany, and Monsanto Co. ended up establishing these restrictions. After traces of GM maize pollen (MON-810) and transgenic proteins (Bt toxins) were found in this beekeper's honey he decided to sue Monsanto Co. in 2005. Three years later, a local tribunal declared that his honey was "not apt for human consumption" because MON-810 is an agricultural product allowed as fodder in the EU, not as human food. This decision produced a critical reaction from the press and protests by beekeepers and anti-transgenic organizations. As a response, the Bavarian government banned the cultivation of this GMO from Bavaria and the state court declared itself incompetent to solve this case and consequently redirected it to the Court of Justice of the European Union (CJ-EU) (Spiegel, 2009).

What followed in this court case has had a broad impact on the importation of honey in the EU, and thus has affected half of the world's honey exportations. In 2011 the CJ-EU closed this case by pronouncing a Sentence declaring that pollen is an ingredient of honey, which implies that any imported honey has to be examined according to the 2003 EU 'Regulation on genetically modified food and feed'. Two possible situations with imported honey arise from this Sentence. If any amount of pollen from GM plants that have not been authorised as human food is found in a honey cargo, this cannot be commercialized in the EU. On the other hand, if foraged GM plants do have this edible authorisation, honey will be tagged as a product "containing genetically modified ingredients" unless its pollen is not more than 0.9% GM (Court of Justice EU, 2011). This Sentence has affected the main countries exporting honey to the EU because GM crops are being cultivated in each one of them: China, Argentina, Mexico, Chile, Brazil, Uruguay and India. However, only in Mexico –specifically in the YP– has a conflict arisen with legal and biophysical consequences on the landscape and on the evolution of GM crops, as I will describe and analyse as follows.

3. Conflict in the Yucatan Peninsula

3.1 Mapping the conflict

3.1.1 Geographic location

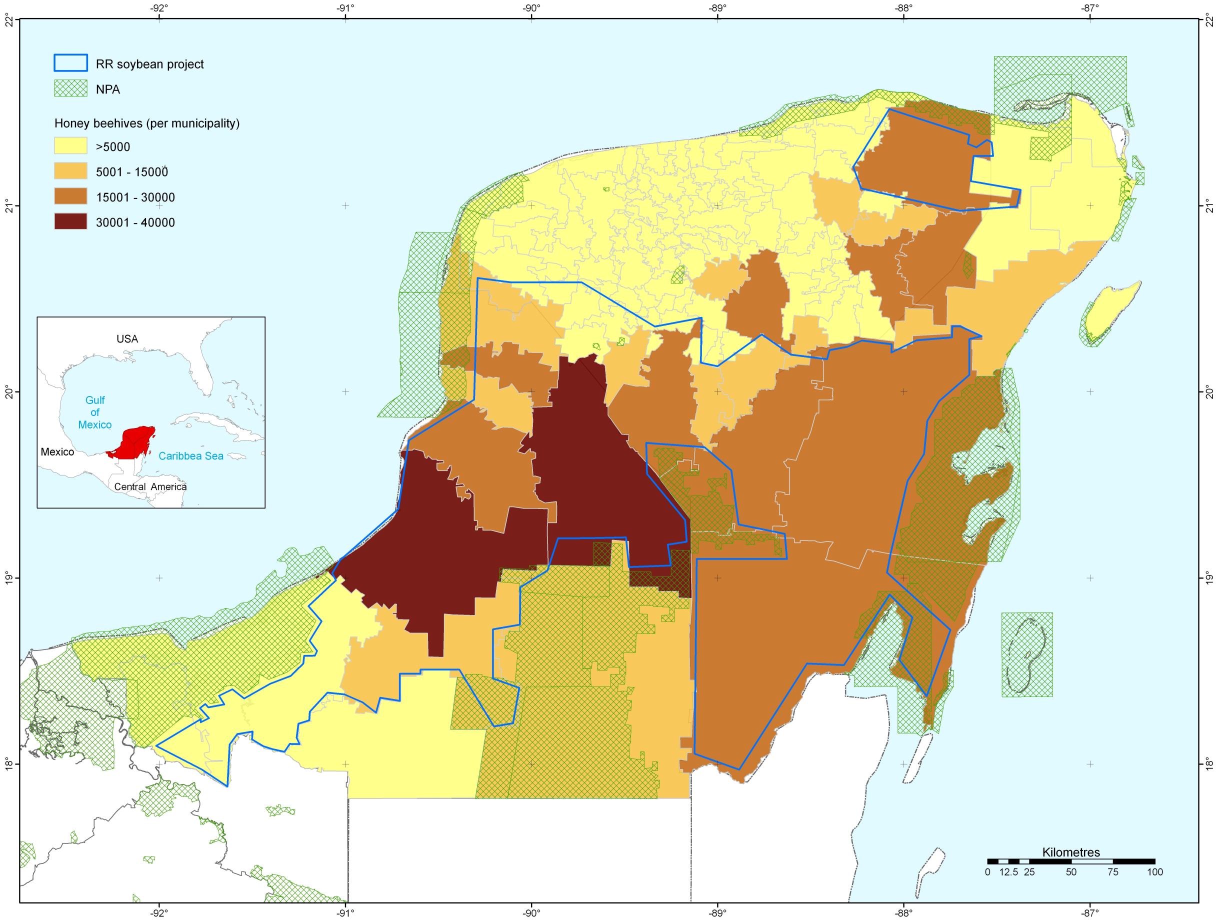
The YP is located in the southeastern part of Mexico. It divides Central America from North America, bordering the Gulf of Mexico and the Caribbean Sea. It is comprised of three federal states: Campeche, Quintana Roo and Yucatan, occupying a total area of 14 million ha. Almost the entire YP is topographically flat and has a very shallow soil made up of a highly calcareous material, which drains fluvial water and prevents the formation of permanent superficial basins. Instead, a subterranean river network lies beneath the whole peninsula, gathering pletoric groundwater that has been the most important natural resource for human communities inhabiting the region for thousands of years. High biodiversity has emerged from such hydrological abundance (CONABIO, 2008).

The second biggest tropical forest on the American continent, after the Amazon, is found in this region covering around 8 million 800 thousand ha (60% of the total peninsula) (ibid.). Forests, coral reefs, sea inlets, wetlands, spring waters, mangroves and coastal dunes shelter great biological diversity, including high endemism, and are the habitat of 6 species of felines, 530 species of birds and 188 species of amphibians and reptiles (ibid.). For their conservation, 16 Natural Protected Areas (NPA) have been established.

YP is home to almost the entire Mayan community of Mexico (INEGI, 2011). Partly due to the geographical homogeneity found here, there has been a common and unique type of Mayan language – known by contemporary philologists as *peninsular* or *yucateco*– ever since the first human settlements in this region occurred some 6500 years ago (Perez, 2004). Mayans in the YP form a rural minority of 759 thousand, who represent 18% of this region's whole population. Maize cultivation and apiculture are their main economic activities. They switch from one activity to the other according to the season of the year.

Almost every municipality in the YP has at least one apiary (honey farm with two or more beehives) (INEGI, 2007).

The 2012 Monsanto Co. project for the commercial cultivation of RR soybean in the YP covers 60 thousand ha divided in two polygons (Monsanto, 2012). The following map shows the location of these polygons, and how they overlap with NPA and honey beehives.



Map 1. Location of the RR soybean project, NPA and honey beehives across the YP

3.1.2 Timeline of the conflict

The conflict between apiculture and GM crops in YP was ignited by the Sentence on "transgenic honey" that I described in section 2, pronounced by the Court of Justice of the EU on September 2011. This Sentence forced honey exporters from the YP to redirect their sale to other markets with a lower price value, and to annually invest (ever since) on laboratory experiments to show their honey has no GM traces exceeding the 0.9% limit. But even if lab results show no GM traces, a negative stigma has already devalued this region's honey within the European markets. Consequently, from the moment this Sentence was pronounced all the different links comprising the apiculture (production and trade) chain in the YP jointly organized the opposition to RR soybean crops.

The MA OGM activist collective, whose short history was given above, has coordinated this mobilization to a great extent. The entire apiculture chain is represented in this collective. Environmental, scientific, peasant and human rights organizations have also participated as members, or supporting its cause in demonstrations and public statements in newspapers, radio, TV and the Internet as well as in tribunals with legal appeals. Since the Fall of 2011 the members of MA OGM have met systematically and followed a common strategy. Periodic workshops and forums (in rural communities and universities) have taken place to discuss and analyse the conflict, organise the resistance and spread the word among beekeepers on the impacts of GM crops, as well as to convince peasants to reject soybean's GM version. Moreover, letters signed by thousands of beekeepers have been delivered to local, state and federal authorities, and some common-property communities (*ejidos*) have reformed their regulations to ban GM crops as a consequence of this mobilization.

RR soybean has been grown in the YP since the year 2000. For ten years (2000-2009) it was grown as part of an 'experimental' project, i.e. in a small area with "containment measures" (physical, chemical, or biological barriers, or a combination thereof) to "restrict its contact with the population and the environment", according to the federal 'Biosecurity Law of Genetically Modified Organisms' (2005). This law is based on the UN 'Cartagena Protocol on Biosafety' (2003). Accordingly, it follows the 'step-by-step' principle for the introduction and expansion of GM crops. The first step is the 'experimental' liberation. The second step is the 'pilot' programme, which may or may not include containment measures in a wider area. 'Pilot' permits for RR soybean were granted to Monsanto Co. for the period 2010 and 2011. Finally, the Biosecurity Law states that 'commercial' liberation is granted if the previous stages were not found to cause unacceptable impacts on the environment and human health.

The first legal appeal against RR soybean in the YP was presented on February 2012 against the 'pilot' programme permit granted a year before. This programme considered an area of 30 thousand ha. In response to this appeal, a local judge decided to suspend the permit in the whole YP for a year. Immediately after, however, Monsanto Co. applied for another permit in twice this area for 'commercial' liberation. Four months later the Mexican government granted Monsanto Co. this upgraded permit.

There has been a twofold reaction against this 2012 'commercial' permit. The executive government of the state of Yucatan, who has openly rejected GM crops in its territory, has led the first reaction.

Through its Ministry of Environment, this government published a decree to support any local community interested in declaring its territory a "transgenic-free zone" (SEDUMA, 2012a), according to the Biosecurity Law. Afterwards, a "state of contingency" was declared by this Ministry (given the "serious risk caused by the presence" of GM crops), which involves the following measures: 1) controlling and monitoring the access, storage and cultivation of GM seeds; 2) financially promoting non-GM soybean seeds among peasants; 3) reforesting the most important apiculture areas with tree species that are foraged by honeybees; and 4) promoting a policy to tag all products with GM ingredients (SEDUMA, 2012b).

MA OGM has led the second reaction against the 2012 permit. After the famous demonstration in eight Mayan archaeological sites (described in the introduction of this paper), this activist collective presented 6 legal appeals (two in each federal state of the YP) signed by Mayan communities and beekeeping associations. Consequently, a local judge ordered a one-year suspension of the permit, but only in the state of Campeche. This Suspension was withdrawn months later by a higher tribunal, who favoured Monsanto Co.'s disagreement. However, no RR soybean was grown in 2012 in the entire YP, presumably because the three state governments decided to stop these controversial plantations during this federal election year. All 6 appeals are being gathered in the state of Yucatan for a final sentence. Meanwhile, MA OGM made another demonstration reported by the mass media, whereby an "invading boat" with pirate flags and carrying the name of Monsanto sailed the coast of Campeche and was theatrically bombed with canyons that were managed by beekeepers from the city's historical fortress (MA OGM, 2013). This demonstration took place the 25th of May as part of the 'International day against Monsanto'.

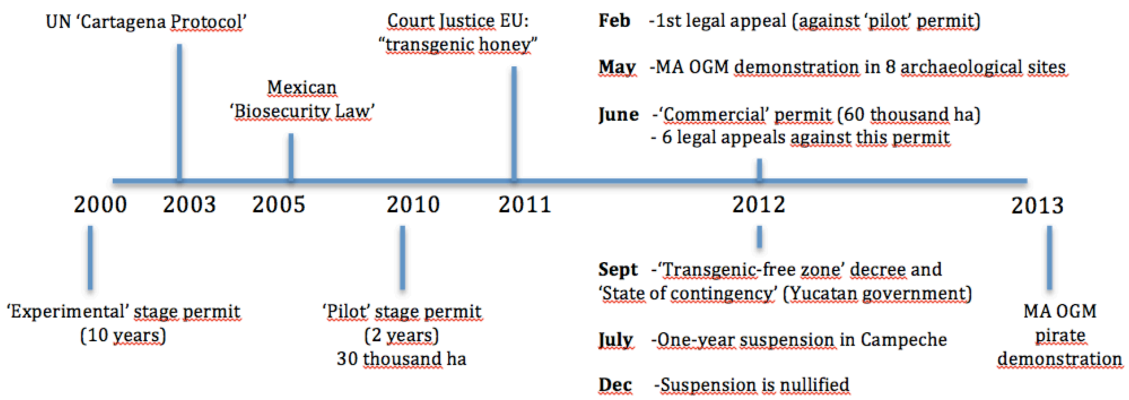


Figure 1. Timeline of the conflict in the YP

3.1.3 Key actors in this conflict

Besides the GM industry, the Mexican executive government has been the most important promoter of RR soybean in the YP. This government has supported the introduction and expansion of three GM crops since the 1990's. Nowadays, Bt cotton and RR soybean are commercially grown in different regions of the country; Bt maize is currently in a pilot stage. The three Mexican ministries in charge of authorising GM crops have invariably favoured this biotechnology: the Ministry of Health (SS, for its name in Spanish), the Ministry of the Environment and Natural Resources (SEMARNAT), and the Ministry of Agriculture, Stockbreeding, Rural Development, Fishery and Food (SAGARPA).

RR soybean is the only GM crop grown in the YP. The authorisation given by SEMARNAT for its commercial liberation contravened the official opinion given by the three governmental institutions dedicated to environmental research and conservation in Mexico: the National Commission for Knowledge and Use of Biodiversity (CONABIO), the National Commission of Natural Protected Areas (CONANP) and the National Institute of Ecology (INE). Separately, they developed an assessment-report equally concluding that the environmental impacts these crops might produce are unacceptable, and thus no permit should be granted (CONABIO, 2012; CONANP, 2012; INE, 2012). The three mention coexistence problems with apiculture as part of their arguments. Such assessment-reports were not taken into account partly because Monsanto Co. and AgroBIO have lobbied successfully. AgroBIO is the consortium of the four GM corporations working in Mexico (Monsanto Co., Bayer, Dow, Dupont and Syngenta). It represents their interests by promoting GM crops in the media, working as a lobby agent, and seeking to link the GM industry with agricultural producers and biotechnology research centres (AgroBIO, 2013).

On the other hand, a great variety of actors have actively expressed their opposition to RR soybean in the YP, gathered in the defence of apiculture. One of these actors is the Yucatan state government, as I have previously outlined. Another one is the United Nations Development Programme (UNDP), which has supported organic apiculture for 20 years in the YP through several projects. The regional UNDP office in the YP has given assistance on GM crop impacts and regulations to apiculture associations ever since the conflict started. It has also participated and hosted meetings that are called by MA OGM, and has publicly expressed the need to follow the 'precautionary principle' considered in the Cartagena Protocol.

Other actors against RR soybean in the YP have jointly mobilized to ban the governmental permits. I have identified 20 apiculture associations and companies, 36 civil society organisations (CSO) and members of 8 universities and research centres that have manifested their opposition to this GM crop. The entire apiculture chain in the YP is involved in this mobilization: small-scale Mayan producers; community, sub-regional, large-scale and organic/fair-trade honey associations; and private companies. For the first time they have all come together for this common goal: banning GM crops to protect apiculture. Except for the organic/fair-trade associations (which are commercially connected in a separate network), all the apiculture sectors in the YP are members of the Mexican Association of Honey Exporters (AMEMAAC), which manages most of the honey exportations from the YP (Financiera Rural, 2011).

3.2 Interests and values against RR soybean in the YP

I carried out fifteen semi-structured interviews (in April and May, 2013) with key actors involved in this conflict, all of which have had a prominent role in the opposition to RR soybean cultivation in the YP. Two of the respondents work on apiculture: the first as the director of an organic and fair-trade association ('EDUCE Sociedad Cooperativa'), and the second as the owner of a production and exportation private company ('Miel Integradora') and treasurer of AMEMAAC at the same time. Six interviewees belong to (environmental, human rights, or peasant) CSO (Greenpeace, *Bioasesores*, *Indignación*, *Litiga OLE*, *Semillas de vida* and UNORCA). Another three are scientists (two biologists and one agronomist) from a research centre (*El Colegio de la Frontera del Sur*) and a university (*Universidad Autónoma Metropolitana*), respectively. Finally, I interviewed the Minister of the Environment of the state of Yucatan, two members of CONABIO in charge of the Biosecurity agenda, and the Director of the UNDP in the YP. Six of my interviewees lead the MA OGM collective.

The interviews were meant to create a channel for key actors to express their interpretation of the (current and potential) landscape impacts of RR soybean plantations in particular and GM crops in general. The interviewees also expressed their account of and their participation in the conflict as well as their view on the interests that have favoured the introduction and expansion of these plantations. Together with other documents –such as official publications, websites, scientific articles and press releases– the interests and values of the actors opposing RR soybean in the YP were analysed. I identified three dimensions in which landscapes in this region are transformed by RR soybean according to their testimonies: economic, ecological and cultural.

3.4.1 Economic impacts

GM crops were identified as a threat for apiculture for the first time when the "transgenic honey" Sentence of the EU was pronounced. Approximately $70 million dollars (20 thousand tonnes) in honey exportation were jeopardized, which represented 40% to 70% income of 15 thousand beekeepers (Financiera Rural, 2011). The EU had been importing 90% of the honey produced in the YP (Germany 61%; the United Kingdom 13%; Switzerland 8%; Belgium 3%) until 2011, when this honey had to be redirected to other markets (mainly to the United States) where the price value was decreased around 25% (Munguía, 2012).

"One of the main criteria to grow GMO in Mexico, according to the Biosecurity Law, is its compatibility with other activities", Xavier Moya, Director of the UNDP office in the YP, told me. "It has been shown that there is no compatibility with the economically most important activity for the region, and for so many families", he followed.[1] Miguel Angel Munguia, the director of EDUCE, undertook a cost-benefit analysis in 2012 comparing honey with soybean. This analysis concludes that the negative impact on apiculture is 55 times higher than the benefit of producing RR soybean. Furthermore, honey's contribution to the YP economy was 5.2 times higher than soybean that same year (Munguía, 2012).

This conflict was strictly commercial at the beginning. However, the different actors defending apiculture had already adopted a critical opinion about GM crops on other fields. They reject the concentration of wealth that they consider is inherent to industrial agriculture and which is exacerbated by the patent system that characterizes its transgenic version. "The industrial model here is contrary to the interests of the communities", said Federico Berrón, treasurer of AMEMAAC.[2] It "has promoted monopolies, gigantic corporations, national and international", agreed Adelita San Vicente, member of Semillas de Vida, a CSO aiming to ban GM crops in Mexico.[3] "What worries us", said Eduardo Batllori, the Minister of Environment of Yucatan, "is that [federal governmental officials] allow this type of agriculture and [the entrance of] transnational companies with this discourse about fighting hunger. The experience in South American countries shows that a dependency is created regarding seed. This is an

[1] Interview #2, Xavier Moya, 18.04.2013
[2] Interview #1, Federico Berrón, 16.04.2013
[3] Interview #5, Adelita San Vicente, 5.05.2013

important economic issue. Producers cannot save seed for the following season or production cycle; they have to buy it again. A dependency is created on food production. Producers are tied to Monsanto, and this creates an undesirable monopoly".[4]

"Several governmental officials I know personally are against discussing this topic", Pablo Duarte told me later. He is the state director of the National Union of Regional Autonomous Peasant Organizations (UNORCA) in Yucatan. "They say GM crops are necessary because they will make us self-sufficient, autonomous in terms of food. This has never been true. This is a great business. Transgenic soybean production is all about capturing the seed market, it is not about improving productivity; that does not happen, it does not exist, transgenics do not improve productivity. They try to eliminate our seed so we depend on their market. It is a process of commodifying seed. Big companies want to keep the seed market for themselves. We do not agree. We are against Monsanto, Bayer, Pioneer, Syngenta, against all the big companies that produce seed. They want to leave rural producers without the possibility of having their own, which would allow their own subsistence with food production. That is the real problem."[5]

But "industrial production is just the tip of the iceberg" Adelita insisted. "It is not really about technology so much as about the appropriation of fitogenetic resources. We see this through the idea of the commons, enclosing the commons, enclosing a common good, which is the seed, through biotechnology, public policies, and laws. It is communality against mercantilism, against capital's domination of seed […] Last year I went to a transgenic inspection laboratory, and it was overwhelming. When I asked 'what do you do when you find transgenes?' they answered 'well, we go back to the land and ask the peasant to get a lawyer'. They use the law the wrong way".

"Besides Monsanto, who is interested in the cultivation of GM crops, and RR soybean in particular in the YP?" I asked my respondents. They mentioned local, national and foreign economic interests. At the local level, agricultural industry businessmen as well as the Mennonite community have jointly grown 10 thousand ha of RR soybean per year in 2010 and 2011, supplying large-scale production for the pork and oil industries. The production of (soybean fed) pork in this region is one of the most important on a national scale. On the other hand, "there is a state and federal policy to turn Campeche in particular into the granary [breadbasket] of Mexico", Irma Gómez told me. She is a member of MA OGM, a forestry PhD student and lives in a town in the state of Campeche (Hopelchen) where large-scale plantations are

[4] Interview #12, Eduardo Batllori, 19.05.2013
[5] Interview #6, Pablo Duarte, 6.05.2013

grown at the expense of the forest. “Given the drought situation in the North of the country”, she explained, “which is unstoppable, there is a need to assign areas in the South-Southeast to produce grains. Campeche is considered to have a great potential [for this]”.[6]

At the national level there has been a policy for grain self-sufficiency. Nowadays a great amount of sorgo, soybean and maize are being imported (Martinez, 2012). “SAGARPA’s official standing”, the biologist and bee expert Remy Vandame affirmed, “is to gain food security, depend less on the importation of food, produce more in the national territory and eventually go for exportation […] It is a fact that Mexico depends on imported soybean, from the United States. But this explains the need to grow soybean. Why transgenic soybean? This is more difficult to explain,” he admitted; “GM crops do not have a higher efficiency”.[7] Federico has a hypothesis: “I met high governmental officials of the State Department of the US and a former ambassador, and I asked them if it was a State policy to introduce transgenics in Mexico. He said ‘if it is a State policy we will not discuss it’. They did not want to address the subject. But you saw what happened with Wikileaks and France” Federico assumed. “The American ambassador in France sent a list of French organisations that are against transgenics for ‘the retaliation measures we have agreed on’. So here in Mexico we are definitely not prepared to say ‘no’ to the US, unless a very big mobilization against GM maize takes place.”

3.4.2 Ecological impacts

“The industrial model [of agriculture], which was introduced [in Mexico] since the [1994 North American] Free Trade Treaty has been disastrous for the environment. For example, there is no biodiversity left in the riverbank. The Hondo River has been contaminated. It has been transformed radically. If you read the [Spanish] conquest chronicles, when Montejo arrived, this river marvels him, and he says ‘the production of honey here is amazing’. All this area is now monoculture, from both sides of the river […] Industrial agriculture is unsustainable. It is like petroleum. In three or four generations of oil drunkenness we are leaving a climate change problem. We may have high productivity in a short period, and then major problems that we will leave to other generations. I am convinced that agro-ecology should be promoted because it is a long-period perspective”, Federico stated. Pablo agrees: “we should go back to producing maize the way we used to, not as monoculture”.

However, there was consensus among my interviewees that for the time being a compromise can be achieved with the industrial interests, growing monoculture but without GMO. “We do not refute the

[6] Interview #15, Irma Gómez, 28.05.2013
[7] Interview #13, Remy Vandame, 20.05.2013

government's argument for food sovereignty" Miguel Angel yields. "If you can help the commercial balance it is ok, we do not discuss that. But the topic here is what type of soybean you are sowing. Why does it have to be transgenic? How much chemicals it demands and how harmful they are for the environment, has been demonstrated. Why do they want to bring a seed from a transnational from whom you even have to buy the chemical and create such a dependence, when you have your own seed that works well and was created by a governmental institution?"[8] Miguel Angel was referring to the 'Huasteca' seed, created by SAGARPA through a long process of genetic selection, without transgenes, and resistant to several diseases (INIFAP, 2012).

Federico complements this argument: "We should have a proactive position. If soybean is good business, if we are already industrialized, let us produce it but not GM. It is even a good food resource. Non-GM soybean and apiculture can be more or less compatible because it is the only thing that is blooming at the moment [between July and September] and honeybees like it". "An alternative should be taken in a way that no one is affected", Xavier stated. "The interests of one sector don't have to clash with the interests of another. Certain peasants should not lose on account of others. Alliances should be looked after, as well as the compatibility of activities. This is always a problem in the same ecosystem, in the same landscape. We have to do planning, one which is much more negotiated, with more participation, like the one in the rural areas of the EU; long term and which takes into account several factors, not just the economic."

The Ministry of the Environment of Yucatan has financially supported soybean production with the 'Huasteca' seed, because "all agriculture activity is now using great quantities of herbicides and pesticides, [but using the 'Huasteca'] has important implications in terms of employment (more workforce is needed to control weed) and for the environment because it uses more specific herbicides, with a narrower spectrum." So despite the environmental harm produced by the large-scale production of 'Huasteca', "there are benefits compared to the GM", Eduardo concludes.

Unlike RR soybean, the 'Huasteca' does not use Roundup. There is a shared concern on the impacts this Glyphosate-based herbicide may have on human health and the environment. Light aircrafts are used to spray it on the fields. "The beekeepers we have interviewed", Rogel Villanueva told me, who is a honey palaeontologist and a bee researcher, "say all the birds around the fumigation area have died; even domestic animals […] Using this herbicide causes air and water contamination. Glifosate has a certain

[8] Interview #7, Miguel Angel Munguia, 8.05.2013

period of life in which it intoxicates wild fauna and human beings. People drink the water directly from wells."[9] Vicente Chulin, the director of Bioasesores –a CSO dedicated to natural resources management and rural sustainable production– mentioned this as well. "Given the type of soil we have here in the Peninsula, which is a highly permeable soil" he said, Roundup "ends up in our water basins, which are under the [RR soybean] liberation zone. This can have serious implications given the vulnerability of our aquifer".[10] A study has been developed on the effects of Roundup in aquatic fauna. Unprecedented fish mortality was found in Bacalar, a lake in Quintana Roo, next to which RR soybean has been cultivated. The dead fish and this lake's water were found to have high levels of Glyphosate (Alvarez, 2012).

Deforestation has been another ecological impact attributed to the expansion of RR soybean. "The soil in the YP or in Chiapas is suitable for [agricultural] machinery; not in the North [of Mexico] because there is a lot of stone over there. In many places where machinery is used they are deforesting for soybean monoculture. This has a serious impact on biodiversity. In some areas this is really dramatic"[11]. In fact, "10 thousand ha of forest were cut down to grow soybean, maize and sorgo in Campeche".[12] Irma considers that there is a risk of further deforestation given that RR soybean polygons overlap with NPA, according to CONAP's assessment-report (CONANP, 2012).

"Common-property lands [*ejidos*] are rented to big companies for long periods –eight, ten, fifteen years. They deforest, land becomes totally unfertile, and they leave. The same has happened in Paraguay, Argentina and Brazil. This is what we want to avoid […] Deforestation affects bee performance because there are fewer plants to forage. Honey productivity in these areas has decreased because there is much less biodiversity of plants for nectar extraction. Land use change should not take place where there is an industry adapted to the Mayan cultural tradition, which is apiculture, and which is vital for the environment."[13]

In its assessment-report CONABIO states that "any situation negatively affecting the development of apiculture, directly or indirectly, has a detrimental effect for biological diversity". "Apiculture fulfils an ecological function", Francisca Acevedo explained; it "fulfils a function directly linked to biodiversity in its landscape".[14] She coordinates the Biosecurity area of CONABIO and directed the elaboration of this report. "If the thousands of families involved in this activity do not consider that it has a value for their

[9] Interview #9, Rogel Villanueva, 10.05.2013
[10] Interview #4, Vicente Chulin, 4.05.2013
[11] Interview #7, Miguel Angel Munguia, 8.05.2013
[12] Interview #15, Irma Gomez, 28.05.2013
[13] Interview #7, Miguel Angel Munguia, 8.05.2013
[14] Interview #10, Francisca Acevedo, 10.05.2013

home and their daily resources anymore; if they stop doing apiculture because it does not offer an important income, this [ecological] function will end […] It is not the same [for markets] if bees have a heavenly landscape like the one in the Peninsula, than just monoculture as a flower availability". "While beekeepers keep on needing vegetation", Elleli Huerta, Francisca's colleague in CONABIO told me, "they will conserve the natural ecosystems themselves, it is in their interest."[15] What affects apiculture affects biodiversity and vice versa. There is a co-dependent relationship between one another, they agreed.

3.4.3 Cultural impacts

"We are not demonizing transgenics. We know, for example, that a great amount of insulin comes from GMO. We know that in the North [of Mexico GM] cotton cultivation can be beneficial because traditional cotton is starting to present certain problems; cotton is not edible, on the other hand. In the YP, GM soybean does not solve any problem" Eduardo claimed. CONABIO has followed the same logic. According to the Cartagena Protocol, this institution has always analysed each case separately. "We should not generalize regarding GMO. We should always look at the context, and always do a case-by-case analysis", Elleli advised. In this case, all my respondents agreed that RR soybean has unacceptable economic, ecological and cultural impacts in the YP. The cultural impacts have been expressed publicly and have been included in the legal appeals.

Apiculture has been a part of the Mayan cultural tradition for thousands of years. Since pre-Columbian times, apiculture in this region uses an endemic species called *Melipona beecheii –Xunan kab* in Mayan. Honey and wax have been used by Mayans from the YP for centuries in a variety of ways, including religious rituals related to their agricultural harvest, offerings and ceremonies (Villanueva y Tuz, 2012). "The Mayans' conception of bees and honey is part of their worldview, their religion. There are several rituals around them. *Amusencap* is the god of the bees. To gather honey they ask permission to *Amusencap*. The right way of handling the *Xunan kab* bee lies in sustainability, which means not extracting all the honey. But it also depends on managing every natural resource in a sustainable way, the forest particularly. There is a need to conserve all the nectar and pollen trees around", Rogel urged. On the other hand, apiculture in the YP –including both the Mayan and the Western subspecies– "is an

[15] Interview #14, Elleli Huerta, 25.05.2013

activity that is very well adapted to the peasant system. There is a perfect combination between these two historical activities, honey and maize".[16]

In our conversation, Jorge Fernandez –the head lawyer of MA OGM and member of *Indignación*, a CSO on Human Rights– described two arguments used in the legal appeals regarding the cultural impacts of the RR soybean permit. The first one addresses the violation of the 'Consultation' right, established in the Mexican Constitution (art. 2) and in Convention No. 169 of the International Labour Organization (ILO). "Whenever the State pretends to implement any public policy that can have an effect on indigenous communities, they should be consulted", Jorge summarized. Consultation should have the following characteristics: it will precede the implementation of the policy; the indigenous community will have all the necessary information to understand its implications; it will be held in the indigenous language; and the community will be able to give an opinion about it. According to Jorge, "none of this was followed by Mexican authorities". The second argument in the legal appeals is more specific: the Mayan culture is being affected. "Without proper markets Mayan apiculture may collapse and an essential part of their culture would disappear." [17]

4. Conclusion

Apiculture has brought together a series of interests and values (currently and potentially) affected by RR soybean in the YP. Their languages of valuations express the transformations that these GM crops have produced in this socio-ecological landscape. Apiculture has been the axis of a common dispute and discourse to resist these transformations, which I analysed in three dimensions: economic, ecological and cultural. The mobilization in defence of apiculture is concerned with this activity's commercial standing because it simultaneously (indirectly) involves such a variety of interests and values, held by actors that are using this landscape or are interested in its conservation. They are in favour of conserving its natural resources and services and the way of life, health and traditions of its inhabitants. Moreover, they are against the socio-economic inequalities produced by the concentration of power that they consider is inherent to industrial agriculture and particularly to its GM version because of its patent system.

These are all topics currently discussed in every landscape of the world where GM crops are being produced and consumed, which makes this case study illustrative of this global debate. It also shows that

[16] Interview #15, Irma Gomez, 28.05.2013
[17] Interview #3, Jorge Fernandez, 19.04.2013

apiculture can be considered an indicator of the socio-ecological impacts that GM crops produce. I have described the co-dependent relationship between apiculture and its landscape. Honeybee life conditions, as well as the quantity and quality of honey production vary according to biodiversity, in particular with reference to floral availability and diversity. They also vary with the presence of biological and chemical stressors; deforestation for monoculture being an example of the former; pesticides an example of the latter. Both stressors can be measured through honey analysis (melissopalynology). Reciprocally, biodiversity in any landscape where apiculture is developed depends on honeybee pollination to a great extent. Finally, apiculture has become an even sharper indicator of such transformations ever since the Sentence by the Court of Justice of the EU on "transgenic honey" was pronounced. Honey was consequently introduced to the food international markets that are restricting GM products; i.e. it reached the other side of this global debate: the consumption landscapes.

This case study is illustrating also because it addresses a conflict that has already had an impact on the evolution of GM crops. Local, national and international actors, from different sectors (government, CSO, science) and identities (environmental, human rights, peasant rights) have participated jointly in stopping (at least temporarily) the cultivation of the world's most expanded GM crop (herbicide tolerant soybean) produced by the biggest GM corporation (Monsanto Co.) in this region. Resistance aims to completely ban GM crops from this landscape in the near future. As with other 'ecological distribution conflicts', the mobilized actors are bearing the socio-ecological transformations entailed by a more powerful institution. They bear the way GM crops have been (and might keep on) transforming forests, soil, groundwater, honey and pollination, as well as the socioeconomic and cultural condition of Mayan communities.

Further research should consider this multidimensional activity, apiculture, as a key indicator of the transformations GM crops produce in socio-ecological landscapes, given the global presence of honey production and the steady expansion that this controversial biotechnology has had in every continent of the world.

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